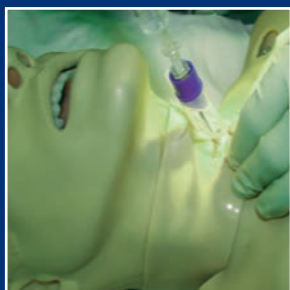


The Objective Structured Clinical Examination in **ANAESTHESIA**



Practice papers for teachers and trainees

Cyprian Mendonca & Shyam Balasubramanian

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Preface

The aim of this book is to help trainees sitting the primary fellowship examination of The Royal College of Anaesthetists. This book consists of five complete sets of OSCE papers that closely simulate the OSCE format of the primary FRCA. To help both teachers and trainees in an objective assessment of their knowledge and skills, marks have been allocated to each OSCE. The tutorial following each OSCE station will provide a depth and breadth of knowledge for candidates and will assist trainers in setting up additional OSCEs on the related subject. Alongside the authors' previously published book *The Structured Oral Examination in Anaesthesia - Practice Papers for Teachers and Trainees* (ISBN 9780521680509), this book supplements the essential study material for the oral part of the primary FRCA examination.

The objective structured clinical examination is a valid tool for evaluating postgraduate clinical performance. We sincerely hope that the information in this book will be beneficial to trainees in their preparation for the FRCA examination and also for other equivalent postgraduate examinations and competency assessments. We wish you good luck with your revision and the exam.

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Foreword

Anaesthesia is not a career for the faint hearted. Progression through training requires passing the primary FRCA, accepted as being one of the most difficult postgraduate medical examinations. There are several hurdles: firstly, the MCQs, covering the three areas of physiology, pharmacology, and physics and clinical measurement; once successful, the lucky doctor has the challenge of tackling the structured oral examinations on the same day as the OSCEs.

Until recently, The Royal College of Anaesthetists was based in a beautiful, but relatively small building, in Russell Square. The burgeoning numbers of candidates could not be contained there for both parts of the exam. This resulted in added anxiety for the candidates, having to navigate around Bloomsbury to the various venues which accommodated the 'vivas', as they were known. Fortunately, the magnificent building now housing the College, in Red Lion Square, is able to host the whole exam.

The OSCEs instil terror in the minds of candidates. The sheer number of stations and brevity of each one demands a profound level of knowledge coupled with continual practice. This book is an invaluable aide to trainees sitting the exam. The stations are authentic, and the explanatory notes are so detailed that they are a valuable supplement to the standard textbooks. College tutors and other trainers will also find it helpful, not only as a source of revision, but also to assist them in setting up new practice stations.

The book is a perfect partner to the earlier published book, *The Structured Oral Examination in Anaesthesia - Practice Papers for Teachers and Trainees*; you will not be disappointed.

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Heart of England Foundation Trust &
Programme Director, Warwickshire School of Anaesthesia

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We thank Dr. Jenny Layton-Henry, General Practitioner, Coventry, for her help with the case scenarios. We gratefully acknowledge the support and help received from our colleagues.

Abbreviations

ABG	Arterial blood gas
Ach	Acetylcholine
AF	Atrial fibrillation
AIDS	Acute immuno deficiency syndrome
ALS	Advanced life support
AP	Antero-posterior
APL	Adjustable pressure limiting
APTT	Activated partial thromboplastin time
ASA	American Society of Anesthesiologists
AV	Atrioventricular
BE	Base excess
BiPAP	Bi-level positive airway pressure
BURP	Backward, upward and right-ward pressure
BW	Bodyweight
CI	Cardiac index
CICV	Cannot intubate, cannot ventilate
CO	Cardiac output
COAD	Chronic obstructive airway disease
CPAP	Continuous positive airway pressure
CPR	Cardiopulmonary resuscitation
CRPS	Complex regional pain syndrome
CSF	Cerebrospinal fluid
CT	Computer tomography
CVA	Cerebrovascular accident
CVP	Central venous pressure
DBS	Double-burst stimulation
DC	Direct current
DDAVP	1-Desamino-8-D arginine vasopressin
DIC	Disseminated intravascular coagulation
DVT	Deep vein thrombosis

ECG Electrocardiogram
ETT Endotracheal tube
FDP Fibrin degradation product
FEF Forced expiratory flow
FEV Forced expiratory volume
FFP Fresh frozen plasma
FGF Fresh gas flow
FRC Functional residual capacity
FVC Forced vital capacity
GA General anaesthesia
GCS Glasgow coma scale
GI Gastrointestinal
GP General practice
GT Greater trochanter
H/O History of
Hb Haemoglobin
Hct Haematocrit
HDU High dependency unit
HR Heart rate
ICP Intracranial pressure
ICU Intensive care unit
ID Internal diameter
IJV Internal jugular vein
INR International normalised ratio
IO Intra-osseous
IPPV Intermittent positive pressure ventilation
IV Intravenous
IVRA Intravenous regional anaesthesia
JVP Jugular venous pressure/pulse
LAD Left anterior descending
LBBB Left bundle branch block
LCA Left coronary artery
LED Light emitting diode
LFT Lacrimal, frontal and trochlear
LMA Laryngeal mask airway
MAC Minimum alveolar concentration
MAP Mean arterial pressure
MH Malignant hyperthermia

N Newton

NIBP Non-invasive blood pressure

NICE National Institute for Clinical Excellence

NSAID Non-steroidal anti-inflammatory drugs

OSAHS Obstructive sleep apnoea hypopnoea syndrome

PA Postero-anterior

Pa Pascal

PAP Pulmonary artery pressure

PAWP Pulmonary artery wedge pressure

PCA Patient controlled analgesia

PCI Percutaneous coronary intervention

PCW Pulmonary capillary wedge

PCWP Pulmonary capillary wedge pressure

PE Pulmonary embolism

PEA Pulseless electrical activity

PEEP Peak end expiratory pressure

PEFR Peak expiratory flow rate

PMH Past medical history

PONV Postoperative nausea and vomiting

PPM Parts per million

PSH Past surgical history

PSIS Posterior superior iliac spine

PSVT Paroxysmal supraventricular tachycardia

PT Prothrombin time

PTC Post-tetanic count

PVR Pulmonary vascular resistance

PVRI Pulmonary vascular resistance index

RA Right atrium

RBBB Right bundle branch block

RV Residual volume

RVH Right ventricular hypertrophy

SA Sino-atrial

SD Standard deviation

SI Systeme international

SVI Stroke volume index

SVR Systemic vascular resistance

SVRI Systemic vascular resistance index

SVT Supraventricular tachycardia

TLCO Transfer factor for carbon monoxide
TLC Total lung capacity
TOF Train of four
TRALI Transfusion-related acute lung injury
TTJV Transtracheal jet ventilation
VA Alveolar volume
VC Vital capacity
VF Ventricular fibrillation
VSD Ventricular septal defect
VT Ventricular tachycardia
WCC White cell count
WPW Wolff Parkinson White

OSCE set 1

Station 1.1 Anaesthetic equipment: circle absorber

Information for the candidate

In this station you will be asked to check a breathing system as you routinely do before starting a list.

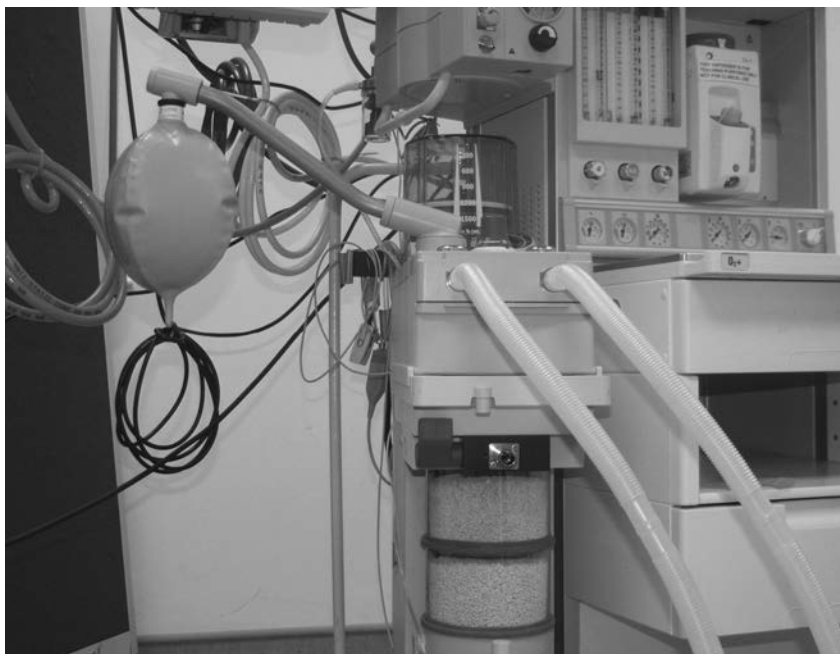


Figure 1.1a Anaesthetic machine with circle absorber system.

Examiner's mark sheet**Can you please check the breathing system on this anaesthetic machine?****marks**

◆ Ensures that soda lime is present and is not used up (check colour).	1	
◆ Visually inspects the system.	1	
◆ Identifies the blocked filter.	2	
◆ Appropriately performs the leak test.	2	
◆ Identifies that it is leaking at the water drain.	2	
◆ Checks function of the one-way valves by connecting bags at both ends.	2	

What are the benefits in using this system?4

- ◆ Economy: fresh gas flow (FGF) can be reduced to less than a litre per minute and consumption of volatile agents is reduced.
- ◆ Humidification: inspired gas will be saturated with water vapour from the expired gas.
- ◆ Reduced heat loss: in addition to conservation of heat, the exothermic reaction of CO₂ absorption assists in maintaining body temperature.
- ◆ Reduced atmospheric pollution: by using low FGF, escape of volatile anaesthetic agents into the atmosphere is minimised.

What happens if the unidirectional valve malfunctions?1

Malfunction of the unidirectional valve leads to mixing of inspired gas with expired gas containing CO₂ and results in hypercapnia.

What is the mesh size of the granules?1

4-8 mesh or 3-4mm spheres.

What do you understand by 4-8 mesh?

1

Strainers with 4 mesh have four equal strands per linear inch in both vertical and horizontal axes. Similarly, strainers with 8 mesh have 8 equal strands per linear inch in both vertical and horizontal axes. Granules of 4-8 mesh size pass through the strainers with 4-8 mesh.

What are the constituents of soda lime?

1

NaOH, Ca(OH)_2 , KOH, water and silica.

Name some contaminants that can be produced in this system

2

Compound A and B are produced with sevoflurane. Desflurane, isoflurane and enflurane react with dry soda lime to produce carbon monoxide. Methane and acetone are other compounds that may be produced.

Total: /20

Information for the examiner

Ensure that the water drain is slightly opened to produce a leak. When you attach the filter, block the circuit with the plastic material from the package. The candidate should identify this during visual inspection or at the stage of performing the test for a leak.

Checking the circle system

This is one of the most commonly used breathing systems and the candidate should be thorough in their knowledge and skill related to this equipment.

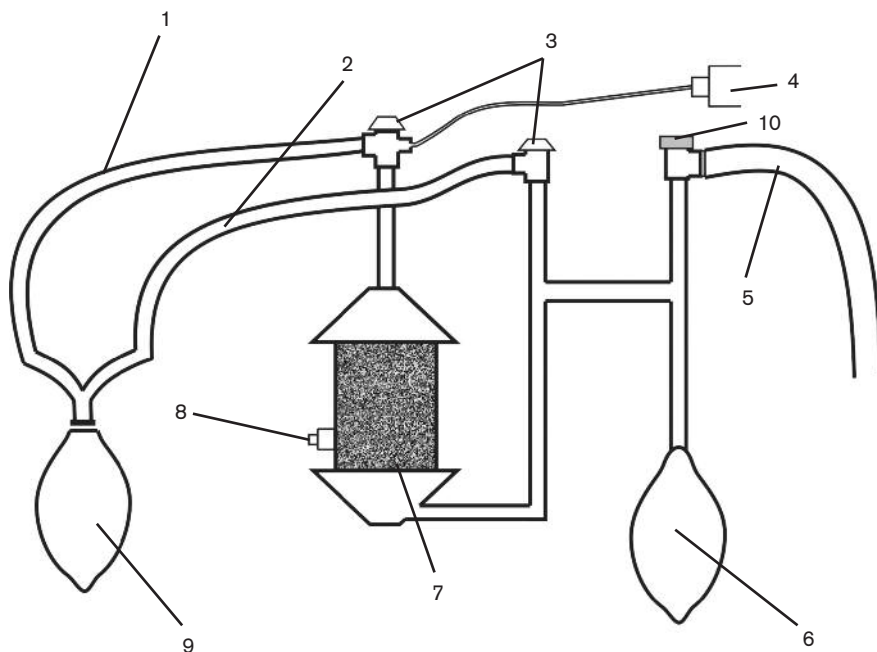


Figure 1.1b Components of the circle system.

1. Inspiratory limb; 2. Expiratory limb; 3. Unidirectional valve; 4. Fresh gas flow; 5. Scavenging; 6. Reservoir bag; 7. Soda lime canister; 8. Water drain; 9. Simulated lung; 10. APL valve.

Performing a leak check of a breathing system

- ◆ Set all gas flows to zero or minimum.
- ◆ Close the adjustable pressure limiting (APL) valve and occlude the Y-piece.
- ◆ Pressurise the breathing system to about 30cm H₂O with an oxygen flush.
- ◆ Ensure that pressure remains fixed for at least 10 seconds.
- ◆ Open the APL valve and ensure that pressure decreases.



Figure 1.1c Checking the function of the unidirectional valves.
1. Simulated lung; 2. Reservoir bag.

Checking the unidirectional valve

- ◆ Place a second breathing bag (simulated lung) on the Y-piece.
- ◆ Fill the reservoir bag with an oxygen flush and manually ventilate.
- ◆ Ensure inflation and deflation of the simulated lung that is connected to the Y-piece; watch for movement of the unidirectional valves.



Figure 1.1d Water drain in the canister.

Chemical reactions during carbon dioxide absorption

First, CO_2 is dissolved in water to form carbonic acid, and then reacts with calcium hydroxide to form calcium carbonate and water. Carbon dioxide also reacts with sodium hydroxide to produce sodium bicarbonate, which then reacts with calcium hydroxide to regenerate sodium hydroxide.

- ◆ $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^-$.
- ◆ $\text{Ca}(\text{OH})_2 + \text{H}^+ + \text{HCO}_3^- \rightarrow \text{CaCO}_3 + 2\text{H}_2\text{O}$.
- ◆ $\text{CO}_2 + 2\text{NaOH} \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{heat}$.
- ◆ $\text{Na}_2\text{CO}_3 + \text{Ca}(\text{OH})_2 \rightarrow 2\text{NaOH} + \text{CaCO}_3$.

Water is required for the efficient absorption of CO_2 . There is some moisture already present in the soda lime. More is added from the patient's expired gas and from the chemical reaction.

Functional analysis

During inspiration, fresh gas and the CO_2 -free gas from the reservoir bag passes through the inspiratory unidirectional valve and inspiratory limb to the patient. During expiration, the inspiratory unidirectional valve closes and expired gas from the expiratory limb passes through the expiratory unidirectional valve to the soda lime canister.

Key points

- ◆ Visually inspect the system for integration, and continuity and completeness of the circuit.
- ◆ Verify that the canister is adequately filled with soda lime.
- ◆ Perform the leak test.
- ◆ Check the function of unidirectional valves.

Station 1.2 Data interpretation: ECG

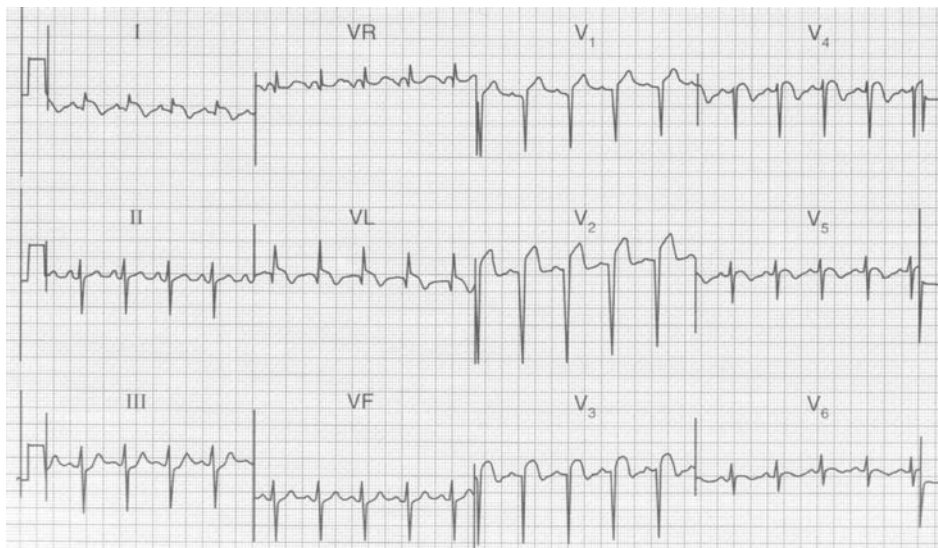


Figure 1.2a ECG 1.

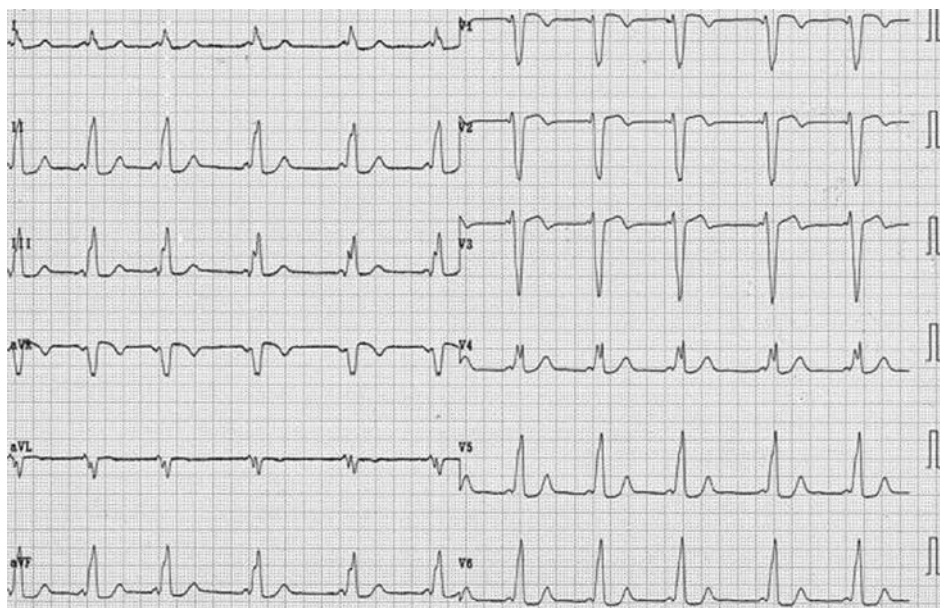


Figure 1.2b ECG 2.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

ECG 1

A 50-year-old male patient presented to the emergency department with chest pain of 6 hours duration. This is the ECG recorded at the time of admission.

1. Heart rate in this ECG is about 75 beats per minute.	True	False	2	☐
2. This ECG is suggestive of an inferior infarction.	True	False	2	☐
3. A blood test on admission is likely to show elevated troponin-T levels.	True	False	2	☐
4. Aspirin should be given orally as soon as possible.	True	False	2	☐
5. An angiogram would show occlusion of the left anterior descending (LAD) artery.	True	False	2	☐

ECG 2

A 38-year-old female patient presented for micro-laryngeal surgery and has a history of paroxysmal palpitation. This is the ECG recorded during pre-operative assessment.

1. Standardisation in this ECG is 5mm = 1mV.	True	False	2	☐
2. The PR interval is within normal limits.	True	False	2	☐
3. Radiofrequency ablation is a treatment for this condition.	True	False	2	☐
4. Digoxin is contra-indicated in this patient.	True	False	2	☐
5. ECG shows left axis deviation.	True	False	2	☐

Total:	/20

Answers

ECG 1

1. False. The heart rate in this ECG is about 120 per minute. The ECG is recorded at a speed of 25mm per second; one large square on the ECG recording paper represents 0.20 sec and 300 large squares represent one minute. In the given ECG there are 2.5 large squares between two consecutive R waves. Since the rhythm is regular, the rate is calculated as $300/2.5 = 120$.
2. False. There is ST segment elevation in V1-V4, lead I and aVL suggesting an anterolateral infarction.
3. True. Although troponin-T peaks after 12 hours of myocardial infarction, it is detectable in serum about 3-6 hours after an acute myocardial infarction. Its level remains elevated for 14 days. Creatine kinase-MB (CK-MB) levels begin to rise within 4 hours after injury, peak at 18-24 hours, and return to normal over 3-4 days.
4. True. Aspirin in a dose of 150-300mg should be administered on diagnosing acute MI. Aspirin interferes with function of the enzyme cyclo-oxygenase and inhibits the formation of thromboxane A2. Aspirin prevents additional platelet activation, and interferes with platelet adhesion and cohesion.
5. True. The circumflex artery branch of the left coronary artery (LCA) and diagonal branches of the LAD are involved in an anterolateral infarct.

ECG 2

1. False. Standardisation is normal in this ECG; 10mm = 1mV.
2. False. It is 0.08 seconds in this ECG; reduced (Wolff-Parkinson-White [WPW] syndrome; see delta waves in II, III, aVF and V4-V6). The PR interval is measured from the beginning of the P wave to the beginning of the QRS complex. The normal interval is 0.12-0.2 seconds.

3. True. Radiofrequency ablation is the ideal treatment to destroy the abnormal pathway.
4. True. Digoxin, by slowing the normal atrioventricular (AV) conduction, facilitates conduction via an abnormal pathway.
5. False. QRS complexes are predominantly positive in both I and III. It is a normal axis.

The coronary arteries involved and ECG location in myocardial infarction are shown in Table 1.2.

Table 1.2 Coronary arteries involved and ECG location in myocardial infarction.

Wall affected	Leads showing ST elevation	Artery involved
Septal	V1, V2	LAD (septal perforators)
Anterior	V3, V4	LCA, LAD (diagonal branches)
Anteroseptal	V1, V2, V3, V4	LAD
Anterolateral	V3, V4, V5, V6, I, aVL	LAD, LCX, or obtuse marginal
Inferior	II, III, aVF	RCA or LCX
Lateral	I, aVL, V5, V6	LCX or obtuse marginal
Right ventricular (often associated with inferior)	II, III, aVF, V1, RV4, RV5	RCA
RCA = right coronary artery LCA = left coronary artery LAD = left anterior descending LCX = circumflex		

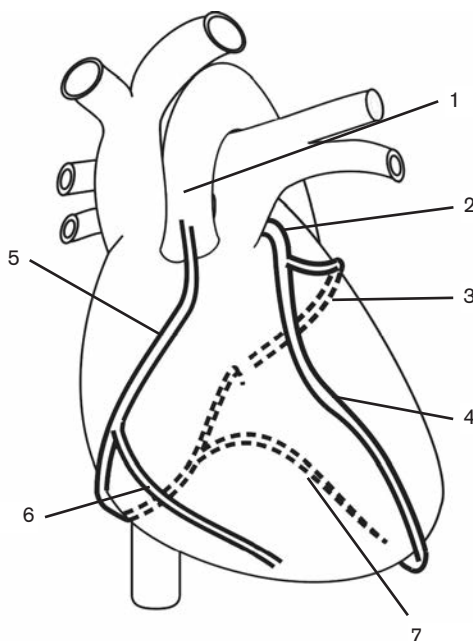


Figure 1.2c Coronary circulation.

1. Ascending aorta; 2. Left main coronary artery; 3. Circumflex artery; 4. Left anterior descending artery; 5. Right main coronary artery; 6. Marginal artery; 7. Posterior interventricular artery.

ECG 2 is suggestive of Wolff-Parkinson-White syndrome. In Wolff-Parkinson-White syndrome, an accessory pathway exists between the atria and ventricle, thereby causing early depolarisation of the ventricle. This results in a short PR interval and abnormal QRS complex on the ECG. A slurred upslope of the R wave is known as a delta (d) wave.

Key points

- ◆ Troponin-T has the greatest sensitivity and specificity in detecting acute myocardial infarction. It is normally not found in the serum and is released only when myocardial necrosis occurs.
- ◆ Aspirin has been shown to decrease mortality and reinfarction rates after myocardial infarction. Clopidogrel is an alternative choice in patients with an aspirin allergy.
- ◆ Recent evidence suggests that primary percutaneous coronary intervention (PCI) is more effective than thrombolysis.

Station 1.3 Data interpretation: haemodynamic data

Information for the candidate

A 39-year-old lady was admitted to intensive care from a medical ward where she was treated for pneumonia and diabetes mellitus. She is intubated and ventilated. Two hours following intensive treatment the following parameters were observed.

- ◆ HR: 126/minute, BP: 80 /42 (54) mmHg, CVP: +4 mmHg.
- ◆ Blood glucose: 24mmol/L; temperature: 38.2°C; Hb: 10gm/dl; WCC: $18.5 \times 10^9/L$.
- ◆ pH: 7.16; PCO_2 : 5.85kPa; PaO_2 : 15.7kPa (FiO_2 of 0.8, PEEP of 8cmH₂O).
- ◆ HCO_3^- : 14mmol/L; BE: -16mmol/L; lactate 3.2mmol/L.
- ◆ Body surface area: 2m²; cardiac-output: 8L/min; stroke volume: 80ml.
- ◆ PA pressure: 25/7(13) mmHg; PAWP: 6 mmHg; SvO_2 : 65%; CaO_2 : 15ml/dl.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. Cardiac index is 4L/m ² .	True	False	2	☐
2. Stroke index is 40ml/m ² .	True	False	2	☐
3. Systemic vascular resistance would be 500dyn.s.cm ⁻⁵ .	True	False	2	☐
4. This patient needs more intravenous fluids.	True	False	2	☐
5. This patient needs a norepinephrine infusion.	True	False	2	☐
6. Oxygen delivery (DO_2) would be 120ml/minute.	True	False	2	☐
7. This patient has a high oxygen extraction ratio.	True	False	2	☐

8. Intravenous sodium bicarbonate is the treatment of choice. True False 2 ☐
9. Haemodynamic data are suggestive of cardiogenic shock. True False 2 ☐
10. This patient needs a blood transfusion to increase DO_2 . True False 2 ☐

Total:	/20

Answers

1. True. The cardiac index is cardiac output (CO) per body surface area, $8\text{L}/2\text{m}^2 = 4\text{L}/\text{m}^2$.
2. True. Stroke volume/body surface area, $80\text{ml}/2\text{m}^2 = 40\text{ml}/\text{m}^2$.
3. True. SVR: $(\text{MAP} - \text{CVP}/\text{CO}) \times 80$; $(54 - 4/8) \times 80$; $(50/8) \times 80 = 500\text{dyn.s.cm}^{-5}$.
4. True. This patient is hypotensive, has a low central venous pressure (CVP) and low wedge pressure.
5. True. This patient has a low systemic vascular resistance (SVR).
6. False. Oxygen delivery = $\text{CaO}_2 \text{ (ml/dl)} \times 10 \times \text{CO (L)} = 15 \times 8 \times 10 = 1200\text{ml/min}$.
7. True. Oxygen delivery is 1200ml/minute and mixed venous saturation is low (65%), suggesting increased oxygen extraction.
8. False. In this patient the cause of acidosis is most likely due to inadequate tissue perfusion. The primary aim is to improve tissue perfusion.
9. False. This patient has a high CO, low CVP and low pulmonary artery wedge pressure (PAWP).
10. False. Blood transfusion is not indicated at a haemoglobin of 10gm/dl .

Normal haemodynamic values

Cardiac index (CI): 2.8-3.5L/min/m².

SVR: 900-1200 dynes.s.cm⁻⁵.

SVRI: 1700-2600 dynes.s.cm⁻⁵.m².

PVR: 120-200 dynes.s.cm⁻⁵.

PVRI: 210-360 dynes.s.cm⁻⁵.m².

O₂ extraction ratio: 0.22-0.33.

O₂ consumption index: 100-180ml/min/m².

O₂ delivery index: 520-720ml/min/m².

Haemodynamic calculations

SVR: (MAP-CVP/CO) x 80.

PVR: (PAP-PAWP/CO) x 80.

SVRI: (MAP-CVP/CI) x 80.

PVRI: (PAP-PAWP/CI) x 80.

DO₂: CO x CaO₂ x 10.

CaO₂: Hb x SaO₂ x 1.34/100.

Oxygen extraction ratio: $\text{CaO}_2 - \text{CvO}_2 / \text{CaO}_2$.

Septic shock

Common sources of sepsis include the abdomen, chest, urinary tract, wounds, and intravascular lines. The presence of severe infection triggers a massive systemic inflammatory response with systemic activation of leucocytes and release of a variety of potentially damaging mediators. These mediators cause profound vasodilatation, increased capillary permeability and myocardial depression. The microvascular changes include increased permeability, micro-embolisation and arteriovenous shunting.

The oxygen extraction ratio = VO_2/DO_2 . An increase in the oxygen extraction ratio results in a decrease in mixed venous oxygen saturation and vice versa. Normal mixed venous oxygen saturation is 70-75%. Depending upon the stage of sepsis the oxygen extraction can increase (as in hypermetabolic states) or decrease (when cellular metabolism is disturbed and cells are unable to use oxygen).

Key points

- ◆ A systemic inflammatory response and sepsis causes profound vasodilatation and a low systemic vascular resistance.
- ◆ Inadequate tissue perfusion results in metabolic acidosis.
- ◆ pH indicates a primary acid base disorder.
- ◆ The metabolic component of the acid base disorder is indicated by the level of bicarbonate in the plasma.

Station 1.4 Data interpretation: statistics

Information for the candidate

In this station you will be shown a correlation-regression graph and will be questioned on statistics.

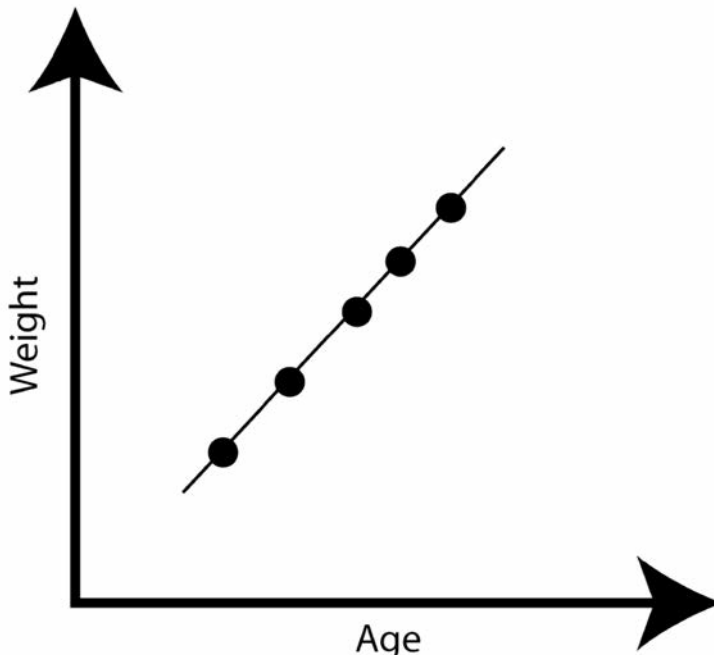


Figure 1.4 Correlation-regression graph: age and weight of children.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. The graph illustrates a positive correlation.	True	False	2	☐
2. The correlation coefficient is denoted by the letter 'r'.	True	False	2	☐
3. It is customary to plot the dependent variable along the horizontal x-axis.	True	False	2	☐
4. It is possible to have a correlation coefficient of 1.1.	True	False	2	☐
5. It is possible to have a correlation coefficient of -0.7.	True	False	2	☐
6. The correlation coefficient of 0.7 is statistically significant.	True	False	2	☐
7. Regression involves estimating the best straight line to summarise the association.	True	False	2	☐
8. A complete absence of correlation is represented by 0.	True	False	2	☐
9. Correlation implies causation.	True	False	2	☐
10. These data could be analysed using a non-parametric test.	True	False	2	☐

Total:	/20

Answers

1. True. Weight increases as age increases, thus a positive correlation.
2. True.
3. False. Here, age is the independent variable and is plotted on the x-axis.
4. False.
5. True. r ranges from +1 to -1.
6. True. 0.7 signifies a strong association.
7. True.
8. True.
9. False.
10. True.

Key points

- ◆ A correlation denotes an association between two quantitative variables.
- ◆ Regression involves estimating the best straight line to summarise the association.
- ◆ The correlation coefficient (r) measures the degree of association and is measured on a scale that varies from +1 through 0 to -1.
- ◆ When one variable increases as the other increases, the correlation is positive; when one decreases as the other increases, the correlation is negative.
- ◆ Complete absence of correlation is represented by 0.
- ◆ The independent variable, such as time or age, is measured along the x-axis.
- ◆ Correlation is not causation.
- ◆ The strength of association for absolute values of r : 0-0.19 is very weak; 0.2-0.39 is weak; 0.4-0.59 is moderate; 0.6-0.79 is strong; 0.8-1 is very strong.
- ◆ The significance of data can be tested using a t-test for parametric data or a non-parametric test, such as a Spearman rank correlation.

Station 1.5 Anatomy: internal jugular vein

Information for the candidate

This station is for the purpose of exploring knowledge on anatomy of the internal jugular vein and its cannulation.

Examiner's mark sheet

marks

Describe the course of the internal jugular vein (IJV)

2

The IJV originates at the jugular foramen (continues with the sigmoid sinus) and runs down the neck, to terminate behind

the sternoclavicular joint, where it joins the subclavian vein to form the brachiocephalic vein.

State the relations of the IJV

3

- ◆ Anterior: internal carotid artery and vagus nerve. The sternocleidomastoid muscle is in the lower part and the vagus lies between the vein and artery.
- ◆ Posterior: sympathetic chain and the dome of the pleura. On the left side, the IJV lies anterior to the thoracic duct.
- ◆ Medial: carotid arteries and cranial nerves IX-XII. The deep cervical lymph nodes lie close to the vein.

Name the tributaries that drain into the IJV

3

Common facial vein, lingual vein, superior and middle thyroid veins and pharyngeal venous plexus.

Demonstrate the insertion of this central line via the IJV (on the manikin)

8

- ◆ Sterile technique; 15°-20° head down tilt.
- ◆ Local anaesthetic infiltration to skin.
- ◆ Describes the use of ultrasound.
- ◆ Appropriate site of skin puncture and correct direction of needle.
- ◆ Aspiration of blood and insertion of guidewire.
- ◆ Passes the dilator and then railroads the CVP catheter over the guidewire.
- ◆ Aspirates all lumens and sutures the line in place.
- ◆ Obtains a chest X-ray.

What are the complications of central line placement?

4

Complications can be categorised as mechanical, infective and thrombotic.

Mechanical complications occur either due to needling or secondary to the introduction and presence of the catheter. They include haemorrhage, pneumothorax, haemothorax, air embolism, nerve damage, extravascular catheter placement and chylothorax.

Total:	/20

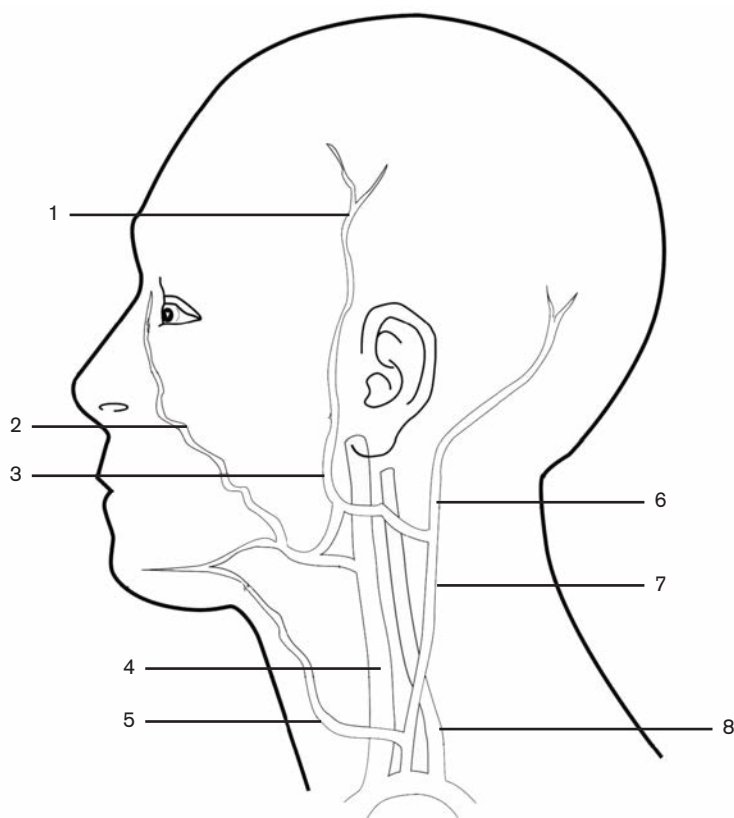


Figure 1.5a Veins of the head and neck.

1. Superficial temporal vein; 2. Facial vein; 3. Retromandibular vein; 4. Internal jugular vein; 5. Anterior jugular vein; 6. Posterior auricular vein; 7. External jugular vein; 8. Vertebral vein.

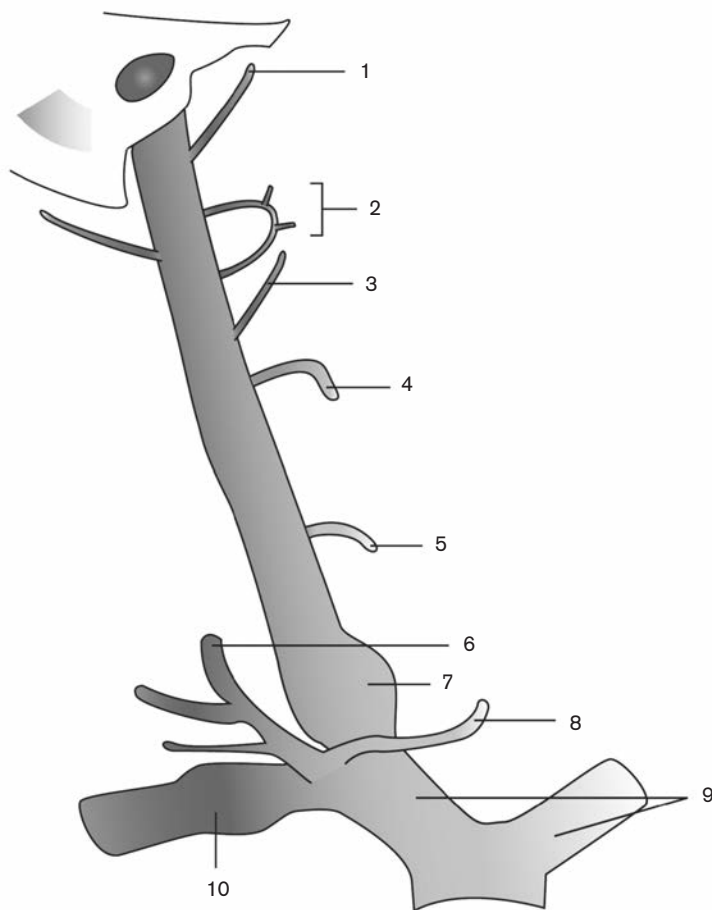


Figure 1.5b Tributaries of the IJV.

1. Inferior petrosal vein; 2. Pharyngeal veins; 3. Facial vein; 4. Superior thyroid vein; 5. Middle thyroid vein; 6. External jugular vein; 7. Internal jugular vein; 8. Anterior jugular vein; 9. Brachiocephalic veins; 10. Subclavian vein.

Major veins of the head and neck

The IJV is the continuation of the sigmoid sinus. It runs down the side of the neck in a vertical direction, lying, at first, lateral to the internal carotid artery, and then lateral to the common carotid artery. The

glossopharyngeal and hypoglossal nerves pass forward between the IJV and internal carotid artery. The vagus nerve descends between and behind the vein and artery in the same sheath.

The IJV receives many tributaries within the neck. During its course it receives the inferior petrosal sinus, common facial, lingual, pharyngeal, superior and middle thyroid veins, and sometimes the occipital vein.

The external jugular vein commences in the substance of the parotid gland at the level of the mandible. It passes downwards to the midpoint of the clavicle and enters the subclavian vein. In its course it crosses the sternocleidomastoid muscle.

Key points

- ◆ The right internal jugular vein has a straighter course and is more commonly used for cannulation.
- ◆ NICE recommends the use of 2-D ultrasound guidance in order to reduce associated complications.
- ◆ The steps involved in central venous cannulation include preparation of the patient (assessing indication/contra-indication, explanation of procedure, consent), preparation of the site (positioning, aseptic precautions) and then the actual technique. Confirm the position of the catheter with X-ray.
- ◆ Complications involved with central venous cannulation can be mechanical, infective or thrombotic. They can be immediate or delayed.

Station 1.6 Communication: awake tracheal intubation

Information for the candidate

A 70-year-old male patient is scheduled for an elective laparoscopic cholecystectomy. His previous anaesthetic history is: failed intubation for an umbilical hernia repair; grade 4 (Cormack and Lehane) laryngoscopic view; and bag and mask ventilation was easy. The patient was woken up from general anaesthesia and surgery was performed under spinal anaesthesia.

Explain to the patient about awake fiberoptic intubation for his laparoscopic cholecystectomy.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient.	1
Asks about the patient's understanding regarding his previous anaesthetic problem.	1
Explains the need for intubation (breathing tube).	2
Explains how it is normally done.	1
Explains why it needs to be done differently this time.	2
Other alternative methods are available (fiberoptic intubation after induction of GA).	1
Able to explain the disadvantages of fiberoptic intubation after induction of GA (there is a possibility of failure to intubate which is unsafe and further danger may arise due to the possible difficulty in ventilation using a bag and mask).	2
Explains the benefits of awake fiberoptic intubation (an awake patient is able to maintain the airway, which is safer than any other alternative method).	2
Explains about sedation during the procedure.	2
Explains about adequate monitoring.	1
Gives a satisfactory explanation of local anaesthetic technique.	2

Compares the technique with endoscopy or something else familiar to the patient. 1

Uses simple terms (telescope or camera). 1

Overall clarity of communication and an ability to establish rapport with the patient. 1

Total:	/20

Information for the actor

There was difficulty in inserting the breathing tube into your windpipe during your last anaesthetic. The anaesthetist had to wake you up. The surgery was done with an injection in the back, uneventfully. Your previous anaesthetist advised you to warn subsequent anaesthetists about the problem. The anaesthetist this time is planning to insert the breathing tube into your windpipe while you are awake. Understandably, you are scared and anxious. You are concerned that it may be very painful to pass the tube.

Awake fibreoptic intubation

Awake fibreoptic intubation is indicated in known or suspected difficult intubation, when there is an aspiration risk and difficult intubation is anticipated, and when there is known or suspected cervical cord instability.

Relative contra-indications include upper airway bleeding or a bleeding tendency, stridor and unco-operative patients.

The patient should be fully monitored during the procedure, an intravenous access should be secured and supplementary oxygen should be administered via a nasal catheter or through a fibreoptic scope. Judicious sedation may be required. Naloxone and flumazenil should be available.

The technique can be performed either from the conventional position from the head end with the patient supine or, in a sitting up, semi-reclined position with the operator standing in front.

The nasal route has the advantage of a better anatomical alignment with the vocal cords. But passing the tube through nostrils in an awake patient can be uncomfortable.

Techniques of airway anaesthesia

There is a wide range of options available to anaesthetise the airway for awake intubation.

Anaesthesia to the nasal passage and nasopharynx with a cocaine solution or paste is commonly used. Cocaine is also a vasoconstrictor. The total recommended dose is 1.5mg/Kg. Lidocaine 5% with 0.5% phenylephrine is a suitable alternative.

Anaesthesia for the oropharynx with lidocaine 4% solution is suitable for oral analgesia. The patient is asked to gargle 4-5ml of solution. This can be supplemented with 3 to 4 sprays of 10% lidocaine (each spray contains 10mg of lidocaine). Lidocaine 2% gel is a suitable alternative for providing analgesia to the tongue and oropharynx.

Nebulisation of local anaesthetic (4% lidocaine) is a simple technique and provides partial analgesia to both the upper and lower airway. Larger particles settle in the upper airway, smaller particles reach the lower airway. This technique is useful, particularly if coughing needs to be minimised.

The lower airway can be anaesthetised using topical anaesthesia or with nerve blocks, topical anaesthesia being more popular.

In the spray as you go technique, 4% lidocaine is injected via the working channel of the fiberoptic scope. An epidural catheter is passed down the working channel of the scope; this allows direct visualisation and application of local anaesthetic solution close to the anatomical structures to be anaesthetised. Following topical anaesthesia to the nasal passage and oropharynx, the fiberoptic scope is advanced until the base of the tongue and epiglottis is seen. 1-2ml of 4% lidocaine should be sprayed onto the base of the tongue and epiglottis. Another 1-2ml of local anaesthetic is sprayed onto the glottis and vocal cords. Then the fiberoptic scope is advanced further close to the glottis and an additional 1ml of local anaesthetic is sprayed through the vocal cords into the trachea. A total of

3-6ml of 4% lidocaine may be required. This technique will provide satisfactory anaesthesia for awake fibreoptic intubation.

The internal laryngeal nerve (branch of the superior laryngeal nerve) can be blocked either by an internal or external approach. The hyoid bone is located directly above the thyroid cartilage. The greater horn is located in the lateral most part of the hyoid bone. The superior laryngeal nerve can be blocked by walking a 25G needle inferiorly off the greater horn and injecting 2ml of 2% lidocaine. Accidental arterial injection (into the carotid) is a possible complication.

The internal laryngeal nerve runs just under the mucous membrane covering the pyriform fossa, where it can be easily blocked by applying a cotton wool ball soaked in 2% lidocaine, using Krause's forceps. The oropharynx and the posterior two thirds of the tongue need to be anaesthetised before performing this block.

In translaryngeal anaesthesia, the skin over the cricothyroid membrane is infiltrated with local anaesthetic. Then a needle or cannula attached to a syringe containing normal saline is inserted through the cricothyroid membrane; the needle should be directed backwards and caudad to avoid trauma to the vocal cords. Correct placement is confirmed by aspiration of air via the needle. 2-4ml of 4% lidocaine should be injected at the end of inspiration. During the process the patient coughs and anaesthesia should spread both above and below the cords.

Topical anaesthesia to the nasal cavity and oropharynx, followed by transbronchoscopic administration of lidocaine is more straightforward and often tolerated by patients.

Key points

- ◆ Antisialogogues are used to reduce secretion and improve the endoscopic view.
- ◆ Skilled assistance is mandatory during the procedure.
- ◆ The patient should fully understand the need for the procedure.
- ◆ Awake intubation is a safe way of securing the airway.
- ◆ Reassure the patient that the procedure as such is not painful.
- ◆ The patient is likely to cough while anaesthetising the larynx and trachea.
- ◆ The patient's co-operation for a local anaesthetic technique is vital.

Station 1.7 Technical skill: cricothyrotomy

Information for the candidate

A 20-year-old patient presented for appendicectomy. Rapid sequence induction of general anesthesia was attempted. Laryngoscopy revealed a grade 4 view, and the bag and mask ventilation failed. The patient is desaturating to 80%. A 'cannot intubate, cannot ventilate' (CICV) scenario has arisen and it is decided to resort to emergency cricothyrotomy and transtracheal jet ventilation (TTJV).

Examiner's mark sheet

marks

Can you perform cricothyrotomy on this manikin?

1 ☐

- ◆ Preparation: checks the equipment.

What equipment do you need for TTJV?

2 ☐

Intravenous (venflon) type cannula, i.e. over the needle catheter (14G) or a jet ventilation catheter (13G), a syringe filled with saline, a manual jet ventilation device or a Sanders injector.

Proceed with the cricothyrotomy

- ◆ Uses aseptic technique.
- ◆ Palpates the landmarks: thyroid cartilage, cricoid cartilage, cricothyroid membrane.
- ◆ Stabilises the cricoid with thumb and middle finger.
- ◆ Puncture site: midline.
- ◆ Directs the needle at a 45° angle caudally.
- ◆ Aspirates air.
- ◆ Advances the catheter or cannula and removes the needle.
- ◆ Aspirates again to check the cannula is in place.
- ◆ Connects the jet and ventilates (press the lever for 1 to 2 seconds).

1 ☐

3 ☐

1 ☐

1 ☐

1 ☐

1 ☐

1 ☐

1 ☐

1 ☐

Why choose the cricothyroid membrane?2

It is superficial and is relatively avascular. The cricoid cartilage is a complete ring and, therefore, holds the airway open.

Give two complications of cricothyrotomy2

- ◆ Bleeding.
- ◆ Oesophageal perforation.
- ◆ Posterior tracheal wall perforation.
- ◆ Surgical emphysema.
- ◆ Barotrauma (pneumothorax).

Describe two precautions you would take to prevent barotrauma2

After first inflation, make sure that the chest is deflating. If there is a complete airway obstruction, insert a second cannula for expiration.

Total:	/20

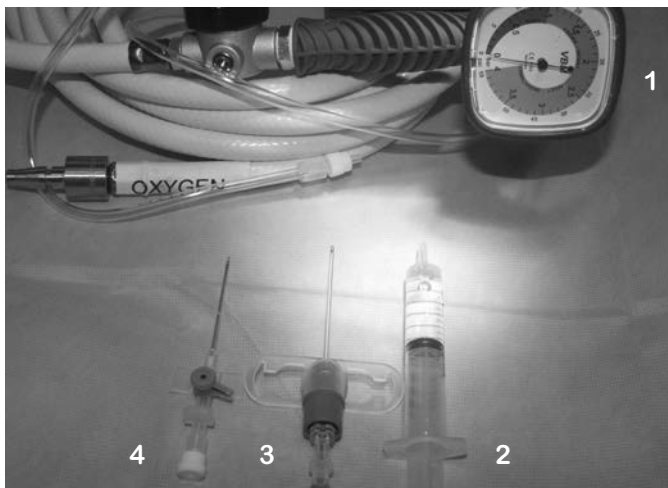


Figure 1.7a Equipment for emergency cricothyrotomy.

1. Manual jet ventilator (Manujet III); 2. Saline filled syringe; 3. 13G jet ventilation catheter; 4. 14G cannula.

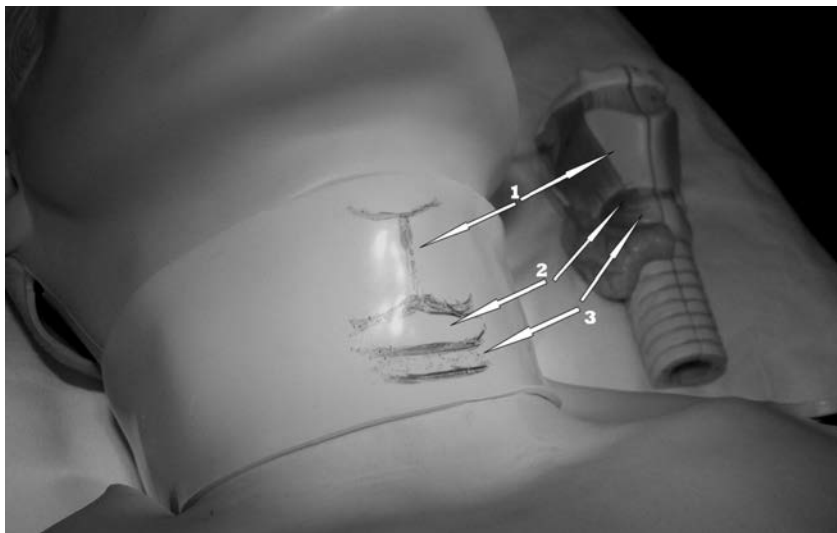


Figure 1.7b Landmarks for cricothyrotomy.

1. Thyroid cartilage; 2. Cricothyroid membrane; 3. Cricoid cartilage.



Figure 1.7c Technique of cricothyrotomy.

Emergency cricothyrotomy

The cricothyroid membrane is subcutaneous in the midline and is located between the strap muscles of the neck. It is on average 8mm deep below the skin (the range is 3-14mm). In adults it is 9mm high and 22-30mm wide, but the width between cricothyroid muscles is about 9mm. Therefore, the largest tube that can be passed should have an outer diameter of less than 9mm (a 6mm tracheostomy tube has an outer diameter of 8.3mm). A 6mm size cuffed tracheostomy tube is commonly used.

For identifying the cricoid cartilage use the index finger to identify the thyroid notch and then follow the finger downwards in the midline. A dip is felt below the thyroid cartilage; this is the cricothyroid space. A prominent structure felt immediately below this is the cricoid cartilage. Once identified, stabilise the cricoid cartilage with the thumb and middle finger, and using the index finger locate the cricothyroid membrane in the midline. If the thyroid cartilage is not prominent, then palpate the trachea at the suprasternal notch, grasp between the thumb and middle finger, and follow the index finger upwards to palpate the cricothyroid membrane.

Emergency cricothyrotomy is performed in a 'cannot intubate, cannot ventilate' scenario to oxygenate the patient.

The following are the three different techniques for emergency cricothyrotomy.

1. In needle cricothyrotomy and transtracheal jet ventilation, a 13G cricothyrotomy cannula or a 14G venflon is commonly used. The small cannula has a high resistance and needs a high pressure oxygen source to ventilate. A jet injector at 1-4 bar pressure (Sanders injector or Manujet injector) is used. Exhalation is passive and must occur through the pharynx and larynx. In the case of complete airway obstruction, a second cannula through the cricothyroid membrane may be required to facilitate exhalation.
2. A large purpose-made cannula with an internal diameter of 4mm or more allows ventilation of the lungs using an anaesthetic breathing system.

3. Surgical cricothyrotomy with a rapid four-step technique involves:

- ◆ Palpation of the cricothyroid membrane.
- ◆ A horizontal stab incision over the cricothyroid space.
- ◆ Traction with a tracheal hook. A scalpel handle inserted through the skin incision is then rotated 90°.
- ◆ Downward traction with a tracheal hook and intubation with a tracheostomy tube.

Key points

- ◆ Locate the cricoid cartilage.
- ◆ The cricothyroid membrane should be punctured in the midline.
- ◆ After the first inflation, ensure that the chest is deflating before further inflations, to avoid the risk of barotrauma.

Station 1.8 Clinical examination: assessment of a trauma patient

Information for the candidate

You are called to Accident and Emergency to see a middle-aged male patient who has been involved in a road traffic accident. You have a single assistant, an experienced paramedic. The rest of the trauma team are on their way and will arrive in 5 minutes.

Examiner's mark sheet

marks

The patient has a head injury

Controls cervical spine throughout.	2	
A - Assesses airway.	1	
States low conscious level will require definitive airway (here or at D).	1	

B - Assesses breathing.

1

C - Attaches monitoring.

1

Asks for cardiovascular parameters or assesses them (BP: 130/70 mmHg, HR: 74 bpm, capillary refill: 2 seconds).

2

The airway is clear; breath sounds are normal and the patient is haemodynamically stable

Establishes intravenous access.

1

D - Assesses Glasgow coma scale (GCS).

3

Assesses pupils.

1

Examination of the pupils shows one side to be fixed and dilated. GCS is 13; eyes: open to verbal commands = 3, movement on command = 6, vocal: confused = 4

What radiological investigations would you request in a trauma scenario?

2

X-rays of neck (c-spine), chest and pelvis.

What is the definitive care plan for this head-injury patient?

2

CT scan and a neurosurgical opinion/referral.

How would you transfer this patient to have a CT scan?

2

Make sure that the patient is stable; ensure that the patient's airway is protected, otherwise the airway needs to be secured with tracheal intubation. Ensure that venous access is secured, monitoring is established and emergency drugs are available.

The CT scan shows an extradural haematoma. What is the treatment?

1

Transfer to the neurosurgical unit and evacuation of the haematoma.

Total: /20

Information for the actor

You will be playing the role of a patient who was involved in a road traffic accident and sustained a head injury.

A doctor will be assessing your injuries to plan appropriate treatment. You have to lie still on a couch when the doctor examines you, open your eyes to command and move your legs or arms only when he asks you to do so. If he/she asks you to squeeze his/her finger then you can respond. If he/she asks any questions you can give some inappropriate answers to show them that you are confused.

Assessment of a trauma patient

Management of a trauma patient involves a rapid primary survey, resuscitation of vital functions, more detailed secondary assessment and initiation of definitive care. In this OSCE, during the given 5 minutes of time, the candidate should demonstrate knowledge and skill of a primary survey. The cervical spine should be initially immobilised by manual inline traction and later immobilised using a semi-rigid collar and two bolsters on either side of the head and neck strapped to the spine board.

To identify life-threatening injuries during a primary survey, the ABCDE (airway, breathing, circulation, disability and exposure) sequence should be followed.

Indications for a CT scan in a head injury patient

- ◆ GCS 12/15 or less.
- ◆ Confusion or drowsiness (GCS 13 or 14/15), followed by failure to improve within at most 4 hours of clinical observation.
- ◆ GCS 15/15 - but with severe nausea and vomiting, severe persistent headache, irritability and altered behaviour or seizure.
- ◆ Deteriorating level of consciousness.
- ◆ Progressive focal neurological signs.
- ◆ New focal neurological signs.

Indications for a neurosurgical referral

- ◆ Persisting coma (GCS score 8/15 or less) after initial resuscitation.
- ◆ Confusion which persists for more than 4 hours.
- ◆ Deterioration in level of consciousness after admission (a sustained drop of one point on the motor or verbal subscales, or two points on the eye opening subscale of the GCS).
- ◆ Progressive focal neurological signs.
- ◆ A seizure without full recovery.
- ◆ Compound depressed skull fracture.
- ◆ Definite or suspected penetrating injury.
- ◆ A cerebrospinal fluid (CSF) leak or other sign of a basal fracture.

Key points

- ◆ The ABCDE sequence should be followed during a primary survey to identify and manage life-threatening injuries.
- ◆ Protecting the cervical spine is most important during airway assessment and management.
- ◆ During a secondary survey a complete neurological examination should be performed, including the GCS score.

Station 1.9 Measuring equipment: pulmonary artery flotation catheter

Information for the candidate

In this station you will be asked questions about invasive cardiac monitoring.

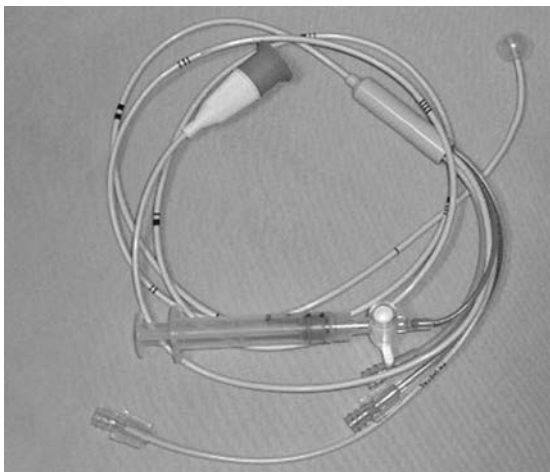


Figure 1.9a.

Examiner's mark sheet**marks****Can you identify this?**1 ☐

Pulmonary artery flotation catheter.

What is the normal pulmonary capillary wedge pressure?1 ☐

4-12 mmHg.

Where will the proximal lumen open? How far is it from the tip and what does it measure?2 ☐

Into the right atrium; 25cm from the tip; it measures CVP.

What is the volume of the balloon in the tip?1 ☐

Approximately 1.5ml.

Can you draw the various traces as the pulmonary artery flotation catheter is inserted and wedged? 4 ☐

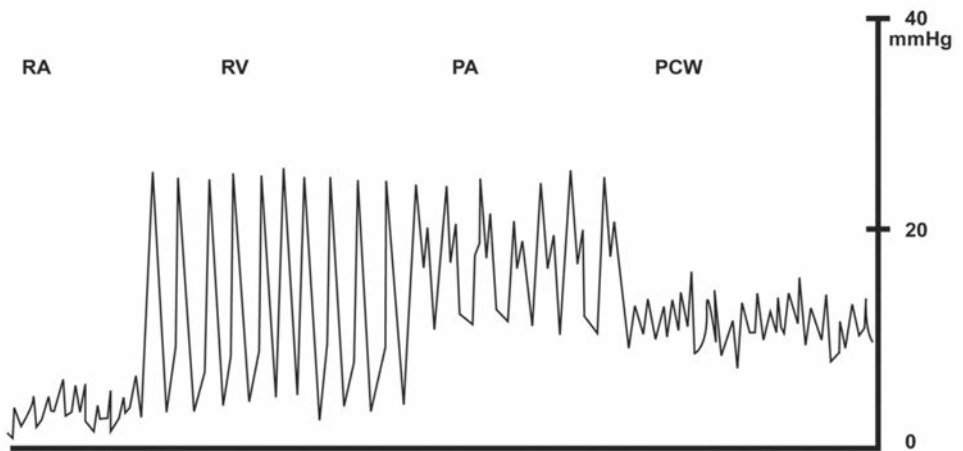


Figure 1.9b Pulmonary artery catheter trace.

RA: right atrium, RV: right ventricle, PA: pulmonary artery, PCW: pulmonary capillary wedge.

What will the trace resemble if the catheter coils back into the right atrium? 1 ☐

It will resemble the trace of the CVP.

Where is the thermistor situated in the catheter? 1 ☐

4cm proximal to the tip of the catheter.

State at least two uses of this catheter 2 ☐

- ◆ Assessment of volume status where the CVP is unreliable.

- ◆ Sampling of mixed venous blood to calculate shunt fraction.
- ◆ Measurement of cardiac output using thermodilution.
- ◆ Derivation of other cardiovascular indices, such as the pulmonary vascular resistance (PVR), oxygen delivery and uptake.

State at least three complications of using this catheter

3

- ◆ Arrhythmias on insertion.
- ◆ Knotting of the catheter in the right ventricle.
- ◆ Balloon rupture.
- ◆ Pulmonary infarction.

State at least two measured values and two derived haemodynamic variables obtained from a pulmonary artery catheter

2+2

- ◆ Measured values: CVP, PAP, PCWP, CO, SVO₂.
- ◆ Derived variables: cardiac index, stroke volume, SVI, SVR, SVRI, PVR, PVRI.

Total: /20

Key points

- ◆ The pulmonary artery flotation catheter was first described by Swan and Ganz in 1970. It is 7 or 7.5 FG in size and 110cm long.
- ◆ There is a balloon at the tip which has a capacity of 1.5ml.
- ◆ A thermistor is located about 4cm proximal to the tip.
- ◆ Before inserting the catheter, it should be connected to the transducer, which should be zeroed. By gently waving the catheter up and down, the corresponding wave should appear on the monitor, ensuring that the catheter is connected to the correct transducer.

- ◆ The catheter should then be advanced 20cm before inflating the balloon.
- ◆ Whilst the catheter is in the right atrium, the CVP waveform is displayed on the monitor. When the catheter enters the right ventricle this waveform changes with a systolic pressure of 25 mmHg and diastolic pressure of 0-5 mmHg. The waveform suddenly changes as the catheter enters the pulmonary artery. Systolic pressure in the pulmonary artery is the same as that of the right ventricle, but diastolic pressure is higher (10-12 mmHg).
- ◆ As the catheter advances through the pulmonary artery it will eventually wedge in a small branch and PAWP is displayed, which reflects the left ventricular filling pressure.

Station 1.10 Resuscitation: paediatric resuscitation

Information for the candidate

A 5-year-old child has collapsed on the ward. There is no nurse available and you are on your own.

Examiner's mark sheet

marks

SAFE approach (1 x 5)

5

1. Checks responsiveness and requests help.
2. Opens the airway and a chin lift and jaw thrust is performed.
3. Assesses the airway by look, listen, feel.
4. Five rescue breaths are given, if not breathing.
5. Checks the pulse (carotid pulse for 10 seconds).

6. Starts CPR at 15 chest compressions: two rescue breaths (correct method of chest compression).

2

How many compressions per minute?

1

100/minute.

When would you call for a resuscitation team?

1

After 1 minute of CPR.

Now the help arrives and the monitor shows this rhythm

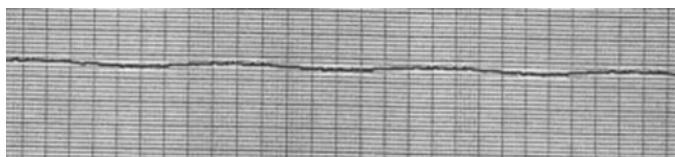


Figure 1.10 ECG.

What is the management?

4

Immediately resume CPR 15:2 for 2 minutes.

During CPR:

- ◆ Corrects reversible causes.
- ◆ Checks electrode position and contact.
- ◆ Attempts/verifies: IV/IO access; airway and oxygen.
- ◆ Gives uninterrupted compressions when the trachea is intubated.
- ◆ Gives adrenaline every 3-5 minutes.
- ◆ Considers atropine.

What is the initial intravenous (IV) dose of adrenaline?

2

10µg/Kg (0.1ml/Kg of 1: 10 000 adrenaline).

What is the intra-osseous dose of adrenaline?

1

10µg/Kg.

How much would you give through the tracheal tube? 1

100µg/Kg.

What will be the approximate weight of this child? 2

18Kg (2 x [age+4]).

What is the volume of IV fluid you would administer to this child as an initial bolus? 1

360ml (20ml/Kg).

Total:	/20

Paediatric life support

After ensuring the safety of both rescuer and child, check the responsiveness, followed by airway and breathing. If the child is not breathing or is making agonal gasps, deliver five rescue breaths followed by one minute CPR before calling for a resuscitation team.

With chest compression, the ventilation ratio for children of all ages is 15:2 (lay rescuers are taught to use 30:2 ratio). In infants, a two-finger compression technique is used when there is only one rescuer. If there are two or more rescuers, then the chest can be compressed using the two-thumb encircling technique. In older children the lower third of the sternum should be compressed with the heel of one hand. The sternum should be compressed one fingerbreadth above the xiphisternum. The compression should be sufficient to depress the sternum by one third of the depth of the chest. The chest compression should be continued uninterrupted when the trachea is intubated.

Vascular access can be difficult in small children and if there is no success after three attempts, an intra-osseous (IO) needle should be inserted. The

onset of drug action and the time to achieve plasma concentration are similar to those provided by a central venous route. Fluid resuscitation using 20ml/Kg of isotonic crystalloid is indicated for volume expansion. It can be repeated after reassessing. The recommended dose of intravenous or intraosseous adrenaline is 10µg/Kg and can be repeated every 3-5 minutes during CPR. Ventricular fibrillation or pulseless ventricular tachycardia should be treated with prompt defibrillation. The recommended energy is 4J/Kg for all shocks (monophasic or biphasic defibrillators).

Key points

- ◆ Ensure the safety of rescuer and child.
- ◆ Open the airway by a chin lift, and, if required, use a jaw thrust. A gentle head tilt can be performed if a cervical spine injury is not suspected. Do not take more than 10 seconds to assess the breathing.
- ◆ Soon after recognising abnormal or absent breathing, give 5 rescue breaths followed by one minute of CPR, then call for a resuscitation team.
- ◆ Administer high flow oxygen.
- ◆ For chest compression (in children >1 years of age), the sternum should be compressed by approximately one third the depth of the chest.

(For further reading please refer to the European Resuscitation Council guidelines on <http://www.erc.edu/>).

Station 1.11 Anatomy: base of the skull

Information for the candidate

In this station you will be asked about the anatomy of the skull and structures passing through various foramen.

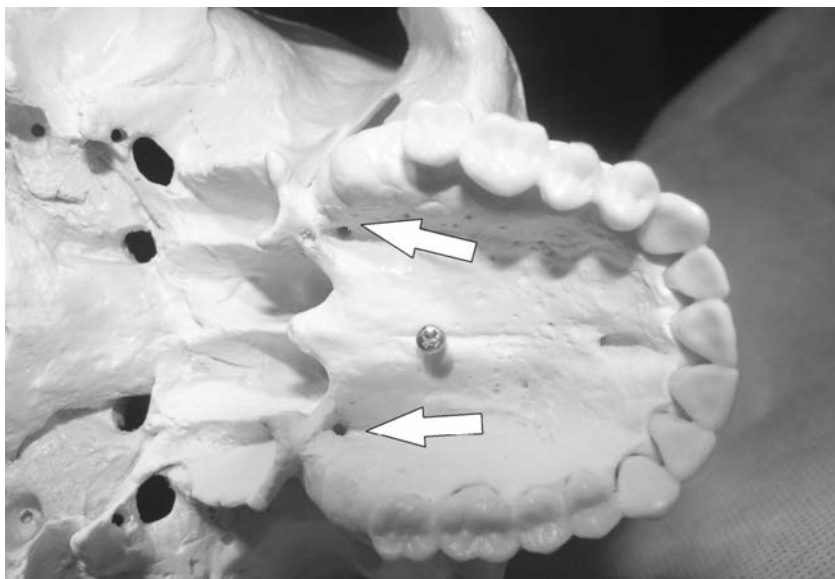
Examiner's mark sheet

Figure 1.11a Palate.

marks

Name the foramen in Figure 1.11a

2

Greater palatine foramen.

What structures pass through this foramen?

1

Anterior (greater) palatine nerve and descending palatine vessels.

Name the foramen 5 in Figure 1.11b

1

Foramen ovale.

What structure passes through this?

1

Mandibular division of the trigeminal nerve (V3).

Name the foramen 4 in Figure 1.11b

2

Foramen rotundum.

What structure passes through this foramen?

1

Maxillary division of the trigeminal nerve (V2).

Which part of the face does this nerve provide sensory supply?

1

Over the cheek.

Does it supply any muscles?

1

No.

Indicate the carotid canal

2

The carotid canal is located in the temporal bone and it connects the base of the skull to the middle cranial fossa. The opening of the carotid canal in the middle cranial fossa is called the foramen lacerum (6 in Figure 1.11b). It contains the internal carotid artery and the sympathetic plexus surrounding the artery.

Indicate the optic canal

2

The optic foramen and canal are located at the base of the lesser wing of the sphenoid bone in the middle cranial fossa (2 in Figure 1.11b). It connects the middle cranial fossa to the orbit.

What does it contain?

2

It contains the optic nerve (II) and ophthalmic artery.

Name the foramen 9 in Figure 1.11b

2

Jugular foramen.

What structures pass through this?

2

Internal jugular vein, IX, X and XI nerves.

Total: /20

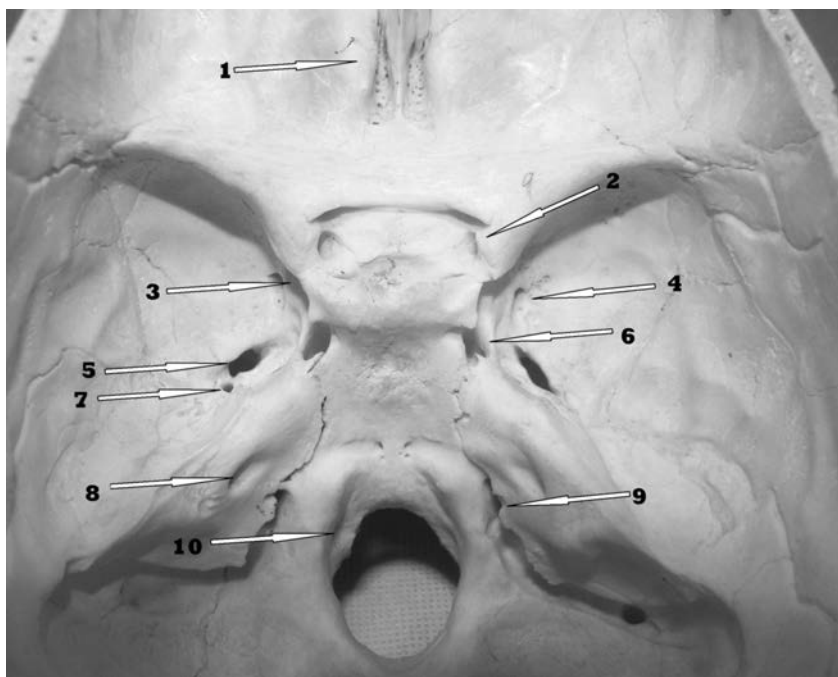


Figure 1.11b Base of the skull.

1. Cribriform plate; 2. Optic canal; 3. Superior orbital fissure; 4. Foramen rotundum; 5. Foramen ovale; 6. Foramen lacerum; 7. Foramen spinosum; 8. Internal acoustic meatus; 9. Jugular foramen; 10. Hypoglossal canal.

Table 1.11 Foramen in the base of the skull.

Foramen	Location	Content
Olfactory foramen	Cribriform plate of ethmoid	I nerve
Optic canal	Lesser wing of sphenoid	II nerve and ophthalmic artery
Superior orbital fissure	Between greater and lesser wing of sphenoid	III, IV, V1 and VI nerves
Foramen rotundum	Greater wing of sphenoid bone	V2 nerve
Foramen ovale	Sphenoid bone	V3 nerve and accessory meningeal artery
Foramen spinosum	Sphenoid bone	Nervus spinosus (branch of V3) and middle meningeal artery
Foramen lacerum	Temporal bone; opening of carotid canal in middle cranial fossa	Internal carotid artery and sympathetic plexus
Internal acoustic meatus	Temporal bone	VII, VIII nerves
Jugular foramen	Temporal and occipital bones	Internal jugular vein, IX, X and XI nerves
Hypoglossal canal	Occipital bone	XII nerve
Foramen magnum	Occipital bone	Spinal cord, meninges, vertebral arteries and veins
Stylomastoid foramen	Exterior: temporal bone	Facial nerve
Supra-orbital foramen	Face: frontal bone	Supra-orbital nerve, artery and vein

Table 1.11 Foramen in the base of the skull *continued*:

Foramen	Location	Content
Infra-orbital foramen	Face: maxillary bone	Infra-orbital nerve, artery and vein
Zygomatico-facial foramen	Face: zygomatic bone	Zygomatico-facial nerve
Mental foramen	Face: mandible	Mental nerve, artery and vein
Incisive foramen	Oral cavity: maxillary bone	Nasopalatine nerve, sphenopalatine artery and vein
Greater palatine foramen	Oral cavity: between maxillary and palatine bones	Greater palatine nerve, artery and vein
Lesser palatine foramen	Oral cavity: palatine bone	Lesser palatine nerve, artery and vein
V1= ophthalmic division of the trigeminal nerve		
V2 = maxillary division of the trigeminal nerve		
V3 = mandibular division of the trigeminal nerve		

Key points

- ◆ The base of the skull is divided into three areas: the anterior, middle and posterior cranial fossae.
- ◆ There are several openings in the base of the skull which transmit cranial nerves and blood vessels.
- ◆ The three divisions of the trigeminal nerve (ophthalmic, maxillary and mandibular) exit the middle cranial fossa through the superior orbital fissure, foramen ovale and foramen rotundum.
- ◆ X, XI and XII cranial nerves exit the posterior cranial fossa via the jugular foramen.

Station 1.12 History taking: teeth extraction

Information for the candidate

In this station you will be asked to take a history from a 25-year-old male patient who is scheduled to have multiple teeth extraction.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient.	1
Confirms the proposed surgery.	1
Past surgical history: elicits H/O previous anaesthetics.	1
Drug history: currently on methadone.	2
Dose of methadone 60mg daily.	1
H/O previous heroin abuse.	2
Route of heroin abuse (intravenous).	2
How long he has been using and when stopped (6 years; stopped 3 months ago).	2
H/O smoking: 20 cigarettes a day.	1
H/O alcohol intake: how much/what?	1
Past medical history: any hospital admission/medical problems (hepatitis 6 months ago).	2

H/O allergy: to egg. 1

Type of allergic reaction (skin rash). 1

H/O reflux and heartburn. 1

Asks about dentures, crowns and caps (which tooth/teeth, is it loose?). 1

Total:	/20

Information for the actor

You are scheduled to have your teeth extraction. You suffer from toothache and your dentist has suggested a tooth extraction. In the past you used to take intravenous heroin for 6 years; you stopped this about 3 months ago. To help with withdrawal symptoms you have been on methadone (30mg in the morning and another 30mg at night time) for the last 3 months. You are a little concerned about the pain during and after the operation. Apart from getting admitted for jaundice due to hepatitis 6 months ago, you do not have any other medical problems. You are allergic to eggs with which you get a rash. You still smoke cigarettes and drink alcohol. You have two (dental) crowns in the front on the upper jaw.

Information for the examiner

The patient has a past history of intravenous drug abuse (no longer abusing), a previous GA for appendicectomy as a child and no other history of note. A history of drug abuse is elicited when questioned about current medication. The patient may volunteer this information only when he is given an opportunity to express his concerns.

General principles for history taking

Time available for gathering all the necessary information is only 5 minutes. Therefore, it is important to have a structured approach. Read the given information carefully and plan your questions. If the information indicates that you take a history, you should not waste time in doing a clinical examination. You should gather information relevant to the clinical condition, as well as general questions that will help you to screen common medical conditions in the given patient. Allow the patient to outline their problem by using an open-ended question, but you should control the interview, so that 5 minutes of time is utilised appropriately.

Structured approach

- ◆ Introduce and confirm the patient's identity.
- ◆ Confirm the proposed surgical procedure, side and indication.
- ◆ Consider the presenting symptoms and whether they have any systemic effect.
- ◆ What is the cause of the current surgical condition, and does it have any systemic complications? Is there any predisposing or risk factor for the presenting problem?
- ◆ Past surgical history (PSH): previous anaesthetics, type of anaesthetic - any problems?
- ◆ Family history of anaesthetic-related concerns, diabetes and heart attack.
- ◆ Past medical history (PMH): previous hospital admissions, operations, visits to general practitioner, rheumatic fever, jaundice, high blood pressure, chest pain, heart attack, palpitations, cough, wheeze, dizziness, black-outs, stroke, jaundice, etc.
- ◆ Drugs: both for therapeutic and recreational purpose. Most women of reproductive age are likely to take the oral contraceptive pill and postmenopausal women may be taking hormone replacement therapy.
- ◆ Any side effects related to current drug therapy or any treatment the patient has received (e.g. radiotherapy, chemotherapy).
- ◆ Allergy: to drugs, food and other substances; type of reaction.
- ◆ History of smoking and alcohol.
- ◆ History of heartburn and gastrointestinal reflux.
- ◆ Mouth opening, crowns, caps, dentures, loose tooth.
- ◆ Neck stiffness, range of movement.

Systematic review (as directed by history)

Cardiovascular system: chest pain, shortness of breath, exercise tolerance, palpitation, dizziness or syncope (black out or faints) and ankle swelling.

Respiratory system: shortness of breath, wheeze, cough.

Central nervous system: headache, convulsions or fits, stroke (cerebrovascular accident), weakness, unsteady gait, paraesthesia, numbness, visual disturbances, mood changes (depression), memory loss and confusion.

Gastrointestinal system: heartburn, reflux, dysphagia, abdominal pain, jaundice, loss of appetite, change in bowel habit, melaena.

Locomotor system: arthritis (stiffness and joint pain), rheumatoid arthritis.

Endocrine system: thyroid disease, weight change, dislike to hot or cold weather, diarrhoea, constipation, palpitations, voice change, depression and tremors.

As you work through the questionnaire, if you identify a problem you can either ask a few questions pertaining to the problem and proceed with the remainder of the questionnaire, or you may first complete the questionnaire and then focus on areas of identified problems. Remember, 5 minutes is a short time and you need to be careful not to spend too much time on a specific issue and omit a big chunk, such as reflux and allergy, which may fetch you the marks.

Some patients may volunteer all information that is useful to you. Some may just be concerned about their current surgical problem and forget about all other significant medical problems that have been investigated and treated in the past. You may not elicit all the information unless you ask specific closed questions. If the patient has a history of jaundice or drug abuse, consider the possibility of hepatitis and AIDS.

Key points

- ◆ Whilst eliciting a drug history, do remember to ask about drugs for recreational purposes.
- ◆ When there is a positive past medical history (such as jaundice), try and find the cause for that (possibly it is due to intravenous drugs/hepatitis in this case); it may lead to a series of relevant questions.
- ◆ Have a structure: introduction, confirmation of surgery, past surgical history, past medical history, family history, drugs, allergy, smoking and alcohol, dentures/mouth opening and neck range of movement.

Station 1.13 Simulation: anaphylaxis

Information for the candidate

A 70-year-old male patient is scheduled for a total hip replacement under general anaesthesia. He is a known hypertensive and is otherwise fit and healthy. He is now on the operating table.

On entering the station:

General anaesthesia was induced with propofol and fentanyl, and relaxation was facilitated with atracurium. The trachea was easily intubated; the lungs are ventilated with positive pressure ventilation. Just before starting the surgery the surgeon requested 1.5g of cefuroxime which was administered intravenously. Can you take over this patient for 5 minutes? You are the anaesthetist in charge for the next 5 minutes (surgery yet to be started). As you take over, the low saturation alarm and high airway pressure alarm sounds.

Examiner's mark sheet

marks

Checks other vital parameters and recognises this as a critical incident.

1

Calls for help.

2

Administers 100% oxygen.	2	☐
Checks the endotracheal tube position.	2	☐
Auscultates the chest for breath sounds and any added sounds.	2	☐
Mentions that he/she can hear a wheeze.	2	☐
Asks for epinephrine/administers epinephrine 100µg IV.	2	☐
Checks the intravenous drip and administers normal saline or Hartmann's solution rapidly.	2	☐
Looks for cutaneous signs of anaphylaxis such as rashes.	1	☐
Asks for antihistamines: chlorpheniramine 10-20mg and hydrocortisone 100mg to be administered intravenously.	2	☐
Checks the response by reassessing the vital parameters and repeats epinephrine if required.	2	☐

Total:	/20

Information for the examiner

On SimMan, the heart rate is set at 130 per minute (sinus tachycardia), the high heart rate alarm is sounding, BP is set at 70/30 mmHg, peripheral pulses are very feeble and a carotid pulse is present. SaO₂ is low at 94%, EtCO₂ is low at 3.0kPa, end tidal isoflurane is 0.9, the high airway pressure alarm is sounding on the ventilator, the tidal volume is 500ml and the respiratory rate is 12 breaths per minute. The chest has bilateral wheezes and there is a reduced compliance of the chest on both sides.

As the candidates take over, the low saturation alarm and high airway pressure alarm sounds. Candidates should ask for a blood pressure reading to be taken (non-invasive blood pressure [NIBP] set at a 5-minute interval).

Recognition of anaphylaxis

In this scenario you should recognise an inadvertent high airway pressure, tachycardia and low oxygen saturation. Immediately check for other vital

parameters: EtCO₂, blood pressure and a peripheral or central pulse. Diagnosis of anaphylaxis is based on the combination of the following clinical findings:

- ◆ Tachycardia.
- ◆ Hypotension.
- ◆ Severe bronchospasm.
- ◆ Low saturation indicating impaired gas exchange and reduced peripheral perfusion.
- ◆ Low EtCO₂ indicating reduced pulmonary perfusion.
- ◆ Unresponsiveness of haemodynamic parameters to initial treatment with ephedrine or metaraminol.

A systematic approach for recognition and management of this critical incident is very important.

Management of anaphylaxis

Primary therapy

- ◆ Stop administration of all agents likely to have caused the anaphylaxis.
- ◆ Call for help
- ◆ Maintain airway, give 100% oxygen and lie the patient flat with their legs elevated.
- ◆ Give epinephrine (adrenaline). This may be given intramuscularly in a dose of 0.5mg to 1mg (0.5-1ml of 1:1,000) and may be repeated every 10 minutes according to the arterial pressure and pulse, until improvement occurs. Alternatively, 50-100µg intravenously (0.5-1ml of 1:10,000) over 1 minute has been recommended for hypotension with titration of further doses as required.
- ◆ Start rapid intravenous infusion with colloids or crystalloids. Adult patients may require 2-4 litres of crystalloid.

Secondary therapy

- ◆ Give antihistamines (chlorpheniramine 10-20mg by slow intravenous infusion).
- ◆ Give corticosteroids (100-500mg hydrocortisone slow IV).
- ◆ Bronchodilators may be required for persistent bronchospasm.

Investigations

Serum tryptase: A blood sample should be collected as soon as possible after the initial management; about one hour after the reaction and about 6-24 hours after the reaction. The blood sample should be stored at 4°C if it can be analysed within 48 hours or should be stored at -20°C if there is a delay.

All events should be documented. All suspected anaphylactic reactions should be reported to the Committee on Safety of Medicine. After discharge from intensive care or the high dependency unit (HDU), the patient should be referred to an immunologist for further investigations.

(For further reading please refer to the Association of Anaesthetists of Great Britain and Ireland - Anaphylaxis guidelines).

Key points

- ◆ You should think about possible causes; the most likely cause is anaphylaxis.
- ◆ The scheduled surgical procedure is an elective one and the surgery has not commenced. So, it should be postponed.
- ◆ The most common substances causing anaphylactic reactions are neuromuscular blocking agents, latex, antibiotics, hypnotics, colloids and opioids (in decreasing order).
- ◆ The most common presentation under anaesthesia is cardiovascular (no pulse, tachycardia, hypotension) with bronchospasm.

Station 1.14 Monitoring equipment: capnography

Information for the candidate

In this station you will be asked about the methods of measuring expired CO_2 and interpretation of the display.

Examiner's mark sheet

marks

Can you identify this?

1 ☐

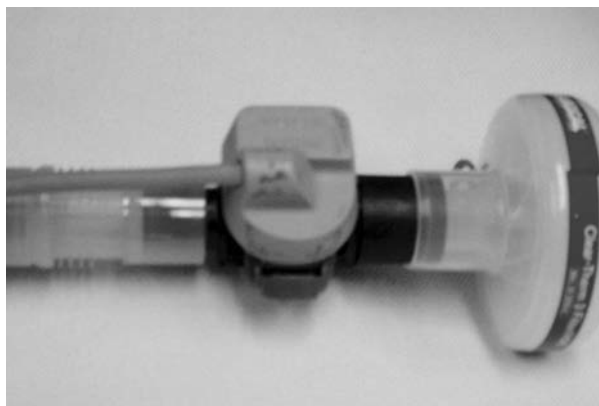


Figure 1.14a.

Main stream CO_2 analyser.

What other type of CO_2 analyser is used in clinical practice?

1 ☐

Side stream analyser.

What are the differences between the two?

4

Main stream

A cuvette containing a CO₂ sensor is inserted between the endotracheal tube (ETT) and breathing system. There is no need for gas sampling. Water vapour can condense on the sensor which can result in a false high reading. To overcome this, the sensor is heated to 39°C. It is heavier and cumbersome.

Side stream

The sensor is located in the main unit; gas is aspirated using a small pump via a sampling tube at a rate of 50-150ml/minute. As this gas also contains anaesthetic agent, it should be scavenged or returned to the patient's breathing system.

What are the advantages of a main stream analyser?

2

There is no delay in response, no loss in gas, and no mixing of sample gas with inspired gas.

Name the factors that can affect the response time

3

- ◆ The response time depends on transit time and rise time.
- ◆ Transit time depends on the length of the sample tube.
- ◆ Rise time depends on the optimum flow rate and the size of the sample chamber. A very low flow rate and large sample chamber increases the rise time.

Name the different phases of this capnograph in 4

Figure 1.14b

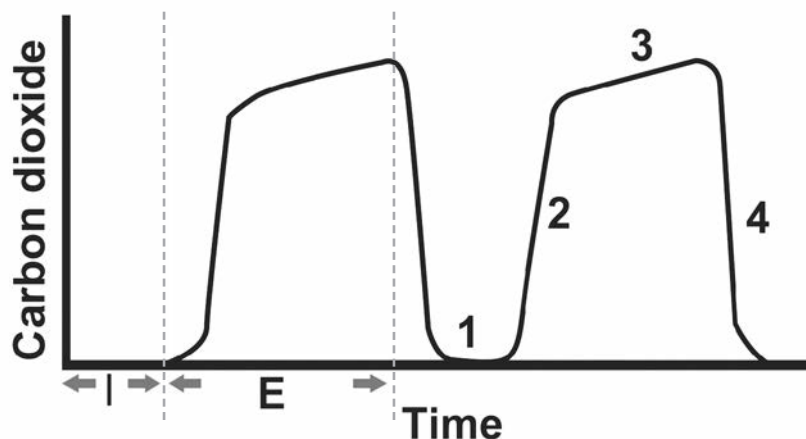


Figure 1.14b Normal capnograph.

1. Inspiratory base line: this should be at 0, since any elevation of the baseline indicates rebreathing.
2. Expiratory upslope phase: onset of expiration. If this is shallow it indicates obstruction.
3. Plateau: this represents mixing of alveolar gas; if sloped rather than flat, this indicates uneven mixing, as in chronic obstructive airway disease (COAD).
4. Fall to 0: inspiratory downstroke.

Name the following abnormal patterns of 5

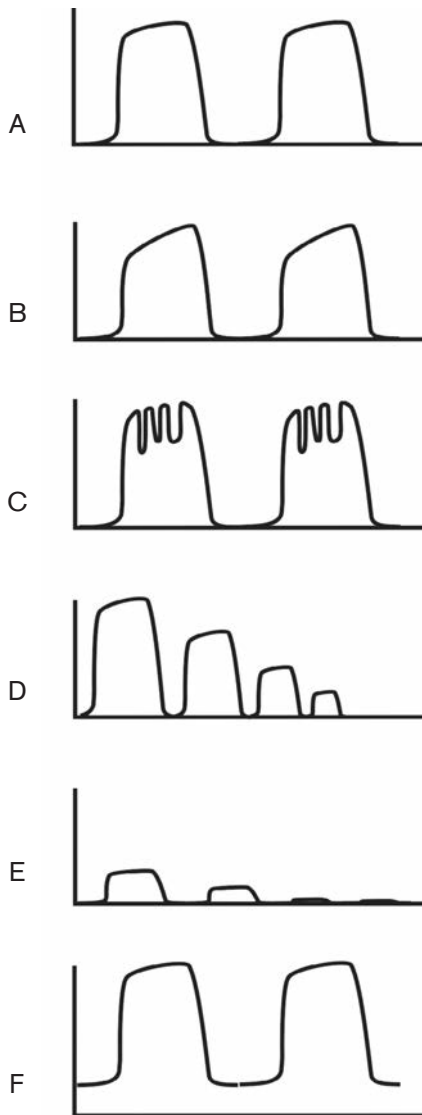


Figure 1.14c Patterns of capnographs.

A. Normal; B. Chronic obstructive airway disease; C. Curare cleft; D. Reduced cardiac output; E. Oesophageal intubation; F. Rebreathing.

Total: /20

Measurement of carbon dioxide

Capnometry is the measurement of CO_2 concentration during the respiratory cycle. Capnography is the graphic display of CO_2 concentration as a waveform, usually plotted as EtCO_2 versus time (CO_2 is plotted along the y axis and time along the x axis).

A capnograph uses the principle of infrared absorption by CO_2 . Gases with molecules containing two or more different atoms absorb radiation in the infrared region of the spectrum. CO_2 has a strong absorption band at a wavelength of $4.26\mu\text{m}$.

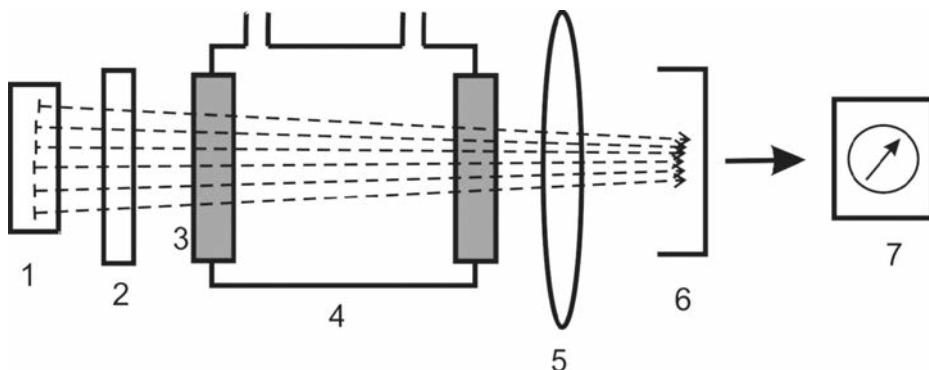


Figure 1.14d Infrared spectroscopy.

1. Infrared radiation source; 2. Filter; 3. Crystal window; 4. Sample chamber; 5. Focusing optics; 6. Photodetector; 7. Display.

The amount of infrared radiation absorbed is proportional to the CO_2 concentration. The electrical output from the photodetector is presented as partial pressure of CO_2 in the sample chamber.

A sudden decrease in the EtCO_2 value to near zero indicates a complete airway disconnection, totally obstructed airway or ventilator malfunction.

A sudden decrease in the EtCO_2 value to a low level (not near to zero) may be due to reduced cardiac output or a leak in the breathing system.

An exponential drop in EtCO_2 is usually as a result of reduced pulmonary perfusion due to low cardiac output or a pulmonary embolism.

A gradual decrease in EtCO_2 value indicates hyperventilation or hypothermia. Similarly, a gradual increase in EtCO_2 value indicates hypoventilation or increasing body temperature.

Key points

- ◆ There are two types of CO_2 analysers: side stream and main stream analysers.
- ◆ A main stream analyser adds additional weight to the breathing tubes and increases dead space.
- ◆ A side stream analyser is more convenient but there may be a delay in the response; the response time of the side stream analyser depends on transit time and rise time.

Station 1.15 Clinical safety: diathermy and electrical safety

Information for the candidate

In this station you will be tested on your knowledge and skills required to safely use clinical equipment.



Figure 1.15a Diathermy machine.

Examiner's mark sheet**marks****What are the clinical uses of this equipment?**1

Diathermy involves employing high frequency alternating current to cut or to coagulate tissues during surgery.

What is the physical principle involved?1

- ◆ High frequency current.
- ◆ Localised high density current.

What is the frequency of current used?1

1MHz.

Why does the patient plate have a large area?1

A large patient plate is to reduce the current density.

What happens if the patient plate is disconnected and diathermy is activated?1

Current flows through the patient and is earthed through any metal objects which are attached to the patient.

Are there any other problems or hazards while using diathermy?1

- ◆ Fire and explosion.
- ◆ Pacemaker dysfunction.

What is the difference between monopolar and bipolar diathermy?2

Monopolar diathermy needs a patient (neutral) plate. Bipolar diathermy is like a pair of forceps where current travels down on

one limb of the forceps and leaves through the other limb of the forceps. Bipolar diathermy delivers a lower power output.

What safety features are incorporated to avoid electrical hazards?

3

The outer case is earthed. An isolating capacitor provides high impedance to low frequency current. It has a floating circuit where the active electrode and neutral electrodes are isolated from the earth connection (earth-free circuit).

What precautions do you need to take to prevent electrical hazards (from diathermy) to the patient?

2 x 3

=6

A good connection of the neutral plate to the patient, not activating diathermy until the active electrode is in contact with the tissues and regular servicing of the equipment.



Figure 1.15b.

What does Figure 1.15b indicate?

2

Type CF equipment (leakage current is less than 10 micro-amperes).



Figure 1.15c.

What does Figure 1.15c indicate?

1

Type BF equipment. It provides a higher degree of protection against electric shock than that provided by Type B. Like Type CF, it is floating (identified by 'F') with respect to earth.

Total: /20

Key points

- ◆ Diathermy is an electrical device that utilises a heating effect of high frequency (0.5-1MHz) alternating current to cut and coagulate.
- ◆ A high frequency current is chosen to minimise the effects on cardiac and skeletal muscle.
- ◆ For cutting, a sine wave pattern is employed; for coagulation, a damped or pulse sine wave pattern is used.
- ◆ Current density is current per unit area. It is high at the diathermy forceps end and is low at the large earth plate (as in monopolar diathermy).
- ◆ Depending on the type of equipment, acceptable levels of leakage currents have been determined.

- ◆ B-type applied parts are non-cardiac grounded applied parts. These are parts that come into contact with the patient.
- ◆ C-type comes into contact with the heart. F stands for floating and is isolated. CF is for cardiac applications and provides a higher degree of protection against electric shock than BF.

Station 1.16 Radiology: chest X-ray

Information for the candidate

A 64-year-old male was admitted from the Accident and Emergency Department following polytrauma. Because of his open right supracondylar fracture he is posted for urgent open reduction and internal fixation. In view of his chest pain a chest X-ray was taken.



Figure 1.16a Chest X-ray.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. X-ray shows a right-sided pneumothorax.	True	False	2	☐
2. The findings are suggestive of tension pneumothorax.	True	False	2	☐
3. There are fractured ribs with flail segments.	True	False	2	☐
4. If clinically deteriorating, immediate management is intubation and intermittent positive pressure ventilation (IPPV) with 100% oxygen.	True	False	2	☐
5. His cardiothoracic ratio is within acceptable limits.	True	False	2	☐
6. There is evidence for a right-sided haemothorax.	True	False	2	☐
7. A supraclavicular brachial plexus block is safe for his proposed surgery.	True	False	2	☐
8. General anaesthesia with oxygen/nitrous oxide/sevoflurane and spontaneous ventilation will be a good choice.	True	False	2	☐
9. This patient may have chronic obstructive airway disease.	True	False	2	☐
10. In a normal chest X-ray you may see 6 ribs anteriorly and 10 ribs posteriorly.	True	False	2	☐

Total:	/20

Answers

- False. Left-sided pneumothorax.
- False. There is no tracheal or mediastinal shift.
- False. There is no obvious bony injury.
- False. Immediate management is decompression with a wide-bore needle in the second intercostal space in the midclavicular line.

5. True. It is <0.5 .
6. False. The costophrenic and cardiophrenic angles are free in the right side.
7. False. There is a risk of pneumothorax and may result in bilateral pneumothoraces.
8. False. Nitrous oxide can increase the size of air-containing cavities.
9. True. There are features of hyperinflation of lung fields.
10. True.

Cardiothoracic ratio

Cardiothoracic ratio: this is a measurement to determine the size of the heart and a screening for heart enlargement.

ID: greatest internal diameter of the thorax.

MRD: maximum transverse diameter of the right side of the heart; it is a line drawn from the midline of the spine to the most distant point of the right cardiac margin.

MLD: maximum transverse diameter of the left side of the heart; it is a line drawn from the midline of the spine to the most distant point of the left cardiac margin.

Cardiothoracic ratio = $\text{MRD} + \text{MLD} / \text{ID}$.

Borders of the heart in a chest X-ray

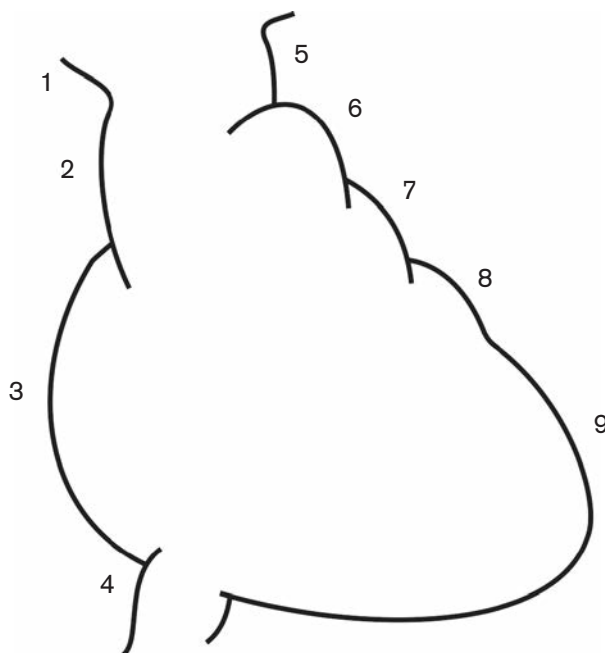


Figure 1.16b Borders of the heart.

1. Brachiocephalic vein; 2. Superior vena cava; 3. Right atrium; 4. Inferior vena cava; 5. Left subclavian artery; 6. Aortic knob; 7. Main pulmonary artery; 8. Left atrial appendage; 9. Left ventricle.

Key points

- ◆ The normal cardiothoracic ratio is less than 0.5.
- ◆ Tension pneumothorax is a clinical diagnosis.
- ◆ The presence of mediastinal shift and tracheal deviation to the opposite side may indicate a tension pneumothorax.

Station 1.17 History taking: arthroscopy of the knee

Information for the candidate

In the following station you will be asked to take a history from a patient who is scheduled to have arthroscopy of the knee as a day-case procedure.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient.	1
Confirms the proposed surgery.	1
H/O trauma 3 days ago (fall while playing football).	2
H/O previous anaesthetic.	1
H/O heart murmur.	2
Diagnosed at the age of 5.	1
Had an echo at the age of 10, which showed a small ventricular septal defect (VSD); surgical correction was not required.	2
Good exercise tolerance.	2
H/O mild asthma, not precipitated by NSAIDs.	2
Drug history: cocodamol for pain; salbutamol metered dose inhaler as and when required.	2
H/O allergy: none known.	1
H/O smoking: 15-20 cigarettes per day.	1

H/O alcohol intake: 6-8 units on weekends.

1

Asks about dentures, crowns and caps.

1

Total:	/20

Information for the actor

You are 25 years old. Three days ago you injured your knee while playing football. Now you require keyhole surgery on the left knee joint. You know that you have a heart murmur. This was diagnosed when you were about 5 years old. You had a heart scan and were told that a small hole in the heart is causing the murmur. You did not require any further treatment. You also have mild asthma for which you take salbutamol via an inhaler when required. You also occasionally take tablets such as ibuprofen for headache.

For the last 3 days you have been taking painkillers (cocodamol). You smoke about 15-20 cigarettes per day, and drink alcohol only at the weekends.

Key points

- ◆ Ensure that all key symptoms have been elicited.
- ◆ Enquire as to the reason for arthroscopy and the nature of injury.
- ◆ Remember to ask complete details regarding the asthma and heart murmur.
- ◆ Ensure that it is safe to use NSAIDs during the peri-operative period in this patient.

(For more information please refer to OSCE set 1, station 1.12).

Station 1.18 Communication: awareness under anaesthesia

Information for the candidate

The nurse from the orthopaedic ward bleeps you to come and see a patient you anaesthetised one week ago. You put him to sleep for multiple long-bone fracture fixations following polytrauma in an emergency list when you were on-call. He claims that he was awake during his operation. He is upset.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient.	1 ☐
Discusses in the presence of a witness, e.g. a ward nurse.	1 ☐
Confirms the facts, listens to the history, finds out what he actually does recollect.	2 ☐
Offers an apology.	1 ☐
Advises the patient that all precautionary measures, including a machine check, choice of drugs, monitoring, etc. were taken.	2 ☐
As he was unstable following polytrauma, until he was stabilised you had to be careful with administration of drugs. It was possibly during that period that he had awareness.	2 ☐
Finds out whether he felt pain during his awareness.	1 ☐
Mentions that this is rare, but a possible complication whilst anaesthetising unstable trauma patients.	1 ☐
Arranges an interview with a senior consultant.	2 ☐

Offers follow-up.	1	☐
Offers to organise psychological support.	2	☐
Reassures that in the future general anaesthetics can be safely provided.	1	☐
Advises him that everything is documented and you will write to his GP.	1	☐
Enquires as to whether he wants to know anything more.	1	☐
Remains courteous and develops rapport.	1	☐

Total:	/20

Information for the actor

You are Mr. AM. A week ago you were brought to the hospital following a motor vehicle accident. You were quite poorly and had lost a lot of blood. You underwent an operation to fix all your bone fractures. You remember the anaesthetist putting the tube into the windpipe and taking you to the theatre. During this you felt as though you were not able to breathe. You were upset because something went wrong with the anaesthetic and you woke up half way through the operation just like you watched on the television a while ago. You wish to speak to the anaesthetist involved to find out what exactly went wrong. You are upset and worried that the same thing may happen again in case you ever need any further operations.

Awareness under anaesthesia

Awareness during anaesthesia can be deliberate (as in regional techniques or during spinal surgeries where patients are woken up in the middle of the procedure - intentionally). Inadvertent awareness during anaesthesia can either be an explicit or implicit memory.

Awareness with an explicit memory can be conscious awareness with recall, with or without pain. In an implicit memory type, there is an apparent perception during anaesthesia without conscious awareness or recall.

Enquire as to the possibility of getting confused with dreaming or delirium (as with ketamine).

The risk of awareness is possibly higher in:

- ◆ Obstetrics and trauma (shocked) patients.
- ◆ Total intravenous anaesthesia (due to technical failures or inadequate drugs).

It can also be due to human error, erroneous clinical judgement or, technical faults.

Key points

When there is a complaint on awareness under anaesthesia:

- ◆ Patients can be furious; remain courteous, professional and objective.
- ◆ See the patient as early as you can.
- ◆ Have a ward nurse or some other responsible personnel present when you discuss this with the patient.
- ◆ Apologising does not imply accepting guilt. But it goes a long way.
- ◆ Get the facts right, listen to the patient; do not be defensive.
- ◆ Find out what exactly they recall, when they were aware and whether they were experiencing pain at that time; rule out dreaming or delirium.
- ◆ Give them a good explanation on the conduct of anaesthesia, and the precautions and safety measures taken to avoid awareness, e.g. machine check, alarms, monitor, clinical evaluation, etc.
- ◆ Most hospitals have a consultant with a special interest in awareness under anaesthesia.
- ◆ Reassure about future anaesthetics.
- ◆ Offer psychological support if they develop post-traumatic stress disorder.
- ◆ Document and communicate with the appropriate doctors, including the GP.

Station 1.19 Anatomy: intercostal nerve block

Information for the candidate

In this station you will be assessed on anatomy of the intercostal space and the technique of intercostal nerve block.

Examiner's mark sheet

marks

Name the structures labelled 1 to 7 in Figure 1.19a

1 x 7

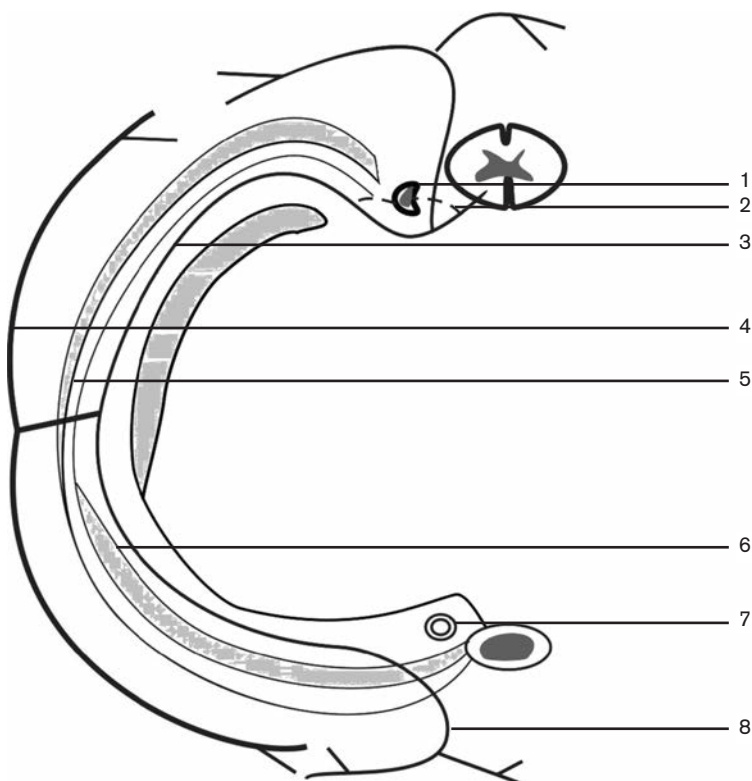


Figure 1.19a Intercostal nerve.

1. Sympathetic ganglia; 2. Rami communicantes; 3. Intercostal nerve; 4. Lateral cutaneous branch; 5. External intercostal muscle; 6. Internal intercostal muscle; 7. Internal mammary artery; 8. Anterior cutaneous branch.

Which are the three important structures passing through the intercostal space? How are they arranged? 3

Intercostal vein, artery and nerve (VAN), from above downwards.

How many veins are there in each space? 2

One posterior and two anterior veins.

Give three indications for intercostal nerve block 3

Thoracic surgery, breast surgery, upper abdominal procedures such as cholecystectomy, rib fractures, intercostal drain insertion.

Between which two muscles are these intercostal nerves and vessels found? 1

The neurovascular bundle is found between the internal intercostal and innermost intercostal muscles.

State three complications of intercostal nerve block 3

Pneumothorax, intravascular injection, bleeding, nerve damage and local anaesthetic toxicity.

What type of nerve is the intercostal nerve? 1

Mixed spinal nerve.

Total:	/20

Intercostal nerves

The T1 to T12 spinal nerves, after emerging from the intervertebral foramina divide into an anterior and posterior division. The posterior division provides sensory and motor innervation to the paravertebral region.

Each nerve is connected to the sympathetic chain that lies antero-lateral to the vertebral body through the white and gray rami communicantes.

The anterior division continues along the intercostal space as the intercostal nerve. It runs in the costal groove on the inner surface of the inferior border of the body of the rib. The costal groove provides a protective function to the neurovascular bundle.

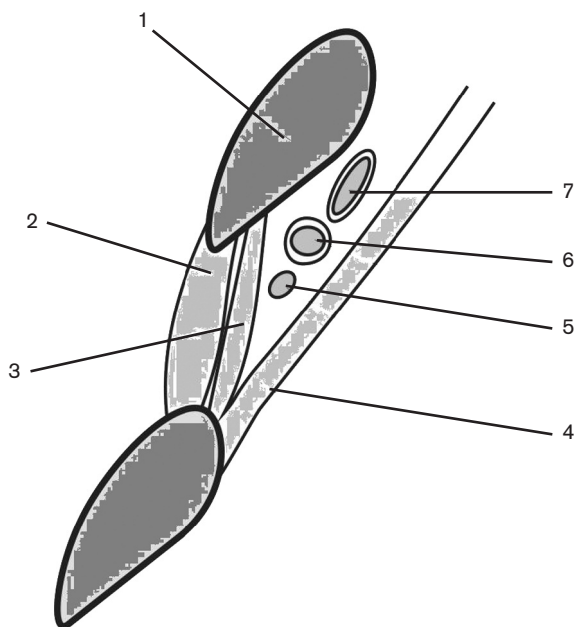


Figure 1.19b Intercostal space.

1. Rib; 2. External intercostal muscle; 3. Internal intercostal muscle; 4. Innermost intercostal muscle; 5. Intercostal nerve; 6. Intercostal artery; 7. Intercostal vein.

The intercostal nerve gives rise to a lateral cutaneous branch (anterior to the mid-axillary line) and an anterior cutaneous branch closer to the midline.

T1 sends fibres to the upper limb. T2 contributes to the intercostobrachial nerve. T3 to T6 supply the thorax and the remainder innervate the abdominal wall. T11 and T12 are described as subcostal nerves.

Intercostal nerve blocks are performed for chest wall procedures and upper abdominal procedures. They do not provide visceral analgesia. Therefore, for upper abdominal surgeries it needs to be combined with a coeliac plexus block for complete analgesia.

In view of the vascularity, intercostal nerve blocks have a high propensity to cause local anaesthetic toxicity, in particular, when multiple level injections are done. The peak plasma level occurs more rapidly and is higher following intercostal nerve block than from other regional nerve blocks when comparable doses are injected.

The optimal site for blocking an intercostal nerve is at the angle of the rib and the optimal needle is one with a short bevel.

Key points

- ◆ Intercostal nerve blocks are performed to provide analgesia for thoracic and upper abdominal procedures.
- ◆ Due to high vascularity, there is an increased risk of local anaesthetic toxicity.

Station 1.20 Clinical examination: cranial nerves

Information for the candidate

In this station you will be asked to perform cranial nerve examination on a volunteer.

Examiner's mark sheet

	marks
Olfactory nerve Asks about smell.	1
Optic nerve Visual acuity: light reflex in both eyes and indirect light reflex.	2
Oculomotor, trochlear and abducens nerves Checks eye movements in all four directions.	2
What nerves do you test by light reflex?	2
II (optic) and III (oculomotor).	
Trigeminal nerve Checks sensation over the face and forehead.	1
Clenching teeth for masseter and temporalis muscles.	1
Facial nerve	
Special senses: asks about taste	1
Motor: asks the patient to shut their eyes tightly; smile/show teeth/blow out their cheeks.	1
Vestibulocochlear nerve Hearing.	2
Glossopharyngeal nerve Gag reflex (not necessary to test).	1
Vagus nerve Movement of soft palate (on saying 'Ha').	1
Accessory nerve Shrugging the shoulders.	1
Hypoglossal nerve Look for tongue wasting/fasciculations.	1

State the signs of complete paralysis of the third cranial nerve 3

Ptosis, the eye is displaced downwards and outwards, the pupil is dilated and there is a loss of accommodation reflex.

Total: /20

Summary of cranial nerve function

- ◆ I - Smell.
- ◆ II - Visual acuity, visual fields and ocular fundi.
- ◆ II, III - Pupillary reactions.
- ◆ III, IV, VI - Extra-ocular movements, including opening of the eyes.
- ◆ V - Facial sensation, movements of the jaw, and corneal reflexes.
- ◆ VII - Facial movements and gustation.
- ◆ VIII - Hearing and balance.
- ◆ IX, X - Swallowing, elevation of the palate and gag reflex.
- ◆ V, VII, X, XII - Voice and speech.
- ◆ XI - Shrugging the shoulders and turning the head.
- ◆ XII - Movement and protrusion of the tongue.

In this station it is unrealistic to expect you to formally examine all 12 cranial nerves. Examination of olfaction, gag reflex, etc., will be restricted to simple questions.

Olfactory nerve

Ensure patency of the nostrils. Each nostril should be tested separately, occluding the other one, with the eyes closed.

Optic nerve

First, visual acuity is examined by asking the patient to read a pocket visual acuity chart. Each eye is tested separately with the other eye covered. Then, visual fields are tested by a confrontation test. The examiner sits

facing the patient at eye level. When the right eye is being examined ask the patient to cover his/her left eye with the left hand and vice versa.

Assess the diameter and equality of pupils. Shine a light and assess the direct and consensual light reflex. A pupillary reflex tests optic and oculomotor nerves. An accommodation reflex can be tested by bringing an object closer to the eye and assessing pupillary size. Eyes accommodate to nearer objects by constricting the pupils.

Oculomotor, trochlear and abducens nerves

These nerves supply the extra-ocular muscles. The trochlear nerve supplies superior oblique (SO4); the abducens nerve supplies lateral rectus (LR6); the remainder are supplied by the oculomotor nerve. These nerves are tested by asking the patient to follow the moving fingers of the examiner without moving his/her head.

The oculomotor nerve also supplies levator palpebrae, the elevator of the eyelids. Third nerve palsy can cause ptosis. Parasympathetic fibres run along with the third nerve, hence third nerve palsy is associated with disruption of parasympathetic activity as well, resulting in pupillary dilatation (sympathetics dilate the pupil and parasympathetics constrict the pupil).

Trigeminal nerve

The trigeminal nerve supplies the muscles of mastication and sensory innervation for the face. Motor supply is tested by feeling for the masseter and temporalis muscle tone after asking the patient to clench their teeth (pterygoids).

Sensory innervation is tested in all three distributions: ophthalmic, maxillary and mandibular divisions. Commonly, pin prick (with a blunt point), fine touch (with cotton wool), and warm and cold modalities are tested.

The corneal reflex involves testing V and VII nerves. With a wisp of cotton touch the cornea. Observe for reflex blinking.

Facial nerve

Look for creases in the forehead, the nasolabial groove, facial asymmetry, etc. The common tests for this nerve include raising the eyebrows (frown), shutting the eyes tight, saying 'E' or smiling to show the teeth, and by trying to blow air with the lips tightly closed (puff out cheeks).

If the lesion in the nerve is peripheral it results in weakness involving the entire half of the face on the involved side. If it is a central lesion, the upper half of the face is spared (as this part receives dual innervation from both hemispheres).

Vestibulocochlear nerve

Although the nerve is important for hearing and balance, at the bed-side, hearing is often tested to identify any lesion. Because of extensive bilateral connection of the auditory system and practical limitations, precise diagnosis of the nature and side of the lesion of the nerve is difficult.

With the patient's eyes closed, in a calm environment, hearing is tested on both sides with sounds, such as ticking of the watch, rubbing of the fingers, etc. Patients should identify whether they hear it in the right or left side. If a tuning fork is provided, Weber (for lateralisation) and Rinne (for air versus bone conduction) tests can be done. Normally, air conduction is greater than bone conduction. If there is a suspicion about hearing impairment, an audiogram should be requested for further evaluation.

Glossopharyngeal and vagus nerves

Both the nerves are tested together. Enquire as to whether the patient has any hoarseness of voice or difficulty in swallowing. Ask the patient to say 'Aah' and look for movement of the pharynx and soft palate. Normally, the uvula remains in the midline and the soft palate rises symmetrically on both sides. In a unilateral lesion, the uvula is drawn to the normal side.

The gag reflex (sensory IX motor X) is tested by stimulating the pharynx (back of throat) on both sides. A normal response is a gag or cough.

Accessory nerve

The accessory nerve innervates trapezius and the sternocleidomastoid muscles. Apart from observing for wasting of these muscles (trapezius from behind), the nerves can be tested by asking the patient to shrug the shoulders against resistance (for trapezius) and by turning the head towards the opposite side against resistance (for sternocleidomastoid).

Hypoglossal nerve

The hypoglossal nerve supplies the intrinsic muscles of the tongue and is tested by asking the patient to protrude his tongue. Normally, it is a sharp protrusion with the tongue remaining in the midline. Look for fasciculations, wasting or deviation. A unilateral lesion causes deviation of the tongue towards the affected side.

Key points

- ◆ A visual field test and reaction of the pupil to light tests the optic nerve.
- ◆ Normal eye movement in all directions indicates normal function of the 3rd, 4th and 6th cranial nerves.
- ◆ The muscles of facial expression are supplied by the 7th cranial nerve.
- ◆ 9th and 10th nerve function are tested by the gag reflex.
- ◆ Paralysis of the 12th cranial nerve causes deviation of the tongue towards the paralysed side.

OSCE

set 2

Station 2.1 Anaesthetic equipment: Humphrey ADE breathing system

Information for the candidate

In this station you will be asked questions with regards to a breathing system.



Figure 2.1 Breathing system.

Examiner's mark sheet**marks****What is this equipment?**2

Humphrey's ADE breathing system.

Name the various components of this system4

- ◆ Inspiratory and expiratory tubing.
- ◆ Humphrey block which consists of an APL valve with indicator and a reservoir bag.
- ◆ Lever to select a spontaneous or controlled mode.
- ◆ Ventilator connection port and safety pressure relief valve.

At what pressure does the safety valve open?2 60cmH₂O.**What are the advantages of this system?**4

- ◆ It is an efficient system both for spontaneous and controlled ventilation.
- ◆ A single system for adult and children.
- ◆ Choice of technique: as a semi-closed system without the soda lime canister or, as a circle system with the canister.
- ◆ Easy scavenging.

Explain the mechanism of its action4

It acts as a Mapleson A system (Magill) when the lever is turned up. When the lever is turned down it acts as a Mapleson E system for controlled ventilation.

What is the fresh gas flow (FGF) required during spontaneous ventilation? 2

50-60ml/Kg/min.

What is the FGF required during controlled ventilation? 2

70ml/Kg/min.

Total:	/20

Humphrey ADE system

The Humphrey ADE system can be converted into a Mapleson A to D or E by selecting the lever position. For spontaneous ventilation it is used as a Mapleson A and for controlled ventilation it is used as a Mapleson E system.

With the lever turned up, it works in Mapleson A mode. The reservoir bag on the ADE block is connected to the inspiratory limb. Expired gas passes through the expiratory limb to an APL valve to which scavenging can be connected. During the end of expiration, a mixture of alveolar and dead space gas escapes through the APL valve. During the inspiratory phase, gas is breathed in from the inspiratory limb and reservoir bag.

With the lever turned down, the reservoir bag is isolated from the inspiratory limb and the APL valve is isolated from the expiratory limb. The whole system acts as a T-piece system, the inspiratory limb acts as a gas delivery tube to the patient end of the T-piece and the expiratory limb acts as a reservoir limb of the T-piece. This is now a Mapleson E system. By attaching a reservoir bag and APL valve to this limb it can be converted to a Mapleson D system. The expiratory limb (reservoir tube of the T-piece) can be connected to a bag squeezer-type ventilator and it can be used for controlled ventilation.

Key points

- ◆ The Humphrey ADE system functions as a Mapleson A system with the lever in the up position.
- ◆ It functions as a Mapleson E system with the lever in the down position.
- ◆ It is suitable for both adult and paediatric use.
- ◆ It is an efficient system, both for spontaneous and controlled ventilation.

Station 2.2 Data interpretation: ECG

Information for the candidate

A 70-year-old male patient is scheduled for repair of a left inguinal hernia. There is a history of angina and syncope on exertion.

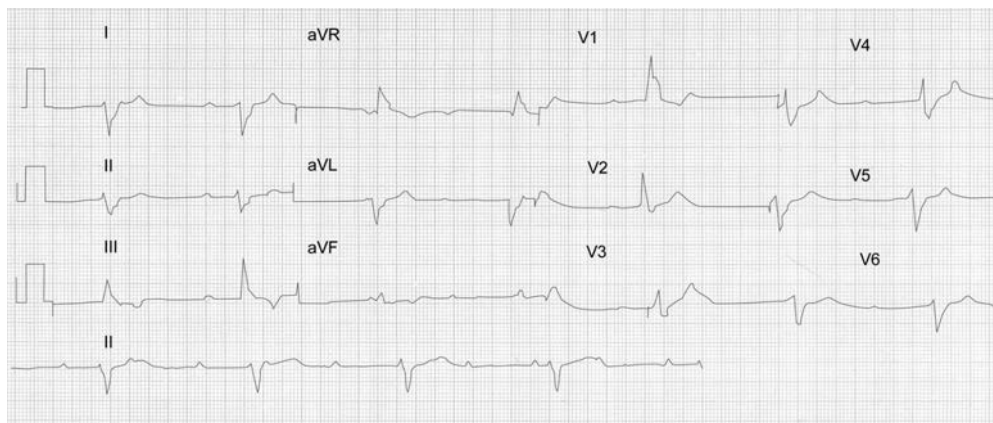


Figure 2.2 ECG.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. Standardisation in this ECG is 5mm = 1mV.	True	False	2	☐
2. Normal recording speed is 50mm per second.	True	False	2	☐
3. The heart rate in this ECG is approximately 75 beats per minute.	True	False	2	☐
4. This ECG shows a first degree heart block.	True	False	2	☐
5. There is right bundle branch block (RBBB).	True	False	2	☐
6. Limit of the normal cardiac axis is -30° to +90°	True	False	2	☐
7. There is right axis deviation.	True	False	2	☐
8. This could be due to fibrosis of the bundle of His.	True	False	2	☐
9. This could be due to block in the left anterior descending (left inter-ventricular artery) branch of the LCA.	True	False	2	☐
10. This patient may need cardiac pacing prior to surgery.	True	False	2	☐

Total:	/20

Answers

1. False. 10mm = 1mV.
 2. False. 25mm/second.
 3. False. Ventricular rate is about 40/minute.
 4. False. Complete heart block.
 5. True.
- ◆ Typical RBBB: QRS duration >120ms; rSR' or rsR' pattern in lead V1; wide terminal S wave in leads I and V6.
 - ◆ Typical LBBB: QRS duration >120ms; upright (monophasic) QRS in leads I and V6; predominantly negative QRS complex in lead V1.

6. True.
7. True. Normally, the depolarisation waves spread in the heart so that the QRS deflections are positive in II and negative in aVR. In general, the axis can be identified by looking at QRS deflections in leads I, II and III. In a normal axis, all three will show positive deflection. In right axis deviation, the deflection in I becomes negative (downward) and the deflection in III becomes positive (upwards). In left axis deviation, the QRS is predominantly negative in III. (But, left axis deviation is not 'significant' until QRS deflection is negative in II as well).
8. True.
9. True.
10. True.

ECG criteria in complete heart block

- ◆ QRS: generally normal looking. When block occurs at the AV node or bundle of His, the QRS complex will appear normal. When block occurs at bundle branch level, the QRS complex will be widened.
- ◆ P waves: normal.
- ◆ Rate: the atrial rate will be unaffected by third degree AV block. The ventricular rate will be slower than the atrial rate. With intranodal third degree AV block, the ventricular rate is usually 40 to 60 beats/minute; with infranodal third degree AV block, the ventricular rate is usually less than 40 beats/minute.
- ◆ Rhythm: the atrial rhythm is usually regular, although sinus arrhythmia may be present. The ventricular rhythm will be regular.
- ◆ PR interval: since the atria and ventricles are depolarised from different pacemakers, they are independent of each other, and the PR interval will vary.

This patient needs to be referred to a cardiologist for the insertion of a pacemaker prior to having his surgery.

The following are indications for a pacemaker:

- ◆ Sinus node: sick sinus syndrome, recurrent Stoke-Adams syndrome, sinus node dysfunction.
- ◆ Conduction system: complete heart block, symptomatic second degree heart block, symptomatic bifascicular and trifascicular heart block.
- ◆ Chronic atrial fibrillation.
- ◆ Persistent and symptomatic second- or third degree AV block associated with myocardial infarction.
- ◆ Atrio-biventricular pacing in moderate to severe heart failure.

Key points

- ◆ In complete heart block, the P wave and QRS complex are independent of each other.
- ◆ A normal axis is between $+90^\circ$ to -30° .
- ◆ Left anterior hemi-block is suspected in the presence of left axis deviation.
- ◆ The left bundle branch usually receives blood from the left anterior descending artery.

Station 2.3 Data interpretation: drug overdose

Information for the candidate

A 35-year-old female patient presented to an emergency department with a history of a drug overdose. Circumstances suggest that she has probably consumed drugs about two hours ago. She has been previously admitted with a drug overdose and has a history of depression for which she is on regular fluoxetine 40mg once daily. She complains of headache, terrible buzzing in her head, and mild deafness. The following are the results of blood tests performed on arrival.

- ◆ PaO_2 : 13kPa, PaCO_2 : 3.7kPa, pH: 7.48, HCO_3^- : 18mmol/L.
- ◆ Na^+ : 141mmol/L, K^+ : 3.0mmol/L, Cl^- : 98mmol/L, glucose: 5.0mmol/L.
- ◆ Plasma salicylate level: 8.5mmol/L.
- ◆ Urea: 5.6mmol/L, creatinine: 70 μ mol/L.

Based on the above blood results answer the following questions.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. Activated charcoal will be useful.	True	False	2	☐
2. Forced alkaline diuresis aids increased elimination of salicylates.	True	False	2	☐
3. The above pH can be explained by associated metabolic alkalosis.	True	False	2	☐
4. This patient has compensatory respiratory alkalosis.	True	False	2	☐
5. This patient may need haemodialysis.	True	False	2	☐
6. A recognised cause of death in salicylate poisoning is non-cardiogenic pulmonary oedema.	True	False	2	☐
7. Acidosis is a poor prognostic sign in salicylate poisoning.	True	False	2	☐
8. The anion gap is reduced in salicylate poisoning.	True	False	2	☐
9. Chronic salicylate intoxication is easier to diagnose than acute intoxication.	True	False	2	☐
10. The anion gap in this patient is 20mmol/L.	True	False	2	☐

Total:	/20

Answers

1. True. Activated charcoal is indicated if an adult presents with a salicylate overdose of more than 250mg/Kg within one hour of ingestion. Gastric absorption after ingestion of a high dosage of salicylates is slow and hence gastric lavage and activated charcoal may be effective up to 24 hours.
2. True. Acidic drugs are eliminated best in alkaline urine. Urinary alkalinisation is achieved with 1.26% sodium bicarbonate. Increased elimination is indicated when plasma levels exceed 3.6mmol/L. Forced diuresis is not a commonly recommended treatment now because of other complications, such as pulmonary oedema.
3. False. It is because of respiratory alkalosis. A mixed respiratory alkalosis with metabolic acidosis with a normal or increased pH is a common presentation in adults.
4. False. Respiratory alkalosis is the primary acid-base disorder. It results from direct respiratory centre stimulation.
5. True. Haemodialysis is the treatment for severe poisoning and is considered in patients with a plasma salicylate concentration of more than 5.1mmol/L or a lower concentration associated with significant metabolic or clinical features. Normally, aspirin is 90% protein bound; in overdose, more than 25% in plasma is free and can be removed by haemodialysis.
6. True. Non-cardiogenic pulmonary oedema, disseminated intravascular coagulation (DIC), deranged clotting, low platelets, haematemesis, hyperpyrexia, hypoglycaemia, hypokalaemia and renal failure are potentially lethal uncommon presentations.

7. True.
8. False. Wide anion-gap.
9. False. Symptoms are non-specific.
10. False. Anion gap = $(\text{Na}^+ + \text{K}^+) - (\text{Cl}^- + \text{HCO}_3^-) = (141+3) - (98+18) = 28\text{mmol/L}$.

Key points

- ◆ Aspirin is a weak acid and is more ionised in alkaline pH.
- ◆ Salicylate at a dose <150mg/Kg is unlikely to cause toxicity, 150-300mg/Kg produces moderate toxicity, >500mg/Kg can cause severe toxicity.
- ◆ Common presentation includes vomiting and dehydration, vertigo, tinnitus and deafness, warm extremities with sweating, tachypnoea and hyperventilation, along with acid-base disturbances.
- ◆ Although the plasma level does not necessarily correspond to toxicity, in general, toxicity is associated with a plasma level >2.5mmol/L.

Station 2.4 Data interpretation: neuro-observation chart

Information for the candidate

The chart (Figure 2.4) belongs to a 47-year-old male patient involved in a road traffic accident who has sustained a severe head injury. The CT scan is suggestive of diffuse axonal injury and revealed a large contusion in the occipital region. He has been ventilated in the ICU for the last 24 hours.



Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. The Glasgow coma scale is very useful in this patient now. True False 2 ☐
2. Intravenous 10% mannitol should be administered slowly to this patient. True False 2 ☐
3. A beta blocker would be useful to control the hypertension. True False 2 ☐
4. The cause of hypertension is likely to be due to a decreased level of sedation. True False 2 ☐
5. At 7.00 hours his cerebral perfusion pressure was 80 mmHg. True False 2 ☐
6. Urinary osmolality will be greater than 350mOsmol/Kg. True False 2 ☐
7. Urinary sodium will be high in this patient. True False 2 ☐
8. This patient's plasma sodium is likely to be less than 140mmol/L. True False 2 ☐
9. Use of 1-desamino-8-D arginine vasopressin (DDAVP) is indicated in this patient. True False 2 ☐
10. Use of dextrose-containing intravenous fluids are absolutely contra-indicated in this patient. True False 2 ☐

Total:	/20

Answers

1. False. Although the GCS is useful in the immediate assessment and to assess prognosis, it is unlikely to be of much help at this stage in a ventilated patient.
2. False. Mannitol is only useful in certain circumstances where definitive management to address an increase in ICP (such as neurosurgical

intervention) is planned. It will be of no benefit for this patient. When administered, mannitol is given rapidly.

3. False. Already the heart rate is low; beta-blockers may not be an ideal drug of choice.
4. False. Hypertension with bradycardia is unlikely to be due to emergence from sedation.
5. False. Cerebral perfusion pressure = MAP - ICP; at 7:00 hours it should have been: $130 - 32 = 98$ mmHg.
6. False. Diabetes insipidus is a recognised complication of brain injury in which the concentrating ability of the kidney is lost due to a deficiency of vasopressin (anti-diuretic hormone), resulting in poorly concentrated urine.
7. False. Low.
8. False. Because of renal water loss, plasma sodium becomes concentrated and the level increases.
9. True. DDAVP (desmopressin) is a synthetic vasopressin analogue.
10. False. Dextrose-containing solutions, if possible, are best avoided. Once dextrose is metabolised in the body, it leaves behind either plain water or a hypotonic saline solution. Water passes into the brain cells thereby causing intracellular oedema and poor neurological recovery. However, if the patient is hypoglycaemic, a glucose-containing solution can be used.

The clinical features in the given scenario are suggestive of a terminal stage of head injury. This patient has hypertension and bradycardia, a phenomenon described by Harvey Cushing in 1902, known as Cushing's

reflex. Ischaemia of the hypothalamus activates the sympathetic system, increases myocardial contractility, heart rate and vasoconstriction. This increases blood pressure and maintains cerebral perfusion. Raised blood pressure increases baroreceptor discharge, inhibiting the vasomotor centre, which in turn increases parasympathetic discharge, resulting in bradycardia.

This patient has a high urine output suggestive of diabetes insipidus. Other features of diabetes insipidus include low urine osmolality (50-200mOsm/Kg), high serum osmolality and normal-to-elevated serum sodium. Urine output usually is greater than 90ml/Kg/day (~4ml/Kg/hour), with a specific gravity of less than 1.010. Trauma and surgery around the region of the pituitary and hypothalamus are common causes of diabetes insipidus. It is treated with subcutaneous, nasal, and oral preparations of vasopressin analogues (DDAVP).

Key points

- ◆ Cushing's reflex is hypertension and bradycardia in the presence of increased intracranial tension.
- ◆ Diabetes insipidus is a recognised complication of severe head injury.
- ◆ Diabetes insipidus is characterised by high urine output, low urine osmolality and high or normal serum osmolality.

Station 2.5 Anatomy: stellate ganglion

Information for the candidate

In this station you will be asked questions on stellate ganglion block.

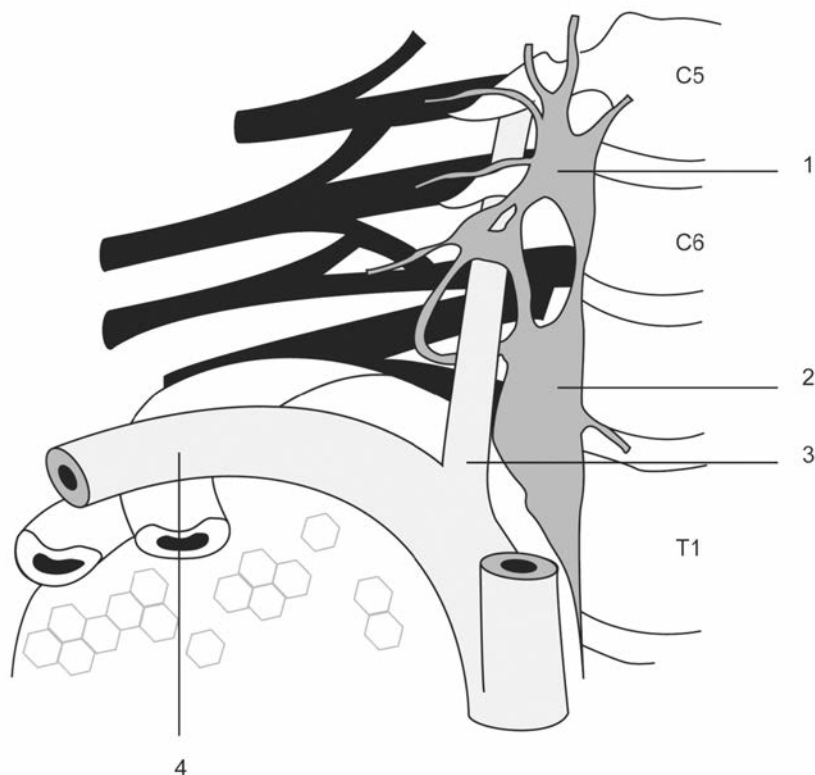


Figure 2.5 Stellate ganglion.

1. Middle cervical ganglion; 2. Stellate ganglion; 3. Vertebral artery; 4. Subclavian artery.

Examiner's mark sheet

marks

In Figure 2.5 identify the stellate ganglion and the vertebral artery

2

At what vertebral level is the stellate ganglion located?

1

C7-T1.

Describe the technique of blocking the stellate ganglion 5

- ◆ Preparation: ensures that the patient has been consented and all drugs and equipment are available and checked.
- ◆ Mentions aseptic precautions.
- ◆ Position: supine with neck extension.
- ◆ Point of insertion: between the trachea and carotid sheath at the level of the cricoid, and Chassaignac's tubercle of C6 vertebra.
- ◆ Negative aspiration and injection of local anaesthetic.

If the stellate ganglion is at the level of C7 why are you aiming at the C6 tubercle? 2

- ◆ To avoid the lungs.
- ◆ To avoid the vertebral artery (that passes through the foramen transversarium at C6 level).

Give two indications for stellate ganglion block 2

Pain syndromes

Complex regional pain syndrome (CRPS) Type I and II, refractory angina and phantom limb pain.

Vascular insufficiency

Raynaud's syndrome, frostbite, obliterative vascular disease, vasospasm and emboli.

Give two features for a successful block 2

Horner's syndrome and an increase in temperature of the ipsilateral upper limb.

What are the features of Horner's syndrome?

2

Ptosis, miosis, anhydrosis, enophthalmos and loss of ciliospinal reflex.

Name four complications of stellate ganglion block

4

Needle in the wrong place

- ◆ Vascular injury: haematoma, trauma to carotid artery or the internal jugular vein (IJV).
- ◆ Neural injury: vagus, brachial plexus roots.
- ◆ Pulmonary injury: pneumothorax, haemothorax and chylothorax.
- ◆ Oesophageal perforation.

Spread of local anaesthetic

- ◆ Intravascular injection: carotid artery, vertebral artery and the IJV.
- ◆ Epidural block, intrathecal.
- ◆ Brachial plexus anaesthesia or injury (intra-neural injection).
- ◆ Local spread: hoarseness (recurrent laryngeal nerve); elevated hemidiaphragm (phrenic nerve).

Infection

- ◆ Soft tissue (abscess), neuraxial (meningitis), bone (osteitis).

Total:	/20

Technique of stellate ganglion block

The patient is placed in the supine position with the neck slightly extended and the head rotated slightly to the side opposite the block. The point of needle puncture is located between the trachea and the carotid sheath at the level of the cricoid cartilage and Chassaignac's tubercle - the anterior tubercle of the transverse process of C6.

The sternocleidomastoid and carotid artery are retracted laterally as the index and middle fingers palpate Chassaignac's tubercle. The skin and subcutaneous tissue are pressed firmly onto the tubercle to reduce the distance between the skin surface and bone, and in an attempt to push the dome of the lung out of the path of the needle. The needle is directed onto the tubercle, and then redirected medially and inferiorly towards the body of C6. After the body is contacted, the needle is withdrawn 1-2mm. This brings the needle out of the belly of the longus colli muscle, which sits posterior to the ganglion and runs along the anterolateral surface of the cervical vertebral bodies. The needle is then held immobile. The chosen local anaesthetic is slowly injected in small aliquots after careful negative aspiration. An initial 0.5cc test dose is given to rule out intravascular (vertebral artery) placement.

Key points

- ◆ The stellate ganglion is located at the level of C7-T1.
- ◆ It is blocked for pain conditions or vascular insufficiency.
- ◆ The anterior paratracheal route is used to approach the stellate ganglion.
- ◆ Successful stellate ganglion block is characterised by Horner's syndrome.
- ◆ Important risks include vertebral artery puncture, recurrent laryngeal nerve and phrenic nerve paralysis.

Station 2.6 Communication: brain stem test

Information for the candidate

A 20-year-old boy was admitted to ICU with a traumatic brain injury following a road traffic accident 48 hours ago. GCS at the scene was 5/15. He was intubated and ventilated by a paramedic and transferred to Accident and Emergency. A CT scan shows extensive cerebral contusions, massive haematoma and significant cerebral oedema. Both the neurosurgeons and intensivists have decided to do brain stem tests.

In this station you will be meeting the patient's father.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient's relative.	1
Confirms that he/she is talking to the right person.	1
Asks the relative about the information already given by others (tell me what you know about his condition).	2
Explains that the patient has been on a breathing machine and breathing support.	2
Explains the scan findings.	2
Explains about the neurosurgical review and opinion.	2
Explains the procedure of a brain stem test.	3
The test will be repeated again before making any further decision.	2
Explains the significance of a brain stem test and switching off the breathing machine.	2
Attempts to find out the possibility of organ donation and to seek an advance directive.	2
Reassures appropriately that at all the above stages someone will come back and explain the results and decisions.	1

Total: /20

Information for the actor

Your son had a car accident 48 hours ago. All you know is that he has a severe head injury, his brain has been damaged and he has a big blood clot on the brain. He has been admitted to intensive care and is on life support with a breathing machine. You saw him last night and the nurse told you that his condition is very serious. You want to know more. You are hoping that he will recover.

You have been waiting to talk to the doctor to find out more details. You are devastated. Now, a doctor from the intensive care unit has come to talk to you.

General principles of communication

- ◆ Introduce and explain your role and the purpose of the interview.
- ◆ Establish the understanding and knowledge of the person about the given clinical scenario.
- ◆ Be honest and provide the correct information and facts.
- ◆ Explain in simple language, in words that are understandable to the patient and relatives.
- ◆ Listen actively to what the patient or relative is trying to express.
- ◆ Appropriate empathy or reassurance should be offered.
- ◆ Respond to verbal and non-verbal cues.
- ◆ Try to summarise and clarify, and provide an opportunity for further clarification.
- ◆ There should be a smooth conclusion without ending the interview abruptly.

Brain stem test

The brain stem test is done to confirm brain stem death. The three preconditions are:

- ◆ Apnoea and mechanically ventilated.
- ◆ An established cause for coma which can lead to irreversible brain injury.
- ◆ Exclusion of reversible causes.

Patient information

When the brain stem stops working, the brain cannot send messages to the body to control our unconscious functions, and equally cannot receive messages back from the body. If this is the case, then the person has no chance of recovery and according to UK law, the person has died.

The tests

A series of strict tests need to be carried out by two senior doctors at your son's bedside: his pupils do not respond to a direct light being shone in his eyes; his eyes do not blink when the surface of the eyeball is stroked with a piece of tissue or cotton wool; his natural eye movements are absent; and he does not breathe when taken off the ventilator. During this time, it is necessary for the level of CO₂ in his blood to rise and exceed the level required to stimulate a breath. He does not show any cough or gag reflex when the back of the throat is stimulated or the breathing tube is suctioned and he does not respond to pain when pressure is applied to certain areas of the body. These tests are frequently repeated to confirm that his brain stem has stopped working.

Why do you need to stop the painkillers and sleeping medicines?

These medications can have an effect on your son's reactions to these tests and so we must make sure that the effects of the medications have worn off completely before carrying out the tests.

Is the heart still beating?

The body's organs can continue to function for a short time while connected to a ventilator. However, if there is already brain stem death, this means that there is no chance of recovery.

Are these tests anything to do with organ donation?

No. It is usual practice to carry out these tests to confirm whether the brain stem has stopped working, regardless of any planned organ donation.

Key points

- ◆ The brain stem test involves a series of tests to confirm that the brain stem is not functioning.
- ◆ Confirmation of brain stem death means that death has occurred. It may be a difficult concept for the patient's relatives to understand.
- ◆ The patient's relatives may be subjected to psychological stress; therefore, appropriate support (presence of an ICU nurse) is important.

Station 2.7 Technical skill: lumbar puncture for spinal anaesthesia

Information for the candidate

In this station you will be asked to identify landmarks and describe the technique of performing spinal anaesthesia.

Examiner's mark sheet

marks

Indicate the space where you are going to perform the lumbar puncture (on an actor)

2

Identifies landmarks (iliac crests at L3/4 or L4 spinous process) with the patient sitting or in a lateral position.

The inter-space chosen must be no higher than L3/4.

Now describe how you would usually perform a spinal anaesthetic

10

- ◆ Ensures that the patient is consented and that resuscitation drugs and equipment are available.
- ◆ IV access must be obtained.

- ◆ Monitoring (ECG, NIBP, SpO₂).
- ◆ Ensures appropriate sterility (gown, gloves, cap and mask).
- ◆ Back preparation with antiseptic solution and sterile draping.
- ◆ Local anaesthetic is infiltrated.

Which of the following needles in Figure 2.7a would you prefer to use?

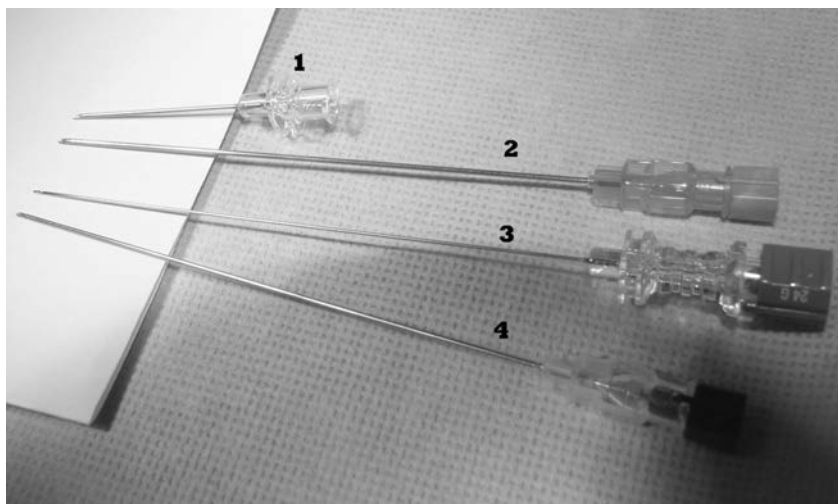


Figure 2.7a Spinal needles.

1. Introducer needle; 2. Whitacre needle; 3. Sprotte needle; 4. Quincke needle.

- ◆ A pencil-point needle smaller than 24 gauge is usually chosen.
- ◆ An introducer needle is inserted first into the interspace.
- ◆ A spinal needle is then introduced with loss of resistance when the dura is pierced.
- ◆ Free CSF flow should be observed.

What would you do if the fluid was blood-stained?

1 ☐

Wait until the CSF becomes clear and then inject; if it remains bloody, then re-site.

How much local anaesthetic would you use for each spinal segment to be blocked? 1

About 0.2ml per segment.

Name two factors affecting the spread of local anaesthetic in spinal anaesthesia 2

- ◆ Baricity of local anaesthetic injection.
- ◆ Position of the patient.

Give four contra-indications to performing spinal anaesthesia 4

- ◆ Patient refusal.
- ◆ Systemic or local infection.
- ◆ Abnormal clotting.
- ◆ Raised intracranial pressure.

Total: /20

Spinal anaesthesia

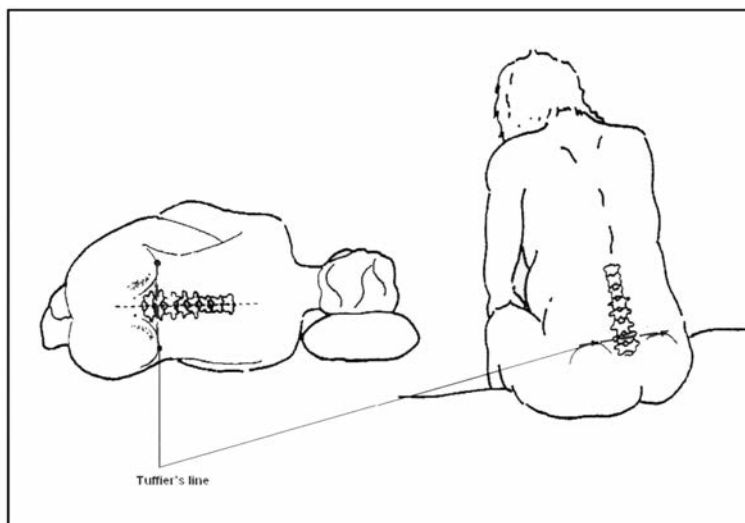


Figure 2.7b Landmarks for spinal anaesthesia.

The following steps should be performed for any nerve block or neuraxial block technique:

- ◆ Preparation of the patient: explain the procedure, describe the possible complications, and obtain consent.
- ◆ Preparation of the room: check the anaesthetic machine, have all resuscitation drugs and equipment ready, prepare the right amount of local anaesthetic, and have a trained assistant present. Secure intravenous access and institute appropriate monitors.
- ◆ Preparation of site: position correctly, ensure sterile precautions and perform the block.
- ◆ Post-procedure: monitor the vital parameters, maintain verbal contact with the patient and check the adequacy of the block.

The level of anaesthesia achieved depends on the volume of local anaesthetic injected and baricity of the solution, height of the patient and patient position. In an average 70Kg man, a volume of 1-1.5ml of 0.5% bupivacaine produces saddle block, 2-2.5ml produces a block to T10 and 2.5-3.0ml produces a block to T4-T6.

Blood supply to the spinal cord

The spinal cord receives its blood supply from one anterior and two posterior spinal arteries. The anterior spinal artery is formed at the level of the foramen magnum, by the joining of the branches of each vertebral artery. There are two posterior spinal arteries originating from postero-inferior cerebellar arteries. The posterior spinal arteries are supplemented by the spinal branches of the vertebral, deep cervical, intercostal, lumbar and the lateral sacral arteries.

The anterior spinal artery is joined by radicular arteries. Most of them are small, except one which is termed the arteria radicularis magna, or the artery of Adamkiewicz. It usually arises from the aorta in the lower thoracic or upper lumbar level. Damage to this artery can result in anterior spinal artery syndrome.

Key points

- ◆ A line drawn through most prominent points of the iliac crest passes through the spinous process of L4 or the L3-4 interspace.
- ◆ The procedure can be performed either in a sitting or a lateral position.
- ◆ Baricity, amount, patient positioning and height of the patient are known factors influencing the level of block.
- ◆ Use of pencil-point needles with a smaller size (less than 24 gauge) reduces the incidence of post-dural puncture headache.

Station 2.8 Clinical examination: cardiovascular system

Information for the candidate

In the following station you will be asked to examine the cardiovascular system of a patient who has presented for pre-operative assessment.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient and explains his/her role.	1
Looks for clubbing.	1
Tongue: cyanosis.	1
Conjunctiva for pallor.	1
Looks for peripheral oedema/ankle oedema.	1
Pulses: examines the radial pulses, rate, rhythm, quality and character.	2

Compares the pulse on both sides. 1

Measures blood pressure. 2

Checks for jugular venous pressure (JVP). 2

Inspects chest. 1

Palpation of the chest

◆ Locates the apical impulse. 1

◆ Feels for thrills and para-sternal heave. 1

Auscultation of the chest

◆ All four areas in a systematic order. 2

◆ 1st and 2nd heart sounds. 1

◆ Auscultates the lung bases. 2

Total:	/20

Examination of the cardiovascular system

- ◆ Start with general appearance: posture, cachexia, breathlessness or distress.
- ◆ General examination: look for anaemia, icterus, cyanosis, clubbing and pedal oedema.
- ◆ Hands: patients with heart failure are vasoconstricted and their hands feel cold. Splinter haemorrhages are seen in infective endocarditis. Finger clubbing is seen in endocarditis and in cyanotic heart disease.

- ◆ Pulse: rate, rhythm, volume, character, radio-femoral delay, left/right asymmetry.
- ◆ The radial pulse is used to assess the rate and rhythm. In coarctation of the aorta, femoral pulses are weak and delayed, compared to the radial pulse (radiofemoral delay).
- ◆ Blood pressure is measured using the correct size of cuff, preferably on both arms.
- ◆ Check for a jugular venous pulse (for a method of checking this, refer to OSCE set 5, station 5.8).
- ◆ Inspection: face, neck, precordium, visible apical impulse, abnormal pulsations (supra-sternal, precordial, chest wall), back, abdomen.
- ◆ Palpation: apical impulse, parasternal heave and thrill.
- ◆ Apical impulse: palpate the precordium by laying the flat of the hand and outstretched fingers on the lower part of the chest wall to the left of the sternum. The apical impulse is located as the most outward and downward point at which pulsation is easily palpable. The normal position of the apex beat is the 5th intercostal space, medial to or at the midclavicular line.
- ◆ Auscultation: mitral, tricuspid, pulmonary and aortic areas for normal and additional heart sounds, and murmurs; lung bases for crepitations.

Key points

- ◆ Follow a methodical order of clinical examination: general examination, inspection, palpation and auscultation.
- ◆ Look for general features of cardiovascular disease.
- ◆ Elicit both normal and abnormal clinical signs.

Station 2.9 Measuring equipment: Wright respirometer

Information for the candidate

In this station you will be asked questions on equipment in order to assess your knowledge on measurement of volume and flow.

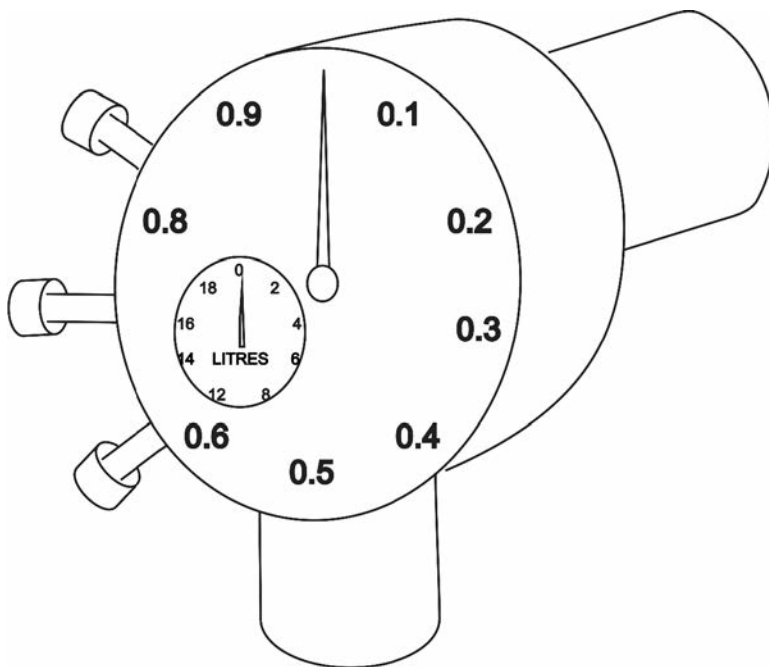


Figure 2.9.

Examiner's mark sheet

marks

Can you name this device?

1

Wright respirometer.

What does it measure?

2

Tidal volume and minute volume.

What is the mechanism involved?

2

It works by directing the breathing gases through oblique slots in a small cylinder enclosing a small vane which is made to rotate. The spindle on which the vane is mounted is connected to a pointer which moves over a dial indicating the volume of gas passed.

Can it be used to measure bidirectional flow?

1

No. Gases that flow back through the device do not register since the flow in the reverse direction impinges on the bottom edge of the vane without producing any rotational movement.

What is the advantage of a Wright respirometer?

2

It is a small, portable device used to measure tidal volume that does not require an electrical supply.

What are the disadvantages?

4

- ◆ A minimum flow of 2L/minute is required.
- ◆ Over-reads at high flow, under-reads at low flow.
- ◆ Water condensation can cause the pointer to stick.
- ◆ No display of measured volume (no electrical output).

What is the resistance to breathing through this?

2

It is low and is about 2cmH₂O at 100L/minute.

Can you name two devices to measure flow?

2

- ◆ Pneumotachograph (constant orifice, variable pressure).
- ◆ Rotameter (constant pressure, variable orifice).

What is the principle behind a pneumotachograph?

2

A pneumotachograph is a constant orifice variable pressure flow meter. As the gas flows through the fixed resistance there will be a drop in pressure. A differential pressure transducer senses the pressure gradient across the resistance. The change in pressure is proportional to the flow.

What are the advantages of a pneumotachograph?

2

High accuracy and the ability to display the readings.

Total:	/20

Measurement of volume and flow

The Wright respirometer is a simple device used to measure the tidal volume. On the outer surface of the case there are on/off and reset buttons. Due to inertia it under-reads at low flows and because of momentum it over-reads at high flows. It has two display dials. The outer one is calibrated at 100ml per division and a smaller inner display is calibrated at 1L per division. Water condensation from expired moisture can prevent the free rotation of the vane. It does not have any alarms. In recent versions the flow can be detected electronically which will be more accurate at low flows.

Gas volume can be measured directly using a gas meter, vitalograph and water displacement spirometer (Benedict-Roth wet spirometer).

Gas volume can be measured indirectly by measuring the pressure drop across a resistance, by measuring the heat transfer or by measuring the mechanical movement resulting from kinetic energy of gas flow. In the rotameter and peak flow meter, the orifice through which gas flows enlarges with increasing flow rate and the pressure drop across the orifice remains constant.

A pneumotachograph is a constant orifice variable pressure drop flow meter. The pressure drop in this device is also influenced by gas composition, temperature and viscosity. The device is designed to measure laminar flow. The values can change in turbulent flow.

Key points

- ◆ The Wright respirometer is a simple, portable device used for gas volume measurement.
- ◆ It measures flow in only one direction.
- ◆ It over-reads at high flows and under-reads at low flows.

Station 2.10 Resuscitation: basic life support of a pregnant mother

Information for the candidate

You are the resident anaesthetist on call and have been bleeped to urgently attend a 36-week pregnant woman who has collapsed on the labour ward.

Examiner's mark sheet

marks

Ensures safety of the patient and self (safe to approach) and checks for responsiveness (no response). 2

Confirms cardiorespiratory arrest: 2

- ◆ Looks/listens/feels for breath after manoeuvres to open the airway.
- ◆ Palpates the carotid pulse.

(Both manoeuvres to be done simultaneously for 10 seconds).

Calls for help (specifies obstetrician and paediatrician in addition to the crash team). 2

Relieves aorto-caval compression (wedge under right buttock or manual displacement of the uterus or a left lateral tilt). 2

Commences CPR (bag and mask available). 2
Compression: ventilation ratio 30:2 (100 compressions/minute).

Help arrives. She has started making some attempts to breathe. On connecting her to the monitor, the ECG rhythm shows bradycardia with a heart rate of 38/minute. How would you manage this patient? 4

Look for adverse signs: rate <40 beats per minute, BP <90 mmHg systolic, heart failure, ventricular arrhythmias.

How would you treat this patient? 2

By administering intravenous atropine 500µg.

What is the maximum recommended dose of atropine? 1

Maximum of 3mg atropine in aliquots of 500µg.

What factors would suggest a risk of asystole? 3

Recent asystole, Mobitz Type 2 block, complete heart block with a broad QRS or a ventricular pause of more than 3 seconds.

Total:	/20

Cardiopulmonary resuscitation in pregnancy

The physiological changes during pregnancy can cause additional problems during resuscitation. Cardiac output, blood volume and oxygen consumption all increase during pregnancy. The fetus should always be considered when a cardiac arrest occurs in pregnant women. The gravid uterus may cause significant compression of the iliac and abdominal vessels, reducing venous return from the lower limbs, resulting in reduced cardiac output. Important causes of maternal death include thrombo-embolism, a hypertensive disorder of pregnancy, haemorrhage, amniotic fluid embolism and pre-existing cardiac disease.

There is an increased risk of acid aspiration in pregnancy; therefore, the correct application of cricoid pressure and early tracheal intubation to protect the lungs are important. Tracheal intubation may be more difficult in the pregnant patient, due to anatomical changes in the upper airway. Ectopic pregnancy, placental abruption and uterine rupture can lead to massive haemorrhage in pregnancy.

If immediate resuscitation attempts fail, an emergency Caesarean section should be considered. There are better chances of an infant's survival if the emergency Caesarean section is done within 5 minutes of cardiac arrest.

Key points

- ◆ The obstetrician and neonatologist should be involved at an early stage.
- ◆ The principles of adult basic and advanced life support apply to pregnant patients as well.
- ◆ Early tracheal intubation, along with cricoid pressure, can reduce the risk of aspiration.
- ◆ The importance of manoeuvres to relieve aorto-caval compression cannot be over-emphasized.
- ◆ Emergency Caesarean section is indicated to improve the chances of both maternal and fetal survival, if resuscitation is unsuccessful after 5 minutes.

Station 2.11 Anatomy: vagus nerve

Information for the candidate

In this station you will be asked questions on anatomy of one of the cranial nerves which is of special interest to anaesthetists.

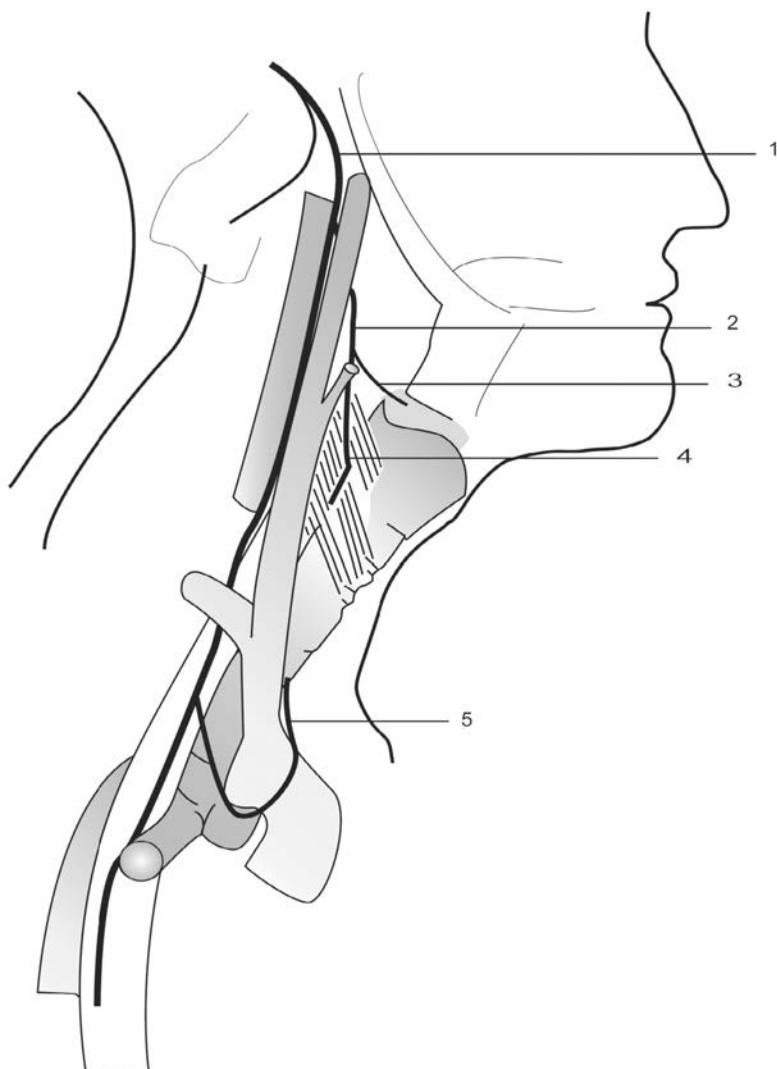


Figure 2.11 Course and distribution of the vagus nerve.

Examiner's mark sheet**marks****Name the structures labelled 1-4 in Figure 2.11**4

1. Vagus nerve.
2. Superior laryngeal nerve.
3. Internal laryngeal nerve.
4. External laryngeal nerve.
5. Recurrent laryngeal nerve.

What is the origin of the vagus nerve?1

It originates from the medulla oblongata.

How many nuclei does it have and what are they?3

Three. They are:

- ◆ Dorsal nucleus.
- ◆ Nucleus ambiguus.
- ◆ Nucleus tractus solitarius.

Through which foramen does it leave the skull?1

Jugular foramen.

Name two other structures that pass through this foramen2

Accessory nerve, glossopharyngeal nerve, internal jugular vein (IJV).

State the relations of the vagus nerve in the neck2

In the neck, it passes down within the carotid sheath, lying between the IJV and internal carotid artery. Beyond the level of

the upper border of the thyroid cartilage it lies between the IJV and common carotid artery.

What is the course of the right vagus nerve inside the thorax?

2

On the right side, the nerve passes across the subclavian artery between it and the right innominate vein and descends by the side of the trachea to the back of the root of the lung where it spreads out in the posterior pulmonary plexus. From the lower part of this plexus two cords descend on the oesophagus, and divide to form, with branches from the opposite nerve, the oesophageal plexus.

What is the course of the left vagus nerve inside the thorax?

2

On the left side, the vagus enters the thorax between the left carotid and subclavian arteries, behind the left innominate vein. It crosses the left side of the arch of the aorta, and descends behind the root of the left lung, forming the posterior pulmonary plexus. From this it runs along the anterior surface of the oesophagus, where it unites with the nerve of the right side in the oesophageal plexus.

Apart from the laryngeal branches can you name three other branches of the vagus nerve?

3

- ◆ In the jugular foramen: meningeal and auricular.
- ◆ In the neck: pharyngeal (superior laryngeal nerve, recurrent laryngeal, superior cardiac).
- ◆ In the thorax: inferior cardiac, anterior and posterior bronchial, oesophageal.
- ◆ In the abdomen: gastric, coeliac, hepatic.

Total:	/20

Key points

- ◆ The vagus is the largest and most widely distributed cranial nerve.
- ◆ It arises as a group of rootlets on the anterolateral surface of the medulla oblongata. After crossing the posterior cranial fossa it leaves the skull through the jugular foramen.
- ◆ The right vagus nerve enters the thorax between the innominate vein and subclavian artery. The left vagus nerve enters the thorax behind the left innominate vein.

Station 2.12 History taking: laparoscopic cholecystectomy

Information for the candidate

In this station you will be asked to take a history from a 40-year-old female patient presenting for a laparoscopic cholecystectomy.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient.	1
Confirms that he/she is talking to the right person and the proposed surgery.	1
H/O previous operations; Caesarean section under GA, arthroscopy.	2
H/O awareness during Caesarean section.	1
Type of awareness: conscious recall, unpleasant dreams, etc.	2
Asks about further details on pain experienced during awareness and counselling received or offered.	2

Hospital admission with cholecystitis 6 months ago.	2	
H/O heartburn but no reflux.	2	
H/O hypertension.	1	
Blood pressure well controlled with amlodipine.	2	
H/O smoking: does not smoke.	1	
H/O alcohol intake: a glass of wine every night.	1	
H/O allergy: no known allergy.	2	

Total: /20

Information for the actor

You are scheduled to have an operation tomorrow (removal of the gallbladder through key-hole surgery). Six months ago you were in hospital with tummy pain and you also felt very sick during that time. You never had jaundice. You do not smoke but take a glass of wine every night. You had an ultrasound scan of your tummy which showed you have gallstones. You also had a camera put down your throat into the food pipe and the result was normal. The treatment for gallstones is removal of the gallbladder.

You are taking medicine for high blood pressure (amlodipine 10mg tablet every night). You also have a high cholesterol and you are on a medicine, simvastatin. You had two operations in the past: Caesarean section, 10 years ago, during which you remember a tube going down your throat and somebody pressing on your throat while going to sleep. You have seen a specialist and you understand the reason why you remember this, so you are not too concerned about that now. Your Caesarean section was an emergency operation and you probably had a low dose of anaesthetic so that the anaesthetic would not affect the baby. Since then you have had an

operation on your right knee (key-hole operation) a year ago. You do not remember having any problems.

Principles of history taking

(refer to OSCE set 1, station 1.12).

In this station you are asked to take a history from a patient scheduled for an elective surgery. You should use a systematic approach and enquire about details of previous operations and anaesthetic-related problems. As this is not a communication station you are not required to explain how you are going to prevent awareness, but ensure that you elicit all details related to previous awareness.

Explicit awareness is when the patient recalls events under general anaesthesia. It is rare. During implicit awareness, the brain retains the ability to take information into the subconscious part of the brain but has no spontaneous recollection of the information.

The incidence of explicit awareness (not associated with pain) in non-cardiac surgery is quoted as probably about 1 in 1000 general anaesthetics. Certain procedures carry a higher risk of unintended intra-operative awareness: cardiac surgery patients, Caesarean section patients under general anaesthesia, acute trauma patients with hypovolaemia and patients undergoing emergency surgery.

Some patients may be at an increased risk for the occurrence of intra-operative awareness:

- ◆ Patients with an impaired cardiovascular status.
- ◆ Patients with an anticipated difficult intubation.
- ◆ Patients with a history of awareness.
- ◆ Patients with a history of heavy alcohol intake.
- ◆ Patients with a history of chronic use of benzodiazepines, opioids, etc.
- ◆ ASA physical status 4 and 5 patients.

(For more information on awareness under anaesthesia, please refer to OSCE set 1, station 1.18).

Key points

- ◆ Follow a structured approach.
- ◆ Enquire as to all the details where there has been a previous anaesthetic problem.
- ◆ Enquire as to the reason for current surgery.

Station 2.13 Simulation: failed intubation

Information for the candidate

This station is based on Difficult Airway Society guidelines on management of the unanticipated difficult intubation. A 20-year-old male patient is on the operating table ready to be anaesthetised for an urgent appendicectomy. He is ASA 1, airway evaluation appeared normal, the anaesthetic machine has been checked and all drugs are available.

Examiner's mark sheet

	marks
Checks the monitor for all vital parameters.	1
Ensures that the cricoid pressure is applied appropriately.	2
Any fasciculations? (You will not see any fasciculations on SimMan).	1
It is 30 seconds since succinylcholine was administered; please perform the laryngoscopy	
Correct method of laryngoscopy: grade 3 view of the larynx.	2

Ensures that the head and neck position is optimal (sniffing the morning air position, extension at the atlanto-occipital joint and flexion of the neck). 2 ☐

Releases or reduces the cricoid pressure transiently and reapplies if no improvement. 2 ☐

Attempts an optimum external laryngeal manoeuvre, which includes backward, upward and right-ward pressure (BURP) on the thyroid cartilage. 2 ☐

Still it is a grade 3 view

Calls for help. 2 ☐

Requests an alternative laryngoscope blade or McCoy laryngoscope. 2 ☐

Requests a gum elastic bougie. 2 ☐

Oxygen saturation decreases to 90% and the low saturation alarm sounds

Ventilates with a bag and mask with 100% oxygen, continues cricoid pressure and wakes up the patient. 2 ☐

Total: /20

Information for the examiner

The patient has been pre-oxygenated for 3 minutes and has just received thiopentone and suxamethonium. Please hand over the case to the candidate soon after administering the thiopentone and suxamethonium. Set the airway parameters of SimMan to a grade 3 view of the larynx by selecting neck stiffness and pharyngeal oedema.

Failed intubation scenario

Cricothyrotomy should be performed to oxygenate the patient if this scenario progresses to a 'cannot intubate, cannot ventilate' (CICV) situation. A cricothyrotomy device (Quick trach or a jet ventilation cannula and a manual jet ventilator) should be requested immediately.

The basic plan for an unanticipated difficult intubation is as follows:

- ◆ A: initial tracheal intubation plan.
- ◆ B: secondary tracheal intubation plan, when plan A has failed.
- ◆ C: maintenance of oxygenation and ventilation, postponement of surgery and waking the patient when earlier plans fail.
- ◆ D: rescue techniques for a CICV scenario.

During initial tracheal intubation, an alternate laryngoscope, optimum head neck position and a BURP manoeuvre should be considered. A secondary tracheal intubation plan involves fiberoptic-assisted intubation through the laryngeal mask airway (LMA) and intubating the LMA.

Cricoid pressure can impair insertion of the laryngoscope, passage of an introducer and can cause airway obstruction. Cricoid pressure should be applied with an initial force of 10 N when the patient is awake, increasing to 30 N as consciousness is lost. The force should be reduced with suction at hand, if it impedes laryngoscopy or causes airway obstruction (refer to OSCE set 4, station 4.19).

Key points

- ◆ Effective airway management requires a careful primary plan with an adequate back-up plan when the primary plan fails.
- ◆ Maintenance of oxygenation takes priority over everything else during the execution of each plan.
- ◆ Seek the best assistance available as soon as difficulty with laryngoscopy is experienced.
- ◆ In the given scenario in this station, there is an increased likelihood of regurgitation and pulmonary aspiration. Pre-oxygenation and cricoid pressure are very important.

- ◆ If intubation fails, despite a maximum of 3 attempts (including attempts with introducer and alternate blades), a failed intubation plan with the aim of maintaining oxygenation and waking the patient is initiated immediately.
- ◆ A further dose of suxamethonium should not be given.
- ◆ Based on the urgency of the surgical procedure, plan C varies. In general, appendicectomy can be delayed and so aim to wake the patient.
- ◆ Maintenance of ventilation and oxygenation is possible with a conventional bag and face mask, with or without an oral or nasal airway. If unsatisfactory, the LMA should be used. The Proseal LMA provides improved protection against aspiration.
- ◆ If ventilation is impossible and hypoxaemia develops, rescue techniques for the CICV situation, such as needle cricothyrotomy with transtracheal jet ventilation (TTJV), are implemented.

Station 2.14 Monitoring equipment: peripheral nerve stimulator

Information for the candidate

In this station your knowledge on equipment used for monitoring during anaesthesia will be tested.



Figure 2.14a.

Examiner's mark sheet**marks****What is this equipment and what is its clinical use?**2

This is a peripheral nerve stimulator used to monitor neuromuscular function. At induction it is used to assess the depth of neuromuscular block, during the maintenance phase of anaesthesia to titrate the repeat dose of muscle relaxant and at recovery to assess the adequacy of reversal from neuromuscular block.

Name two factors which determine the energy requirement to propagate a nerve impulse2

- ◆ Stimulus strength (current in mA).
- ◆ Duration of stimulus (milli seconds).

Why would you use a supramaximal stimulus?1

To ensure all motor fibres of the nerve are stimulated.

Indicate where you would place the electrodes for stimulating the ulnar nerve1

- ◆ Distal electrode: 1cm proximal to the flexion crease of the wrist.
- ◆ Proximal electrode: 2-3cm proximal to the distal electrode.

Indicate how you would connect the leads2

Negative lead distally (negative on the nerve) and positive lead proximally.

Which muscle contraction would you observe when the ulnar nerve is stimulated? 1

Adductor pollicis brevis (adduction of thumb).

State three methods available to assess muscle contraction 3

- ◆ Visual.
- ◆ Tactile.
- ◆ Electromyography.
- ◆ Accelerography.
- ◆ Mechanomyography.

What is double-burst stimulation (DBS)? 2

DBS consists of two short bursts of 50-Hz tetanic stimulation separated by 750ms.

What is a post-tetanic count (PTC)? 2

Single-twitch stimulations following a tetanic stimulation and count the responses.

What is the mechanism behind a post-tetanic count? 2

Tetanic stimulation increases mobilisation of acetylcholine (Ach). Subsequent single twitches release a supranormal concentration of Ach.

What is the significance of a post-tetanic count? 2

PTC <5: profound block; >15 equal to two twitches of train of four (TOF).

Total:	/20

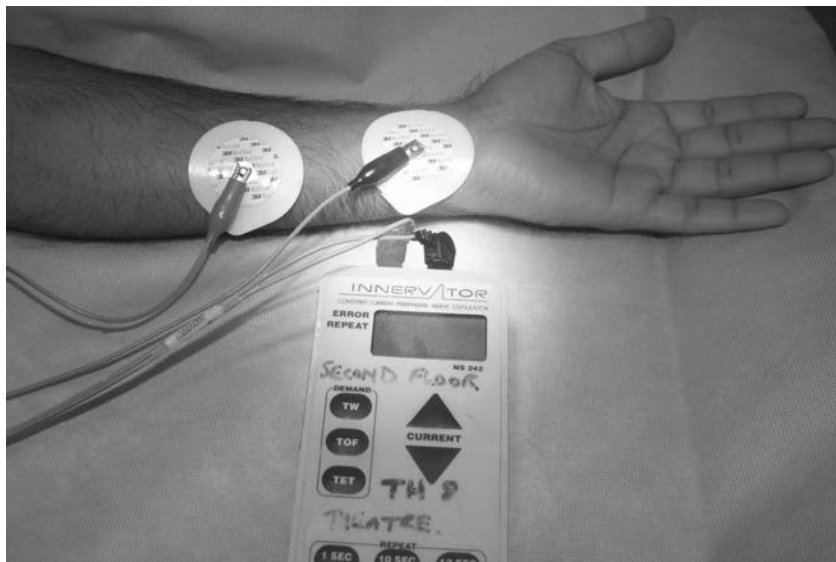


Figure 2.14b Placement of electrodes for ulnar nerve stimulation.

Neuromuscular monitoring

Factors determining the response to the nerve stimulation are:

- ◆ Stimulus strength: the rheobase is the minimal current required to create a nerve impulse.
- ◆ Duration of the stimulus: the chronaxie is the duration of the stimulus required to stimulate at twice the rheobase.

Supramaximal stimulation

The reaction of a single muscle fibre to an electrical stimulus follows an all-or-none law. Each fibre of a muscle will either contract maximally or will not contract at all. This means that a strong enough stimulus impulse (maximal stimulus) is required for all fibres of the stimulated muscle to contract. Increasing the stimulus above the maximal level does not produce a stronger response. A current setting of 60mA will achieve supramaximal stimulation in most cases.

The response to muscle stimulation can be assessed by:

- ◆ Visual and tactile method: less accurate.
- ◆ Electromyography: using electrodes, compound muscle action potential is recorded.
- ◆ Mechanomyography: the force generated by muscle contraction is recorded using a transducer.
- ◆ Acceleromyography: force of muscle contraction is mass times acceleration. If the mass is constant, the force of contraction is directly proportional to the acceleration. Therefore, acceleration of muscle contraction is inversely proportional to the degree of neuromuscular block.

In non-paralyzed muscle, the response to double-burst stimuli (DBS) is two short muscle contractions of equal strength. In the partly paralysed muscle, the second response is weaker than the first. DBS was developed to improve tactile detection of residual paralysis under clinical conditions. With DBS it is easier to feel the fade in the response when compared to train of four (TOF) stimulation. Residual neuromuscular blockade corresponding to a mechanically measured TOF ratio of 0.6 to 0.7 can reliably be detected by manual evaluation of the DBS response, whilst the detection limit for the tactile assessment of the TOF response is only about 0.4 to 0.5.

Post-tetanic count (PTC)

This stimulation pattern comprises 5 seconds of tetanus, then a 3-second pause followed by 10 to 20 single pulses at 1-second intervals. This pattern is used in deep relaxation where there is no twitch response to a single twitch or TOF stimulus (when using non-depolarising drugs only). In effect, the tetanus burst reduces the neuro-muscular blocking effect and enhances the muscle's response to electrical stimulation following this burst. PTC should not be repeated more often than once in 10 to 12 minutes, as otherwise spurious recovery will be indicated.

Key points

- ◆ A peripheral nerve stimulator is used to assess the depth of neuromuscular blockade.
- ◆ The nerve is stimulated using a cathode, a negative electrode.
- ◆ Non-depolarising muscle relaxants exhibit fade to TOF and tetanic stimulation.

Station 2.15 Clinical safety: defibrillator

Information for the candidate

A 70-year-old male patient has collapsed on the surgical ward. The cardiac monitor shows ventricular fibrillation (VF). You have already confirmed cardiorespiratory arrest and are about to defibrillate.

Examiner's mark sheet

	marks
Checks leads: position on patient and monitor.	2
Confirms rhythm.	2
Applies gel pads and correctly places paddles.	2
Charges safely to correct energy level (150-360J in a biphasic defibrillator or 360J in a monophasic defibrillator).	2
Visual sweep prior to delivering shock - 'stand clear'.	2
Removes oxygen.	2
Delivers shock while looking at monitor.	2

Places the paddles back on the defibrillator.

2 ☐

How would you place the paddles if someone has a pacemaker?

2 ☐

The defibrillator electrodes should be placed at least 12-15cm from the pacemaker unit.

What do these symbols in Figures 2.15a and 2.15b indicate?

2 ☐



Figure 2.15a.



Figure 2.15b.

Figure 2.15a shows a Type BF defibrillation proof equipment. Figure 2.15b shows a Type CF defibrillation proof equipment.

Total:	/20

Safe use of the defibrillator

Confirm the diagnosis of VF to avoid the inappropriate delivery of shock. Check the connection of leads. Adult paddles have a typical diameter of 13cm. Conductive gel pads improve electrical contact between the paddles and chest. A firm pressure of 10Kg force is used.

The standard procedure is to place one electrode to the right of the upper sternum below the clavicle and the other level with the 5th left intercostal space in the anterior axillary line. It allows maximum current flow through the myocardium. If the patient has a cardiac pacemaker, the current may travel along the pacemaker wire causing burns where the electrode tip makes contact with the myocardium. Placing the defibrillator electrodes at least 12-15cm from the pacemaker unit should minimise the risk. Antero-posterior electrode placement can also be used in patients with a pacemaker. The anterior electrode is placed on the left anterior chest, midway between the xiphoid process and left nipple, corresponding to the V2-V3 ECG electrode position. The posterior electrode should be placed beneath the left scapula.

The paddles should either be on the equipment or on the patient's chest. It should be charged only when on the patient's chest. A charged paddle in the air can cause arcing and accident.

If the defibrillator is charged but a shock is no longer indicated, it should be discharged through the defibrillator internally (by altering the energy setting) before removing the paddles from the chest.

To avoid risk to members of the resuscitation team, check no-one touches the patient or the bed, or holds the intravenous fluid bag, etc, and shout 'stand clear' before delivering the shock. As the current takes the route of least resistance, be careful with wet surroundings due to vomit, water, blood or other fluids.

Any equipment with no display of a 'defibrillator protected' electrical safety symbol should be disconnected from the patient before delivering a shock. If co-ordinated rhythm is not restored by defibrillation, a second and further shock should be given only after additional cycles of chest compressions.

Key points

- ◆ Use the paddles correctly and safely; the paddles should either be on the defibrillator or on the patient's chest.
- ◆ Ensure safety of other members of the team. Shout 'stand clear' before delivering the shock.
- ◆ Disconnect all unsafe equipment from the patient before delivering the shock.
- ◆ Be familiar with electrical symbols.

Station 2.16 Radiology: chest X-ray

Information for the candidate

Figure 2.16 is a chest X-ray of a 59-year-old male patient who is scheduled for an emergency laparotomy. He was diagnosed to have biliary peritonitis following a perforated gallbladder. On clinical examination, the pulse rate is 110/minute, BP is 110/70 mmHg, SpO₂ is 91% in room air and the respiratory rate is 28 per minute. He has rapid shallow breathing.

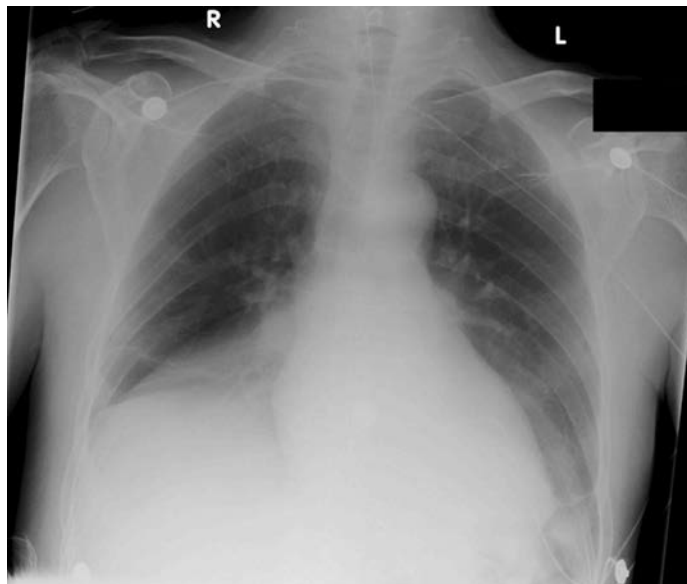


Figure 2.16 Chest X-ray.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. This chest X-ray appears to be a PA view.	True	False	2	☐
2. There is a small pneumothorax at the left apex.	True	False	2	☐
3. This film is well centered.	True	False	2	☐
4. There is homogeneous shadowing at the right lower zone.	True	False	2	☐
5. The diaphragm on the left side is elevated.	True	False	2	☐
6. There is no cardiomegaly.	True	False	2	☐
7. The film is taken in deep inspiration.	True	False	2	☐
8. Consolidation of the left lower lobe is possible.	True	False	2	☐
9. This patient needs a high concentration of oxygen.	True	False	2	☐
10. This patient is likely to require ventilatory support in the postoperative period.	True	False	2	☐

Total:	/20

Answers

1. False. AP view; if the scapulae overlie the lung fields then the film is AP; if they do not, it is probably PA.
2. False. There are lung markings.
3. False. The medial end of the clavicles should be equidistant from the spinous process. If one clavicle is nearer than the other the patient is rotated.
4. True.
5. False.
6. True. But it is difficult to comment on the size of the heart in an AP film.
7. False. During full inspiration, the anterior end of the 6th rib should be above the diaphragm as should the posterior end of the 10th rib; pain, exhaustion or disease can prevent the full intake of breath.
8. True.
9. True.
10. True.

Reporting a chest X-ray

There are several structured ways to interpret a chest X-ray. First, ensure the identity and date of the X-ray. Then, ascertain projection (AP or PA), penetration (over or under penetrated), rotation (centralisation is adequate) and adequacy. One mnemonic is ABCDEFGHI.

- ◆ A = Airway: trachea in the midline or slightly deviated to the right. Are the trachea and mainstem bronchi patent?
- ◆ B = Bones: any obvious defects in clavicles, ribs and sternum, scapulae and vertebrae?

- ◆ C = Cardiac silhouette: shape of heart, cardiothoracic ratio.
- ◆ D = Diaphragm: right diaphragm higher than the left, the costophrenic and cardiophrenic margins. Any air under the diaphragm?
- ◆ E = Effusion/empty space: is either present?
- ◆ F = Fields (lungs): are there infiltrates, increased interstitial markings, masses, air bronchograms, increased vascularity, discrete or generalised shadows?
- ◆ G = Gastric bubble.
- ◆ H = Hilar region: left hilum higher than the right, hilar shadowing, mediastinum.
- ◆ I = Inspiration: did the patient inspire well enough for 6 ribs to be counted anteriorly and 10 ribs to be counted posteriorly?

Initially check the technical quality of the film in terms of adequacy of penetration, orientation (right/left) and rotation.

An AP or PA view is defined by the direction of the X-ray beam in relation to the patient. In an AP film the beam comes from the front of the patient and in a PA film the beam comes from behind and the film is placed in the front. Standard chest X-rays are PA films. But in the ICU or in emergencies, the films taken at the bedside are often AP. In AP films, the scapulae overlie the lung fields. Due to placement of the films, in a PA view the heart is closer to the film, whereas in an AP view, the heart is further away and is therefore distorted. Hence, in an AP view, the heart appears bigger and it is difficult to estimate heart size reliably.

In a PA view, look to see whether the clavicles are straight. Count the anterior and posterior ribs. Anterior ribs are at an angle and may attach to the sternum. Posterior ribs are straight and attach to the vertebral body. Count the spaces between ribs; there should be 8-10 with normal lung expansion; 10 or more spaces imply hyperinflation.

Appearance of structures in an X-ray film

The greater the density, the lesser the penetration of the X-rays through the object. The film remains underexposed and the image appears white. It is described as radiodense or radiopaque, e.g. bone, barium.

The less dense objects allow more X-rays to penetrate it. The film is more exposed and the image appears black. It is described as radiolucent, e.g. air. The intermediate dense objects appear in various grey scales, e.g. fat, blood, muscles.

Key points

- ◆ Before commenting on X-rays ensure adequacy of exposure, penetration, orientation and rotation.
- ◆ Read the provided history; often it gives you a hint as to what to look for in the X-ray.
- ◆ Have a structured approach to interpretation of the chest X-ray.
- ◆ You can only estimate the size of the heart in a PA view.
- ◆ The cardiac silhouette should not exceed over half the total width of the chest.

Station 2.17 History taking: varicose veins

Information for the candidate

In this station you will be asked to take a history from a 30-year-old female patient who is scheduled to undergo ligation of varicose veins as a day-case procedure.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient.	1
Confirms the proposed surgery and the correct side.	1
Asks about previous anaesthetics and elicits H/O previous craniotomy.	2

Craniotomy was 4 years ago, following a road traffic accident.	2	
Elicits H/O ICU admission and tracheostomy.	2	
Duration of stay in ICU.	1	
H/O epilepsy and details of anti-epileptic drugs.	2	
Last episode of convulsions: more than 2 years.	1	
H/O smoking: 10 cigarettes a day.	2	
H/O alcohol intake: none	2	
Drug history: oral contraceptive pills.	2	
H/O allergy: nuts.	1	
Details of allergic reaction: rash and face swells up.	1	

Total:	/20

Information for the actor

You are scheduled to have a varicose vein operation today (for big swollen veins on your right leg, which have been bothering you for the past 2 years; your leg swells up on standing for a long time). An anaesthetist will see you before having your operation today.

10 years ago you underwent removal of a lump from the breast. After the anaesthetic you felt quite sick for 2 days. Four years ago you had a road traffic accident for which you had an operation under general anaesthetic to remove a blood clot from the brain. Following the operation you were in the intensive care unit and stayed in hospital for 6 weeks, of which 4 weeks were in the intensive care unit. You were on a breathing machine and for that you had a hole in the windpipe in the neck (tracheostomy).

Since you sustained the head injury you suffer from fitting, but for the last 2 years you have had no fits.

You quit smoking 2 weeks ago and you don't drink alcohol. You regularly take phenytoin tablets for fits and the contraceptive pill, and are allergic to nuts; they give you a rash and your face swells.

Key points

- ◆ Follow a structured approach.
- ◆ Enquire as to all the details of past medical history.
- ◆ Elicit the nature and severity of any drug allergy.

(For more information please refer to OSCE set 1, station 1.12).

Station 2.18 Communication: suxamethonium apnoea

Information for the candidate

As the on-call anaesthetist, you have just given an anaesthetic to a fit and well 10-year-old girl for an urgent appendicectomy. General anaesthesia was induced with a rapid sequence technique using thiopentone and suxamethonium. At the end of the surgery, the child would not breathe. She is haemodynamically stable. Her HR is 80 bpm, BP is 100/60 mm Hg, SpO₂ is 100%, EtCO₂ is 5.5 kPa, tympanic temperature is 36.8°C, and her pupils are midsize and reacting. Neuromuscular monitoring with train of four is suggestive of suxamethonium apnoea. The child is now sedated and ventilated in intensive care.

In this station you will meet the mother of the child.

Examiner's mark sheet

	marks
Introduces him/herself to the patient's relative.	1
Confirms that he/she is talking to the right person.	1
Clearly explains the reason for admitting to intensive care.	2
Avoids jargon.	1
Reassures that her daughter is sedated (kept sleepy), pain-free and should wake up in 4-6 hours time.	2
Explains that suxamethonium was the correct drug to use and why it was used.	2
Mentions that this is a recognised complication of suxamethonium.	1
Explains the reason why her daughter is not able to breathe after suxamethonium.	2
Explains blood tests for suxamethonium apnoea.	2
Explains that her daughter can safely have anaesthetics in the future.	1
Confirms he/she will write to the general practitioner.	2
Emphasises the need for the entire family to undergo a blood test for suxamethonium apnoea.	2
Sympathetic throughout and satisfactory conclusion.	1

Total:	/20

Information for the actor

Your daughter was admitted to the hospital with severe pain in her tummy. The doctor told you that she has appendicitis and requires an urgent operation to remove the appendix. She was taken to the operating theatre 2 hours ago. You expected the operation to last for about an hour. But, you have been waiting for quite some time. One of the nurses informs you that your daughter is in the intensive care unit. You are naturally very worried and anxious as your daughter is normally very fit and has only had a tummy ache.

The anaesthetist is about to talk to you now about her condition. The operation went well without problems. At the end of the operation your daughter did not wake up due to a problem related to one of the anaesthetic drugs. Your concerns are: Is she alright? When will she wake up? Why was that particular drug used? Why did they not anticipate the problem before?

Suxamethonium apnoea

Suxamethonium is still the desirable drug when rapid onset of action, short duration and profound depth of neuromuscular block is required as in rapid sequence induction. Recovery from suxamethonium-induced blockade is dependent on plasma cholinesterase. In patients with a normal cholinesterase level, the neuromuscular block usually lasts for 4-6 minutes. A prolonged block can be due to acquired and genetic factors.

Unless there is a clear family history, it is difficult to identify the impending problem prior to anaesthesia. Suxamethonium apnoea is suspected on clinical grounds where other possible causes for delayed recovery from anaesthesia have been excluded. Neuromuscular monitoring with train of four reveals reduction in height of all four twitches, no fade with tetanic stimulation and no post-tetanic facilitation.

Once the condition is suspected, continue sedation and ventilation until the neuromuscular block wears off. Document all the events. The patient and his/her general practitioner need to be notified in writing. The test to confirm suxamethonium apnoea is done at least 3 days after exposure to

the drug. If the patient had received a homologous blood transfusion then the waiting period should be at least 8 weeks. Blood samples are taken for a dibucaine number and plasma cholinesterase level. The normal level of plasma cholinesterase is 1000-3500 units/L.

The dibucaine number represents the percentage inhibition of plasma cholinesterase by the amide local anaesthetic, dibucaine. The normal value is 75-85. It is about 60 in the heterozygous variant and is less than 20 in the homozygous variant of abnormal cholinesterase. In the heterozygous variant population the block lasts for about 10-20 minutes; in homozygous it is prolonged up to 4-8 hours. Most of the acquired causes for suxamethonium apnoea are drug-induced inhibition of plasma cholinesterase, e.g. methotrexate, neostigmine, organophosphorus compounds, lithium.

Key points

- ◆ Apnoea due to incomplete recovery from the effects of the drug is a recognised side effect of the drug. 4% of the population have heterozygous variants and for the homozygous genotype it is about 1:2800.
- ◆ It was essential to use the drug as part of the general anaesthetic and is a commonly used drug in similar emergency operations.
- ◆ Reassure the mother that her daughter is stable and that she will wake up as soon as the effect of suxamethonium (muscle relaxant) wears off, which may take 4-8 hours.
- ◆ She will be sedated to keep her asleep until the effect of the drug wears off completely, so she is not in any distress now.
- ◆ Avoid jargon (instead of a 'paralyzing agent to intubate the trachea' say a 'drug to relax the muscles to allow the passing of a tube into the windpipe').
- ◆ As this condition is inherited, other members of the family should be investigated. The necessary arrangements should be made for further investigations and the appropriate support offered.
- ◆ Reassure the mother that she will be able to visit her daughter in intensive care.

Station 2.19 Anatomy: cubital fossa

Information for the candidate

In this station you will be asked to demonstrate peripheral nerve blocks on the upper limb.

Examiner's mark sheet

marks

Name the structures labelled 1-5 in Figure 2.19a

5

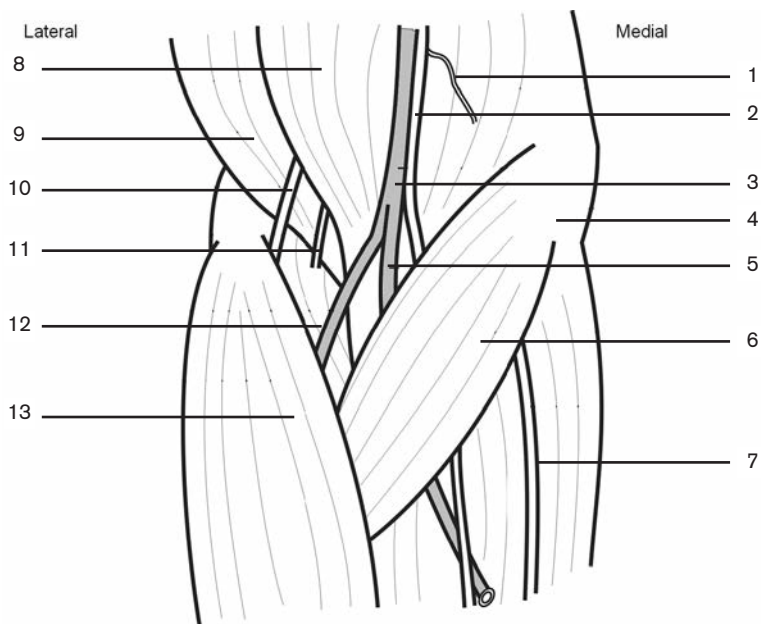


Figure 2.19a Contents of the cubital fossa.

1. Medial cutaneous nerve of the forearm.
2. Median nerve.
3. Brachial artery.
4. Medial epicondyle.
5. Ulnar artery.
6. Pronator teres muscle.
7. Ulnar nerve.
8. Biceps muscle.
9. Brachialis muscle.
10. Radial nerve.
11. Lateral cutaneous nerve of the forearm.
12. Radial artery.
13. Brachioradialis muscle.

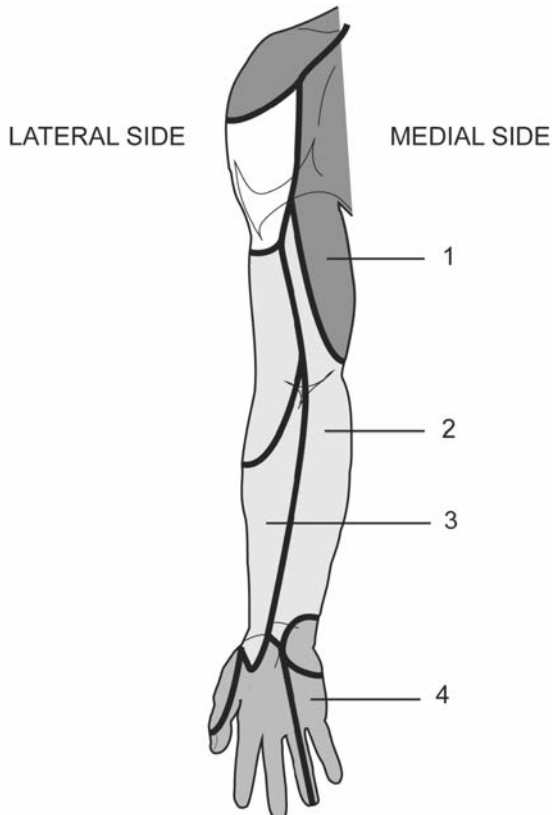


Figure 2.19b Cutaneous innervation of the upper limb.

Name the nerves supplying areas labelled 1-4 in Figure 2.19b 4

1. Medial cutaneous nerve of the arm.
2. Medial cutaneous nerve of the forearm.
3. Lateral cutaneous nerve of the forearm (branch of the musculocutaneous nerve).
4. Ulnar nerve.

How would you block the lateral cutaneous nerve of the forearm? 2

The lateral cutaneous nerve of the forearm is a sensory nerve and is the continuation of the musculocutaneous nerve into the forearm. It innervates the skin of the lateral (radial) aspect of the forearm. It can be blocked by subcutaneous infiltration of local anaesthetic or by injecting local anaesthetic in the groove between brachioradialis (laterally) and biceps (medially).

What movements would you elicit by stimulating the median nerve at the axilla? 2

It causes flexion of the wrist and abduction of the thumb.

How would you block the median nerve at the elbow? 2

The median nerve is blocked medial to the brachial artery, at the elbow crease.

How would you block the ulnar nerve at the elbow? 2

- ◆ The ulnar nerve passes through the ulnar groove of the medial epicondyle at the posterior aspect of the elbow.
- ◆ Preparation: ensure that the patient has been consented for the procedure, and that equipment and drugs are available.
- ◆ Position: the elbow should be flexed, arm abducted and forearm supinated. 3-4ml of local anaesthetic should be injected 2-3cm proximal to the epicondyle.

Where would you find the radial nerve in the cubital fossa and how would you block it?

2

The radial nerve runs deep in between the biceps brachii tendon and brachioradialis muscle. It is blocked at or about 2cm above the crease line between these 2 structures.

What would be the response if the radial nerve was stimulated at this level?

1

Stimulation of the radial nerve at this level results in wrist and finger extension.

Total:	/20

Cubital fossa anatomy

Boundaries

- ◆ Roof: deep fascia reinforced by the bicipital aponeurosis.
- ◆ Floor: brachialis and supinator muscles.
- ◆ Superior: line connecting the medial and lateral epicondyles of the humerus.
- ◆ Medial: pronator teres muscle.
- ◆ Lateral: brachioradialis muscle.

Contents

The radial nerve is located between the brachioradialis and brachialis muscles. The brachial artery usually bifurcates near the inferior part of the cubital fossa into the superficial radial artery and the deep ulnar artery. The median nerve lies medial to the brachial artery.

Radial nerve block at the elbow

The radial nerve is made up of fibres from C5-T1. In the axilla, the nerve lies posterior and inferior to the axillary artery. In the upper part of the arm,

the nerve passes behind and across the posterior aspect of the humerus. It runs between the medial and long heads of triceps and supplies the triceps muscle. It also gives rise to sensory branches to the posterior aspect of the arm. Further down its course, between the lateral epicondyle (of the humerus) and musculospiral groove, the nerve divides into 2 terminal branches: superficial and deep. The deep branch supplies the extensor muscles of the forearm. The superficial branch courses along with the radial artery and provides sensory innervation to the dorsal aspect of the wrist and thumb, and the index and middle fingers.

At the level of the elbow, with all aseptic precautions, the nerve is blocked at the level of the crease or 1-2cm above the crease line. The short bevel needle is inserted just lateral to the biceps tendon, between the biceps tendon and brachioradialis muscle. Although conventionally paraesthesia was elicited to confirm vicinity to the nerve, a nerve stimulator can easily be used to increase success rate. The motor response to stimulation is extension of the wrist and fingers. Recently, ultrasound-guided blocks have gained popularity.

Median nerve block at the elbow

The median nerve is made up of fibres from C5-T1. In the axilla, the nerve lies anterior and superior to the axillary artery. After leaving the axilla, the nerve closely follows the course of the brachial artery. At the level of the elbow the median nerve lies medial to the brachial artery which in turn lies medial to the tendon of biceps. Further down, the nerve provides motor innervation to the flexor muscles of the forearm. As the nerve approaches the wrist it lies deep to and between the tendons of the palmaris longus and flexor carpi radialis muscles.

At the level of the elbow, the nerve is blocked at the crease level. Using a 1½-inch short bevelled needle the nerve is located medial to brachial artery pulsation. The nerve is located using paraesthesia, a nerve stimulator or ultrasound-guided techniques. When stimulated at this level the motor response would include flexion of the wrist and abduction of the thumb.

Ulnar nerve block at the elbow

The ulnar nerve is made up of fibres from C6-T1. The nerve lies anterior and inferior to the axillary artery in the axilla. It initially follows the brachial artery and later courses medially to pass between the olecranon process and medial epicondyle of the humerus. The nerve courses down between the two heads of flexor carpi ulnaris muscle and then moves along with the ulnar artery. About 2cm proximal to the wrist crease, the nerve divides into dorsal and palmar branches.

At the level of the elbow, posteriorly, the olecranon process (the proximal bony process of the ulna that fits into the olecranon fossa of the humerus) and the medial epicondyle of the humerus are identified. The ulnar sulcus between these 2 bony landmarks is palpated. Under aseptic precautions the short bevelled needle is inserted just proximal to the sulcus in a slight cephalad trajectory. The nerve is fairly superficial in this location.

Use of a peripheral nerve stimulator for nerve blocks

Stimulation of nerves with low intensity current is used to locate the nerves. It requires a nerve stimulator able to deliver low intensity current and an insulated needle with an electrical lead attachment. Initial output of 1-1.5mA is usually chosen. A frequency of 2Hz is used. Higher frequency causes tetanic stimulation; lower frequency can miss the nerve. Once the motor response is elicited, current output is reduced and the threshold at which twitches disappear is noted. Strong twitches elicited at a low intensity of current (e.g. <0.2 mA) may suggest intra-neural placement of the needle.

Key points

- ◆ The median nerve lies medial to brachial artery pulsation.
- ◆ The ulnar nerve should be blocked 2-3cm proximal to the medial epicondyle. The incidence of neuritis is high if blocked at the ulnar groove.
- ◆ The radial nerve is blocked between biceps tendon and brachioradialis.
- ◆ The peripheral nerve stimulator is useful to locate median, radial and ulnar nerves at the elbow.

Station 2.20 Technical skill: ankle block

Information for the candidate

A 60-year-old male patient is scheduled for a correction of hallux valgus of the left foot under regional block. Correction of hallux valgus involves an osteotomy and k-wire insertion at the first metatarsophalangeal joint.

Examiner's mark sheet

marks

Name the nerves that need to be blocked in order to provide anaesthesia for this surgical procedure

3

The three nerves that need to be blocked are:

- ◆ Superficial peroneal nerve.
- ◆ Deep peroneal (anterior tibial) nerve.
- ◆ Saphenous nerve.

What are the other two nerves in the ankle that are required to be blocked for a complete ankle block?

1

Tibial nerve and sural nerve.

Of the five nerves which one is not a branch of the sciatic nerve?

1

Saphenous nerve.

Name the structures labelled 1-5 in Figure 2.20

5

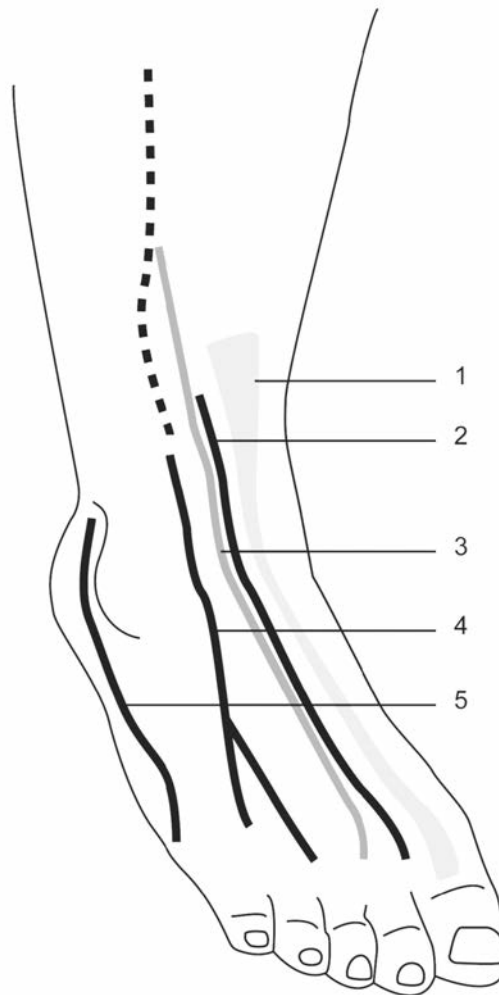


Figure 2.20 Nerve supply of the foot.

1. Extensor hallucis longus tendon.
2. Deep peroneal (anterior tibial) nerve.
3. Dorsalis pedis artery.
4. Superficial peroneal nerve.
5. Sural nerve.

Name the terminal branches of the tibial nerve

2

The tibial nerve divides into the medial and lateral plantar nerves.

How would you block the tibial nerve at the ankle?

2

The tibial nerve is blocked by injecting local anaesthetic behind the medial malleolus and anterior to the tibial artery pulsation.

How would you block the deep peroneal nerve?

2

It lies on the medial side of the dorsalis pedis artery. The nerve is blocked by injecting local anaesthetic on the medial side of the artery, between the artery and extensor hallucis longus (in the 1st metatarsal space).

Where would you inject local anaesthetic to block the sural nerve?

2

The sural nerve can be blocked by subcutaneous infiltration of local anaesthetic behind the lateral malleolus.

Where would you inject local anaesthetic to block the saphenous nerve?

2

Subcutaneous infiltration 5-10cm above the medial malleolus along the course of the long saphenous vein.

Total:	/20

Nerves of the leg

The sciatic nerve terminates in the apex of the popliteal fossa to divide into the common peroneal and tibial nerves. The tibial nerve leaves the

popliteal fossa between the heads of gastrocnemius to run on the tibialis posterior, then passes medially and enters the foot behind the medial malleolus between the posterior tibial artery and flexor hallucis longus tendon. It terminates into the medial and lateral plantar branches which provide sensory supply to the sole of the foot.

In the popliteal fossa, the tibial nerve gives off a sensory branch, the sural nerve, which passes downwards along the lateral aspect of the leg and then behind the lateral malleolus to supply the foot.

The common peroneal nerve winds round the neck of the fibula and divides into superficial peroneal and deep peroneal branches. It is at this location that the nerve is vulnerable to pressure neuropathy. The superficial peroneal nerve provides sensory supply to the lower and outer aspect of the leg and dorsum of the foot. The deep peroneal nerve supplies the skin over the web space between the first and second toe.

Tibial nerve block at the ankle

The tibial nerve provides sensory innervation to the posterior portion of the calf, the heel, and the medial plantar surface. In the ankle, the nerve courses medially between the Achilles tendon and the medial malleolus, where it divides into the medial and lateral plantar nerves. To block the nerve, the area between the medial malleolus and the Achilles tendon is prepared. The nerve lies in the posterior groove of the medial malleolus and is blocked by inserting the short bevelled needle anterior to the posterior tibial artery pulsation.

Sural nerve block at the ankle

The sural nerve is a branch of the (posterior) tibial nerve. The nerve passes from the posterior calf around the lateral malleolus to provide sensory innervation of the posterolateral aspect of the calf, the plantar surface of heel, the lateral surface of the foot and the fifth toe. To block this nerve, the posterior groove behind the lateral malleolus is identified. The area between the lateral malleolus and Achilles tendon is prepared. The nerve is blocked either by eliciting paraesthesia in the groove or by subcutaneous infiltration behind the lateral malleolus.

Saphenous nerve block at the ankle

The saphenous nerve is the largest sensory branch of the femoral nerve. It provides sensory innervation to the medial calf, medial malleolus, and a portion of the medial arch of the foot. It has a fairly superficial course and runs along the long saphenous vein. To block the nerve at the ankle, the tendon of extensor hallucis longus is identified. This tendon can be made prominent by asking the patient to extend the big toe against resistance. A subcutaneous injection is made from this tendon, medially towards the medial malleolus.

Deep peroneal nerve block at the ankle

The common peroneal nerve after passing through the fibular tunnel (between the fibula and peroneus longus muscle) divides into two terminal branches: the superficial and deep peroneal nerve. The deep peroneal nerve has a course closely related to the anterior tibial artery and it provides sensory innervation to the web space of the first and second toes and adjacent dorsum of the foot. To block this nerve, the extensor hallucis longus tendon is located as described earlier. The nerve is blocked between the extensor hallucis longus tendon and dorsalis pedis artery in the proximal portion of the 1st metatarsal space.

Superficial peroneal nerve block at the ankle

The superficial peroneal nerve continues down the leg in conjunction with the extensor digitorum longus muscle. The nerve gives rise to terminal branches just above the ankle, which provide sensory innervation to most of the dorsum of the foot. The nerve is blocked by a subcutaneous infiltration between the extensor hallucis longus tendon and the lateral malleolus.

Key points

- ◆ The 5 nerves for ankle block are the superficial peroneal nerve, deep peroneal nerve, tibial nerve, sural nerve and saphenous nerve.
- ◆ Superficial and deep peroneal nerves are branches of the common peroneal nerve; the sural nerve is a branch of the tibial nerve. They are all branches of the sciatic nerve.
- ◆ The saphenous nerve is a sensory branch of the femoral nerve.

OSCE

set 3

Station 3.1 Anaesthetic equipment: anaesthesia machine check

Information for the candidate

In this station you will be asked to check the anaesthesia machine in a systematic order.

Examiner's mark sheet

	<i>marks</i>
Checks the machine/monitor is connected to an electrical supply.	1 ☐
Checks the monitoring device and recognises that there is no EtCO ₂ monitor.	1 ☐
Checks the oxygen analyser on the machine is working and calibrates it for 100% and 21%.	2 ☐
Performs a tug test.	1 ☐
Checks the pipe line pressure gauge (should be 4 bar).	1 ☐
Checks that the oxygen cylinder is available.	2 ☐
Checks that the blanking plug is fitted to the empty cylinder yoke.	1 ☐

Flow meters3

- ◆ Checks all three valves are operational (O₂, N₂O, air).
- ◆ Checks for anti-hypoxia device (mention it).
- ◆ Checks for emergency oxygen flush.

Checks the vaporisers4

- ◆ Adequately filled.
- ◆ Correctly seated.
- ◆ Checks for leak (both in the on and off position).
- ◆ Turns the vaporiser off when checks are completed.

What precautions would you take before fitting a cylinder to the machine?3

- ◆ Plastic dust cover is removed.
- ◆ Make sure the sealing washer is present.
- ◆ Before fitting, gently open the cylinder to let some gas escape.

Why would you do this?1

To blow out any dust/grit from the outlet that might damage the pressure regulator.

Total:	/20

Anaesthesia machine check

In this OSCE station you are asked to check the anaesthetic machine. You have only 5 minutes to complete the task. It is vital that you follow a systematic order to identify any faults with the machine or monitoring equipment.

Check that the anaesthetic machine is connected to the electricity supply (if appropriate) and switched on

- ◆ Take note of any information or labelling on the anaesthetic machine referring to the current status of the machine. Servicing labels should be filed in the service logbook.

Check that all monitoring devices, in particular the oxygen analyser, pulse oximeter, and capnograph are functioning and have appropriate alarm limits

- ◆ Check that gas sampling lines are properly attached and free of obstructions.
- ◆ Check that an appropriate frequency of recording non-invasive blood pressure is selected.

Check with a 'tug test' that each pipeline is correctly inserted into the appropriate gas supply terminal

- ◆ Ensure that an adequate supply of oxygen is available from a reserve oxygen cylinder.
- ◆ Check that adequate supplies of other gases (nitrous oxide, air) are available and connected as appropriate.
- ◆ Check the cylinder yoke; an empty yoke should be fitted with a blanking plug.
- ◆ Check that all pipeline pressure gauges in use on the anaesthetic machine indicate 400-500kPa.

Check the operation of flow meters

- ◆ Check that each flow valve operates smoothly and that the bobbin moves freely throughout its range.
- ◆ Check the anti-hypoxia device is working correctly.
- ◆ Check the operation of the emergency oxygen bypass control.

Check the vaporiser(s)

- ◆ Check that each vaporiser is adequately filled.
- ◆ Check that each vaporiser is correctly seated on the back bar and is not tilted.

- ◆ Check the vaporiser for leaks (with vaporiser on and off) by temporarily occluding the common gas outlet.
- ◆ Turn the vaporiser(s) off when checks are completed.
- ◆ Repeat the leak test immediately after changing any vaporiser.

Check the breathing system to be employed

Note: a new single-use bacterial/viral filter and angle-piece/catheter mount must be used for each patient.

- ◆ Inspect the system for correct configuration. All connections should be secured by a 'push and twist'.
- ◆ Perform a pressure leak test on the breathing system by occluding the patient-end and compressing the reservoir bag. Bain-type co-axial systems should have the inner tube compressed for the leak test.
- ◆ Check the correct operation of all valves, including unidirectional valves within a circle, and all exhaust valves.
- ◆ Check for patency and flow of gas through the whole breathing system, including the filter and angle piece/catheter mount.

Check that the ventilator is configured appropriately for its intended use

- ◆ Check that the ventilator tubing is correctly configured and securely attached.
- ◆ Set the controls for use and ensure that an adequate pressure is generated during the inspiratory phase.
- ◆ Check the pressure relief valve functions.
- ◆ Check that the disconnect alarms function correctly.
- ◆ Ensure that an alternative means to ventilate the patient's lungs is available.

Check that the anaesthetic gas scavenging system is switched on and is functioning correctly

- ◆ Check that the tubing is attached to the appropriate exhaust port of the breathing system, ventilator or workstation.

Check that all ancillary equipment which may be needed is present and working

- ◆ This includes laryngoscopes, intubation aids, intubation forceps, bougies, etc. and appropriately sized face masks, airways, tracheal tubes and connectors, which must be checked for patency.
- ◆ Check that the suction apparatus is functioning and that all connectors are secure.
- ◆ Check that the patient trolley, bed or operating table can be rapidly tilted head down.

Check that an alternative means to ventilate the patient is immediately available (e.g. self-inflating bag and oxygen cylinder)

- ◆ Check that the self-inflating bag and cylinder of oxygen are functioning correctly and the cylinder contains an adequate supply of oxygen.

Recording

- ◆ Sign and date the logbook kept with the anaesthetic machine to confirm the machine has been checked.
- ◆ Record on each patient's anaesthetic chart that the anaesthetic machine, breathing system and monitoring has been checked.

(For further reading please refer to The Association of Anaesthetists of Great Britain and Ireland - Checking anaesthetic equipment, 2004).

Key points

- ◆ Check the anaesthetic machine using the above systematic order.
- ◆ Ensure the oxygen analyser is present and working correctly.
- ◆ The oxygen failure alarm must be checked once weekly.
- ◆ If nitrous oxide is to be used, an anti-hypoxia device must be present.

Station 3.2 Data interpretation: biochemistry

Information for the candidate

A 57-year-old man is admitted for laparoscopic cholecystectomy. He has a history of COAD and shortness of breath on minimal exertion. Routine pre-operative blood tests reveal the following results.

- ◆ Hb: 16.9g/dl, WCC: 11.8×10^9 cells/L, platelets: 479×10^9 cells/L, Hct: 0.54.
- ◆ Na^+ : 136mmol/L, K^+ : 3.1mmol/L, urea: 8.7mmol/L, creatinine: 98 μ mol/L.
- ◆ ABG in room air - pH: 7.33, PaO_2 : 7.7kPa, PaCO_2 : 7.4kPa, HCO_3^- : 34mmol/L.
- ◆ FEV1: 1.1L, FVC: 2.9L.

Examiner's mark sheet

marks

Name five abnormalities shown in the test results

5

Polycythaemia, hypokalaemia, hypoxia, hypercarbia, compensated respiratory acidosis, obstructive lung disease or airflow limitation.

What is the likely cause of this patient's shortness of breath?

2

Chronic obstructive airway disease, Type 2 respiratory failure or cor pulmonale.

Name four physical signs you may find on examining this patient

4

Central cyanosis, clubbing, tremor, bounding pulse, tachypnoea, raised JVP, hyper-resonant percussion note, displaced apex, difficult to palpate apex, peripheral oedema, hepatomegaly, widespread wheeze, fine and/or coarse crackles.

Name two changes you might expect to see on the chest X-ray

2

Hyperinflation, flat diaphragm, enlarged hilar vessels, loss of peripheral vascular markings, emphysematous bullae and enlarged heart (cor pulmonale).

What two ECG changes might you expect to find in this patient?

2

Peaked P waves, right axis deviation, right ventricular hypertrophy (RVH), right bundle branch block (RBBB), atrial fibrillation (AF).

Please tick the correct answer - true or false.

1. This patient should be on oxygen.	True	False	1	
2. This patient will have increased pulmonary dead space.	True	False	1	
3. This patient will have a reduced pulmonary vascular resistance.	True	False	1	
4. Cessation of smoking is unlikely to improve this patient's prognosis.	True	False	1	
5. Laparoscopic procedures are safe in this patient.	True	False	1	

Total: /20

Answers

1. True, $\text{PaO}_2 < 9 \text{ kPa}$ and forced expiratory volume in 1 second (FEV1) $< 1.2 \text{ L}$. Even in patients with a history of COAD, the conventional myth that oxygen administration can eliminate the 'hypoxic drive' and depress respiration is over-emphasized. Oxygen should be administered until the clinical condition improves.
2. True.
3. False. Pulmonary hypertension and raised pulmonary vascular resistance.
4. False. Ceasing to smoke even at this stage improves prognosis.
5. False. Although less invasive, intra-operative abdominal distension can further compromise respiratory function.

Chronic obstructive airway disease (COAD)

COAD is a group of diseases characterised by limitation of airflow in the airway that is not fully reversible (in contrast to bronchial asthma where it is reversible). The two common diseases included under this category are chronic bronchitis and emphysema. Congenital deficiency of alpha-1-antitrypsin can cause the condition. More commonly acquired COAD is due to smoking.

The cardinal symptoms of COAD are shortness of breath, wheezing, and cough with expectoration. Chronic bronchitis is diagnosed when there is productive cough for most days for 3 months of a year for two consecutive years. There is inflammation and resultant narrowing of the small airways that limit airflow. Emphysema is a 'histological' diagnosis. There is enlargement of airspaces distal to the terminal bronchioles with associated destruction of their walls.

COAD is characterised by a reduction in FEV1 ($< 80\%$ of predicted value) and a decrease in the FEV1/FVC ratio ($< 70\%$). Arterial blood gas analysis

reveals hypoxia and CO_2 retention. In chronic states, respiratory acidosis is compensated by metabolic alkalosis due to increased renal elimination of bicarbonate ions. Hypoxic stimulation on kidneys liberates erythropoietin and resultant polycythemia. There is no specific diagnostic X-ray feature for chronic bronchitis apart from increased broncho-vascular markings. Emphysema results in hyperinflation of the lungs and concomitant changes in the configuration of the thoracic cavity.

Cor pulmonale describes a change in structure and function of the right ventricle as a result of respiratory disease. Anatomical changes in the lungs, hypoxic pulmonary vasoconstriction and increased blood viscosity due to polycythemia, can impose strain on the right side of the heart. Initially there is right ventricular dilatation followed by hypertrophy. Eventually, right heart failure ensues.

Key points

- ◆ Respiratory failure: Type 1 $\text{PaO}_2 < 8\text{kPa}$, $\text{PaCO}_2 < 6\text{kPa}$; Type 2 $\text{PaO}_2 < 8\text{kPa}$, $\text{PaCO}_2 > 6\text{kPa}$.
- ◆ In ABG interpretation, first determine the primary acid-base disorder. In an acid-base disorder, the pH can be low (acidosis $\text{pH} < 7.35$), normal (compensated) or high (alkalosis > 7.45). The compensatory mechanism never 'over-compensates'.
- ◆ Metabolic versus respiratory disorder: in a metabolic disorder, the pH changes in the same direction as bicarbonate and PaCO_2 . In a respiratory disorder, the pH changes in the opposite direction to bicarbonate and PaCO_2 .
- ◆ With spirometry testing:

Obstructive disorder: $\text{FEV}_1 \downarrow$ $\text{FVC} \text{ N}$ / $\uparrow$ and FEV_1/FVC ratio $\downarrow$.

Restrictive disorder: $\text{FEV}_1 \downarrow$ $\text{FVC} \downarrow$ and FEV_1/FVC ratio $\text{N} / \uparrow$.

N = normal, $\uparrow$ = increased, $\downarrow$ = decreased.

Station 3.3 Data interpretation: ECG

Information for the candidate

In this station you will need to interpret the ECG of an elderly patient with a history of breathlessness in the past, now presenting for elective surgery.

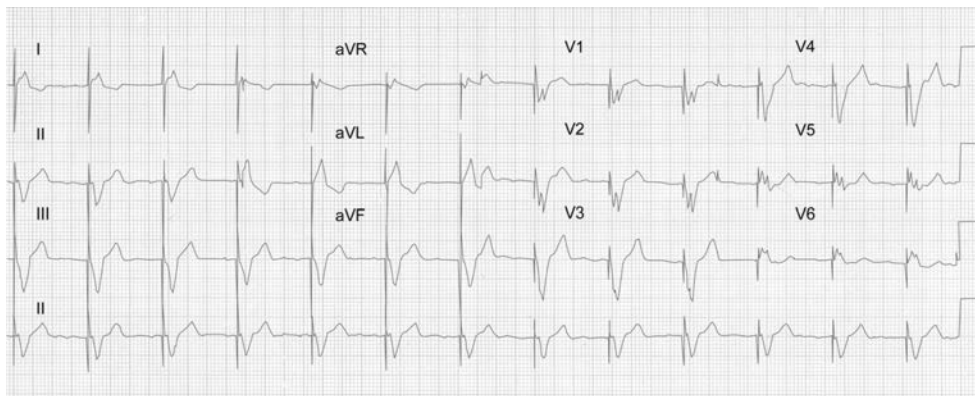


Figure 3.3 ECG.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. The standard speed of recording is 25mm/second.	True	False	2	☐
2. Standard calibration is 1mV = 1cm.	True	False	2	☐
3. The rhythm is sinus.	True	False	2	☐
4. The rate is 100 beats/minute.	True	False	2	☐
5. Left axis deviation is present.	True	False	2	☐
6. The PR interval is within the normal range.	True	False	2	☐
7. The QRS complex is widened.	True	False	2	☐

8. There is a left bundle branch block.	True	False	2	☐
9. T waves are of normal morphology in all the leads.	True	False	2	☐
10. The rhythm is suggestive of atrial pacing.	True	False	2	☐

Total:	/20

Answers

1. True.
2. True. Calibration is 1mV = 10mm = 1cm.
3. False. Pacemaker rhythm.
4. False. 75/minute.
5. True. There is a positive QRS in I and a negative QRS in III and aVF; common in the presence of a pacemaker.
6. False. The P wave is not seen and the pacemaker spike is followed by a QRS complex.
7. True. There is a widened QRS complex.
8. True. It is commonly present with a pacing rhythm.
9. False. Inverted T waves in I and aVL.
10. False. There are no P waves; it is suggestive of ventricular pacing.

Pacemakers

When the electrical activity of the heart is deranged either due to initiation of impulse (e.g. sinus node disorder, severe bradycardia) or due to failure of conduction of impulse (e.g. complete heart block, symptomatic trifascicular block), the mechanical activity of the heart fails, thereby reducing cardiac output. A pacemaker is a device to regulate the electrical activity of the heart.

Temporary pacing can be done by a transcutaneous and transvenous route. Permanent pacing is with an implantable pacemaker where the lead wires are attached to the chambers. Recently, biventricular pacemakers have been introduced. Left ventricular or biventricular pacing can improve systolic function in patients with dilated cardiomyopathy and intraventricular conduction delay by resynchronizing contraction.

When a patient with an implanted pacemaker presents for pre-operative assessment, conduct a routine evaluation with special emphasis on heart disease. About 40% of these patients will have coronary artery disease. The indication for pacemaker placement should be identified. Elicit the history from the patient about symptoms prior to pacemaker insertion and whether similar symptoms have returned now. The recent details of the pacemaker clinic check-up will be valuable. An ECG and X-ray are taken to ascertain electrical activity and structural integrity of the system.

In the given ECG there are no P waves. The most likely underlying reason for pacing is chronic atrial fibrillation with a slow ventricular response.

Pacemaker generic code

The various pacing modes of a pacemaker are described using a 5-letter format:

- ◆ The first letter describes the chamber paced: atrium (A), ventricle (V), dual (D).
- ◆ The second letter describes the chamber sensed: atrium (A), ventricle (V), dual (D).
- ◆ The third letter describes the response to sensing: none (N), triggered (T), inhibited (I), dual (D).
- ◆ The fourth letter describes rate modulation or programmability: rate modulated (R), communicating (C), multiprogrammable (M), simple programmable (P), none (N)
- ◆ The fifth letter describes anti-tachycardia function: paced (P), shocks (S), dual (D).

Key points

- ◆ In a pacemaker rhythm one can notice the pacemaker artefacts or spikes. Depending on the fixed rate or demand rate mode, the spikes can be regular (as it is in this ECG) or sporadic.

- ◆ In atrial pacing, P waves are present followed by the QRS complex. This mode is preferred in sinus node dysfunction with normal AV conduction.
- ◆ Ventricular pacing can successfully maintain resting cardiac output and prevent syncope, yet it does not preserve the physiological relationship between the atrium and ventricle. A ventricular pacing spike is followed by QRS complexes.
- ◆ There is a 10-50% improvement in cardiac output with AV sequential pacing (dual chamber pacing) when compared to ventricular pacing alone.

Station 3.4 Data interpretation: coagulation studies

Information for the candidate

A 35-year-old male patient was involved in a road traffic accident and sustained blunt injury of the abdomen. He underwent laparotomy for splenectomy and repair of a liver tear. 15 units of packed cells and 4 units of fresh frozen plasma (FFP) were transfused. He has just been admitted to ICU and the following are the results of a blood test taken at the end of the procedure.

- ◆ Hb: 6.8g/dl, WCC: $8.5 \times 10^9/L$, platelets: $45 \times 10^9/L$.
- ◆ INR: 3.6, APTT ratio: 3.5, PT: 48 sec.
- ◆ D-Dimers: 5.4mg/L, fibrinogen: 0.3g/L.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. This patient requires further blood transfusion.	True	False	2	☐
2. These blood results do not correspond with the patient's clinical presentation.	True	False	2	☐
3. This patient needs vitamin K.	True	False	2	☐
4. This patient requires a further 4 units of FFP.	True	False	2	☐
5. Platelet transfusion is not necessary.	True	False	2	☐
6. Cryoprecipitate should be given, as his INR is raised.	True	False	2	☐

7. The fibrinogen level is within normal limits.	True	False	2	
8. This patient is likely to be in DIC.	True	False	2	
9. All these abnormalities may be due to excessive administration of colloids in theatre.	True	False	2	
10. This patient is likely to have an acid-base disorder.	True	False	2	

Total:	/20

Answers

1. True. Unless there is chronic compensation, in general, a haemoglobin less than 8g/dl indicates the need for further blood transfusion.
2. False. These clotting derangements can ensue following massive blood transfusion.
3. False. Vitamin K is indicated when there is a clotting abnormality secondary to vitamin K deficiency, as in liver failure.
4. True. Prothrombin time (PT) and activated partial thromboplastin time (APTT) $>1.5 \times$ mean control correlates with increased surgical bleeding.
5. False. Following 1.5×2 blood volume replacement, the platelet count can fall to less than $50 \times 10^9/L$. In post-trauma clinical conditions where there is a high risk of rebleeding, a target platelet count of $100 \times 10^9/L$ is aimed for.
6. False. Cryoprecipitate is given to replace fibrinogen and factor VIII.
7. False. The normal fibrinogen level is 1.5-4g/L.
8. True. Fibrin degradation products (FDP, normally $<5\text{mg/L}$), and D-dimer (normally $<0.5\text{mg/L}$) are elevated in DIC.
9. True. Haemodilution with hydroxyethyl starch solutions and gelatin can impair haemostatic mechanisms.
10. True. Both metabolic acidosis (because of hydrogen ion load) and metabolic alkalosis (due to citrate load) can ensue following massive blood transfusion.

Key points

- ◆ A normal platelet count is $150\text{--}300 \times 10^9/\text{L}$. Although a target count of $>75 \times 10^9/\text{L}$ is acceptable in most clinical situations, following multiple trauma or head injury a count $>100 \times 10^9/\text{L}$ is safe. The dose is 'one adult pack' in adults or 10ml/Kg body weight in children.
- ◆ Aim for PT and APTT $<1.5 \times$ mean control and fibrinogen $>1.0\text{g/L}$. The dose of FFP is 4 units (about 1L) in adults or $10\text{--}15\text{ml/Kg}$ in children.
- ◆ Fibrinogen $<0.5\text{g/L}$ is associated with microvascular bleeding. A low fibrinogen prolongs both PT and APTT. Cryoprecipitate is specific for replacing fibrinogen. The dose is 2 x 5 donation pools for an adult.

(For further reading please refer to the *Handbook of Transfusion Medicine*, 4th ed. McClelland DBL. United Kingdom Blood Services, 2007).

Station 3.5 Anatomy: neck and thorax

Information for the candidate

In this station you will answer questions relevant to the anatomy of the neck and thorax.

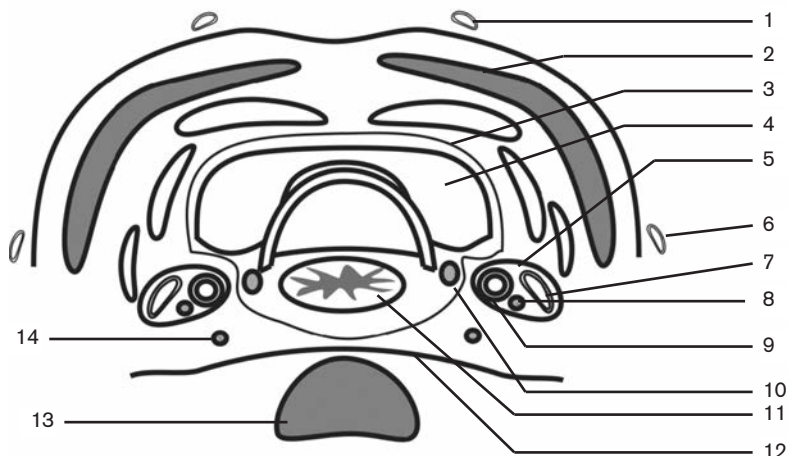


Figure 3.5a Cross-section of the neck.

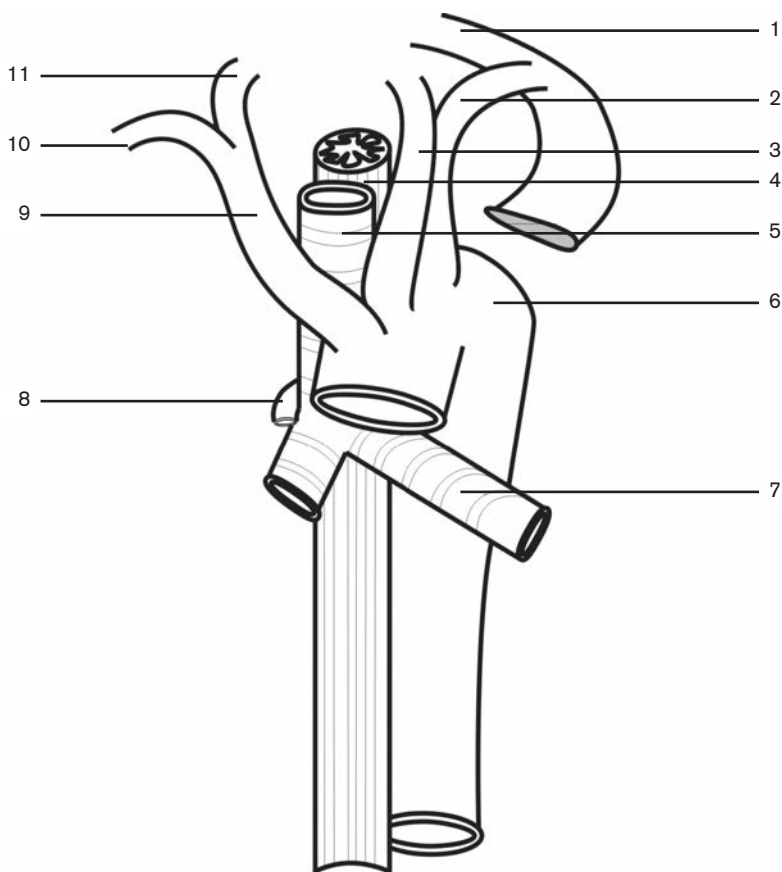


Figure 3.5b Intrathoracic relations of the trachea.

Examiner's mark sheet

marks

Name the structures labelled 1-9 in Figure 3.5a

9

1. Anterior jugular vein.
2. Sternocleidomastoid muscle.

3. Pretracheal fascia.
4. Thyroid gland.
5. Carotid sheath.
6. External jugular vein.
7. Internal jugular vein.
8. Vagus.
9. Carotid artery.
10. Recurrent laryngeal nerve.
11. Oesophagus.
12. Prevertebral fascia.
13. C6 vertebra.
14. Cervical sympathetic chain.

Name the structures labelled 1-8 in Figure 3.5b

8

1. First rib.
2. Left subclavian artery.
3. Left common carotid.
4. Oesophagus.
5. Trachea.
6. Aortic arch.
7. Left main bronchus.
8. Azygos vein.
9. Brachiocephalic artery.
10. Right subclavian artery.
11. Right common carotid artery.

Name three structures encountered during surgical tracheostomy

3

Skin, strap muscles, the isthmus of the thyroid gland, the anterior jugular vein, and the thyroidea ima artery.

Total:	/20

Anatomy relevant to tracheostomy

In the adult, the epiglottis is at the level of C2, the vocal cord is at C4 and the cricoid is at C6. Anterior to the trachea lies the skin, subcutaneous tissue and strap muscles. The isthmus of the thyroid gland crosses the trachea over the second and third tracheal rings. The trachea is formed of semicircular cartilaginous rings anteriorly and laterally. The posterior aspect of the trachea and the spaces between the rings are membranous.

The brachiocephalic trunk crosses from left to right anterior to the trachea at the superior thoracic inlet behind the sternum. Abnormal anatomy of this artery or an aneurysm of the arch of the aorta can pose a life-threatening risk of bleeding if missed during examination prior to tracheostomy. Occasionally, the isthmus of the thyroid is supplied also by the thyroidea ima artery, a branch of the brachiocephalic trunk, the arch of the aorta or the left common carotid artery.

On the left side of the neck the thoracic duct forms an arch about 3-4cm above the clavicle. The vagus nerve, left common carotid artery and internal jugular vein lie anterior to the thoracic duct. The thoracic duct ends by opening into the junction of the left internal jugular vein and subclavian vein.

In adults the trachea is about 10cm long, extending from the larynx to the carina. It commences at the level of the C6 vertebra. The bifurcation of the trachea into main bronchi is located at the level of T4/T5. It comprises 15-20 U-shaped rings; posteriorly the gap is filled with a fibrous membrane.

The inferior thyroid vein (along with the recurrent laryngeal nerve) travels in the tracheo-oesophageal groove. The anterior jugular vein is formed by the confluence of several superficial veins from the submaxillary region. It descends between the anterior border of the sternocleidomastoid muscle and the midline of the neck. Just above the sternum the two anterior jugular veins communicate by a transverse trunk, the venous jugular arch, which receives tributaries from the inferior thyroid veins.

The carotid artery and internal jugular vein run laterally. These structures are vulnerable to injury during tracheostomy if the dissection goes lateral and deep.

Complications of tracheostomy

- ◆ Immediate complications include: bleeding, air embolism, subcutaneous emphysema, tracheostomy tube dislodgement.
- ◆ Delayed complications include: infection, mediastinal sepsis and tube blockage.
- ◆ Late complications include: tracheal stenosis and tracheocutaneous fistula.

Key points

- ◆ In the adult the cricoid cartilage is located at the level of the 6th cervical vertebra.
- ◆ At the level of the thoracic inlet there are highly vascular structures that lie anterior to the trachea.
- ◆ The trachea bifurcates into the main bronchi at the level of T4/T5.

Station 3.6 Communication: postponed surgery

Information for the candidate

In this station you will meet a patient who is scheduled for biopsy of a lesion inside the cheek of the mouth. She has to be cancelled today, because the list is over-running; the previous patient on the list haemorrhaged in the recovery room following radical neck dissection and was taken back to theatre, hence the delay.

Examiner's mark sheet

marks

Introduces him/herself and confirms that he/she is talking to the right person.

2

Expresses sympathy.	2	
Gives an appropriate explanation to alleviate the patient's concern (reason for the cancellation of the operation).	2	
Explains the urgency of the procedure.	2	
Explains that she will have her operation in the near future.	2	
Explains that all measures will be taken to prevent cancellation next time.	2	
Reassures that the delay in the biopsy should not make any impact on the prognosis of the disease.	2	
Reassures that she will be placed first on the list next time.	2	
Advises that the consultant surgeon is still busy in theatre and will talk to her as soon as possible.	2	
Clear communication without medical words.	2	

Total:	/20

Information for the actor

You have been scheduled to have a biopsy of a lump inside the cheek of your mouth. You have been told that there is a possibility of a tumour which will be confirmed only after the biopsy. You are very worried.

Your operation was scheduled for 4pm. It is 6pm now and nobody has told you why there is a delay. You have been starved since this morning. You have a 6-month-old baby at home and with difficulty you have arranged childcare. You are upset when the doctor says that they can't do the operation today.

Your two important concerns are:

- ◆ You are very worried about the lump inside your mouth.
- ◆ You may have great difficulty in re-arranging child care.

Key points

- ◆ Explain that the delay is due to unanticipated complexity of the case in theatre. It is taking longer than originally planned.
- ◆ Reassure that the delay in her surgery by a few days should not cause any adverse outcome.
- ◆ Explain that her surgery will be rescheduled to the next earliest possible slot. Advise that measures will be taken to schedule her first in the list and all steps will be taken to avoid any delays or cancellations then.
- ◆ Apologize for her inconvenience this time and express sympathy.

Station 3.7 Technical skill: tracheostomy tube exchange

Information for the candidate

This patient (manikin) underwent surgical tracheostomy 5 days ago. Now the cuff is leaking and the tracheostomy tube needs to be changed. Currently, the patient is ventilated with a FiO_2 of 0.5.

Examiner's mark sheet

marks

Please change the tracheostomy tube

Ensures the appropriate monitoring: SpO_2 , ECG, EtCO_2 .

2

Checks all equipment: face mask, airway, laryngoscope, ETT, 2
 bougie, Ambu bag, suction.

Alternates source of oxygenation and ventilation. 1

100% oxygen before starting the procedure. 1

Position: neck extension. 1

Checks the new tracheostomy tube. 2

Lubricates the tube. 1

Lubricates and inserts bougie or a tube exchange catheter 2
 through the existing tube.

Removes the tube. 1

Railroads the new tube over the bougie. 1

Inflates the cuff and confirms the ventilation. 1

What will you do if you are not able re-insert the tube? 2

- ◆ Call for help.
- ◆ Oxygenate the patient.

What are the available options to manage the airway? 3

After occluding the tracheostomy hole, the following can be tried:

- ◆ Bag and mask ventilation.
- ◆ Endotracheal intubation.
- ◆ Laryngeal mask airway.

Total:	/20

Tracheostomy tube exchange

Tracheostomy tubes, frequently placed surgically in critically ill patients who require prolonged airway access and ventilatory management, occasionally need to be changed. Attempting to change a fresh tracheostomy tube before maturation of the tracheal cutaneous tract (typically 5-7 days) may result in dissection between tissue planes, creating a false passage and loss of the airway.

The airway exchange catheter may be of benefit when a tracheostomy tube must be changed before maturation of the tracheal cutaneous tract.

- ◆ Ensure minimum mandatory monitoring: ECG, SpO₂, NIBP and EtCO₂.
- ◆ Although there is an existing definitive airway, still prepare for intubation to manage unforeseen difficulties.
- ◆ Check the new tracheostomy tube for cuff leak and lubricate.
- ◆ Check the suction apparatus is available and working.
- ◆ Pre-oxygenate the patient; administer 100% oxygen for about 3 minutes before starting the procedure.
- ◆ Provided there is no contra-indication, extend the neck.
- ◆ A lubricated bougie is inserted through the existing tracheostomy tube, the cuff is deflated and the tube is removed over a bougie.
- ◆ Rail-road the new tube with the bougie *in situ*.
- ◆ Inflate the cuff and confirm position with EtCO₂, chest movements, fiberoptic scope, etc.
- ◆ Airway exchange catheters are available to facilitate oxygenation of the patient during the tube exchange process.
- ◆ Failure with these exchange devices and the danger of losing the tracheostomy tract have been reported. It is prudent to be prepared for a failure to re-insert scenario.

Key points

- ◆ Tracheostomy tube exchange during the first few days after tracheostomy may create a false passage.
- ◆ Pre-oxygenate the patient prior to the procedure.
- ◆ An airway exchange catheter enables oxygenation during the procedure.

Station 3.8 Clinical examination: respiratory system

Information for the candidate

In this station you will be asked to examine the respiratory system of an actor.

Examiner's mark sheet

marks

Introduces him/herself and obtains permission to examine.

1

General observation

- ◆ Appears comfortable, not dyspnoeic/not cyanosed.
- ◆ Respiratory rate.
- ◆ Looks for clubbing and feels for a radial pulse.

2

1

2

Inspection

- ◆ Shape of the chest/deformity/scars.
- ◆ Symmetry of chest movements.

1

1

Palpation

- ◆ Palpates the trachea correctly.
- ◆ Symmetry of movements: both anterior and posterior aspects.
- ◆ Vocal fremitus.

1

2

1

Percussion

- ◆ Anterior, axillary/infra-axillary, posterior.

3

Auscultation

- ◆ Anterior, posterior, bilateral axillary/infra-axillary areas.
- ◆ Vocal resonance.

4 1

Total:	/20

Respiratory system examination

Position

Ideally, patients should be sitting upright or gently semi-reclined. The arms should be in the neutral position during examination of the anterior chest; they should be abducted with both hands placed on the back of the head for examining the axillary and infra-axillary region; and they should be moved forward with the hands holding the opposite shoulders during examination of the posterior chest, so that the scapulae will move away.

The examination comprises a general examination which includes assessment of consciousness, comfort, anaemia, cyanosis, clubbing, pulse, respiratory rate and blood pressure. Specific system examination includes inspection, palpation, percussion and auscultation.

Inspection

Inspect for signs of respiratory distress (shortness of breath, paradoxical breathing, pursing of lips, intercostal/subcostal recession), symmetry of chest movement and tracheal position (pulled towards by collapse, fibrosis, pushed away by pneumothorax, pleural effusion), chest wall deformities (barrel-shaped, kyphosis, scoliosis), scars and sinuses.

Palpation

Confirm the position of the trachea, symmetry of chest expansion (anterior and posterior), areas of tenderness or deformity, and tactile vocal fremitus (by asking the patient to say one, one ... or ninety-nine ...).

Percussion

Percuss for normal resonance, hyper-resonance (pneumothorax, large bulla, emphysema), dullness (consolidation, pleural effusion), and diaphragmatic excursion (find the level of diaphragmatic dullness on both sides. Ask the patient to take a deep breath; the level of dullness should move down by 3-5cm on both sides).

Auscultation

Auscultate normal vesicular breath sounds, wheeze (COAD, asthma), crackles (bronchiectasis, pulmonary oedema), bronchial breath sounds (consolidation, cavity, broncho-pleural fistula), and vocal resonance.

Key points

- ◆ Look for signs of respiratory disease in general observation.
- ◆ Patients with COAD with right heart failure (cor pulmonale) may have peripheral oedema and a raised jugular venous pulse.

Station 3.9 Measuring equipment: temperature measurement

Information for the candidate

In this station your knowledge on equipment and the relevant physics of temperature measurement will be tested.



Figure 3.9.

Examiner's mark sheet

marks

Can you identify the equipment in Figure 3.9?

1 ☐

Tympanic membrane thermometer.

What is the principle behind its function?

2 ☐

It relies on the measurement of infrared radiation. The frequency of infrared light radiated from the tympanic membrane is measured.

What is its advantage?

1 ☐

It is quick and non-invasive.

Are there any disadvantages?

2

In the presence of wax the reading can be erroneous. There is a risk of perforation of the tympanic membrane.

What are the non-electrical methods available to measure temperature?

2

The non-electrical methods include liquid thermometers (mercury and alcohol thermometer) and dial thermometers (bimetallic strip and Bourdon gauge).

Name three other sites to measure temperature

3

Skin, nasopharynx, oesophagus, rectum, bladder, pulmonary artery.

What are the disadvantages of a mercury thermometer?

2

The response time is slow. It can break and there is a possibility of mercury toxicity. It carries the risk of cross-infection.

What electrical methods of measuring temperature are you aware of?

3

Resistance thermometer, thermistor and thermocouple.

What is the physical principle behind the thermocouple?

1

Seebeck effect.

What are thermistors?

2

Thermistors are semiconductors. They are metal oxide beads. As the temperature increases, their resistance decreases exponentially.

Name one disadvantage of the thermistor

1

The calibration is liable to change if it is subjected to severe changes in temperature (as it happens with heat sterilization).

Total: /20

Temperature measurement

Temperature can be measured by electrical means, e.g. resistance thermometer, thermistor and thermocouple or by non-electrical means, e.g. mercury thermometer, alcohol thermometer, bimetallic strip thermometer, Bourdon gauge type thermometer or infrared thermometer.

Mercury and alcohol thermometers work by liquid expansion. The mercury thermometer has a linear scale and is used for higher temperatures. An alcohol thermometer has a less linear scale and is used for measuring lower temperatures (mercury solidifies at -39°C ; alcohol boils at 78.5°C).

Bimetallic strips work on the basis of the differential coefficient of thermal expansion. The Bourdon gauge has a coiled tube containing fluid. Variation in temperature is measured by volume or pressure change of the contained fluid.

In the resistance thermometer, electrical resistance of a metal (e.g. platinum) increases linearly with the temperature. Thermistors are semiconductors made up of metal oxide beads. Here, the resistance falls exponentially as the temperature rises. The Wheatstone bridge circuit is used to measure resistance values.

The Seebeck effect is whereby at a junction of two dissimilar metals a small voltage is produced; the magnitude of this voltage depends on the temperature at the junction.

Key points

- ◆ Temperature can be measured by electrical and non-electrical means.
- ◆ Infrared thermometers measure temperature using black body radiation (generally infrared) emitted from objects.
- ◆ In resistance thermometers, electrical resistance increases linearly with temperature.
- ◆ In thermistors, resistance falls exponentially as the temperature increases.
- ◆ The thermocouple works on the basis of the Seebeck effect.

Station 3.10 Resuscitation: atrial fibrillation

Information for the candidate

You have been called to see a 70-year-old patient who had a hemi-arthroplasty 6 hours ago. He has palpitations and feels dizzy.

Examiner's mark sheet

marks

How would you treat this patient?

3

- ◆ Support ABC; oxygen, IV cannula.
- ◆ Monitor ECG, BP, SpO₂.
- ◆ Record 12-lead ECG.

The ECG shows the following findings (Figure 3.10).

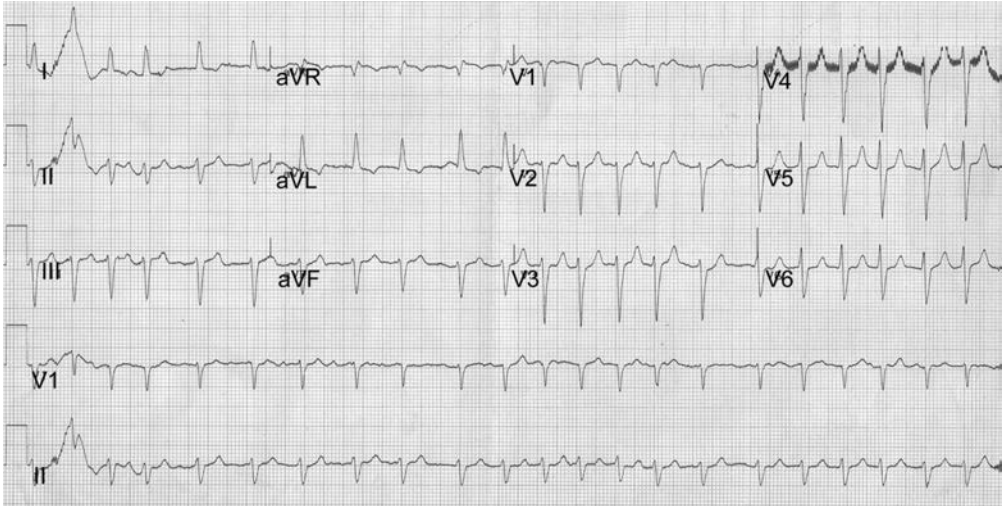


Figure 3.10a ECG.

What does the ECG show?

2

It shows an irregular narrow complex tachycardia, possibly fast atrial fibrillation.

What clinical signs would indicate that this patient is unstable?

4

- ◆ Reduced level of consciousness.
- ◆ Systolic BP <90 mm Hg.
- ◆ Chest pain.
- ◆ Heart failure.

How would you treat the patient considering he is stable?

3

Control heart rate with an intravenous beta blocker or digoxin. If it is of recent onset (<48 hours), which is most likely in this case, consider amiodarone.

How much amiodarone would you give?

2

300mg intravenously over 20-60 minutes followed by 900mg /24 hours.

This patient now deteriorates and has a BP of 70 mmHg and HR 160/minute. How would you treat the patient?

2

Synchronised DC shock up to 3 attempts.

What energy level would you choose?

2

120-150J biphasic or 200J monophasic and increase in increments if further shocks are required.

Now complete the missing part of the advanced life support (ALS) algorithm

2

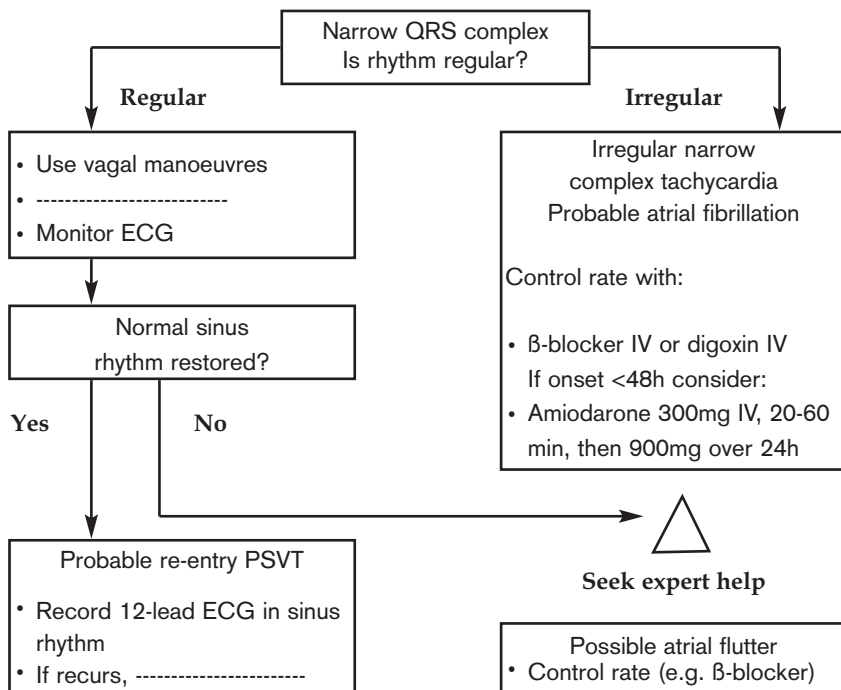


Figure 3.10b ALS algorithm. PSVT: paroxysmal supraventricular tachycardia.

- ◆ If a regular narrow QRS rhythm: adenosine rapid 6mg intravenous bolus; if unsuccessful, give 12mg; if still unsuccessful, give a further 12mg.
- ◆ Probable re-entry paroxysmal supraventricular tachycardia: if it recurs, give adenosine again and consider choice of anti-arrhythmic prophylaxis.

Total:	/20

Narrow complex tachycardia

An irregular narrow-complex tachycardia is most likely to be AF with an uncontrolled ventricular response or, less commonly, atrial flutter with variable AV block. Record a 12-lead ECG to identify the rhythm. If the patient is unstable, with adverse features caused by the arrhythmia, attempt synchronised electrical cardioversion.

If there are no adverse features, treatment options include:

- ◆ Rate control by drug therapy.
- ◆ Rhythm control using drugs to encourage chemical cardioversion.
- ◆ Rhythm control by electrical cardioversion.
- ◆ Treatment to prevent complications (e.g. anticoagulation).

Obtain expert help to determine the most appropriate treatment for the individual patient. The longer a patient remains in AF the greater the likelihood of atrial thrombus developing. In general, patients who have been in AF for more than 48 hours should not be treated by cardioversion (electrical or chemical) until they have been fully anticoagulated for at least three weeks, or unless transoesophageal echocardiography has shown the absence of atrial thrombus.

If the aim is to control heart rate, options include a beta blocker, digoxin, magnesium, or a combination of these. If the duration of AF is less than 48 hours, and rhythm control is considered appropriate, this may be attempted using amiodarone (300mg IV over 20-60 minutes followed by 900mg over 24 hours). Electrical cardioversion remains an option in this setting and will restore sinus rhythm in more patients than chemical cardioversion.

Seek expert help if any patient with AF is known or found to have ventricular pre-excitation (WPW syndrome). Avoid using adenosine, diltiazem, verapamil, or digoxin in patients with pre-excited AF or atrial flutter as these drugs block the AV node and cause a relative increase in pre-excitation.

(For further reading please refer to the European resuscitation guidelines, 2005 - Peri-arrest arrhythmias).

Key points

- ◆ Atrial fibrillation in the ECG presents as irregular narrow complex tachycardia.
- ◆ Cardinal features suggesting decompensation are a reduced level of consciousness, hypotension (systolic pressure less than 90 mmHg), chest pain and heart failure.
- ◆ In stable patients, beta-blockers, digoxin and amiodarone are options.
- ◆ In unstable patients, synchronized DC shock is the treatment of choice.

Station 3.11 Anatomy: trigeminal nerve

Information for the candidate

In this station you will be asked about anatomy of a cranial nerve.

Examiner's mark sheet

marks

Which cranial nerve provides sensory innervation to the face?

1

Fifth cranial (trigeminal) nerve.

Describe the origin of the trigeminal nerve

1

It arises from the ventrolateral surface of the pons. It has a large sensory root and a small motor root.

What is the intracranial course of the roots soon after their origin?

1

About a centimetre after the origin the sensory root passes in a lateral and forward direction to enter Meckel's cave to form its ganglion.

What is the other name for this ganglion?

1

Semilunar or Gasserian ganglion.

Where is this ganglion located and what other structures is it related to?

4

It lies at the apex of the petrous temporal bone (Meckel's cave) and overlaps the foramen lacerum. The motor root of the trigeminal nerve and deep petrosal nerve pass deep to the ganglion. The temporal lobe is above the ganglion; the carotid artery lies medial to the ganglion. The cavernous sinus is posterior to the ganglion.

Name the three divisions of the trigeminal nerve

3

Ophthalmic, maxillary and mandibular.

State the course of the ophthalmic nerve

2

It passes through the superior orbital fissure, providing sensory innervation to the forehead and part of the lateral wall of the nose and septum (anterior and upper part).

What is the course of the maxillary nerve?2 ☐

It exits the middle cranial fossa via the foramen rotundum and enters the pterygo-maxillary fissure. Then it passes through the inferior orbital fissure to enter the orbit. The terminal branch enters the face through the infra-orbital foramen.

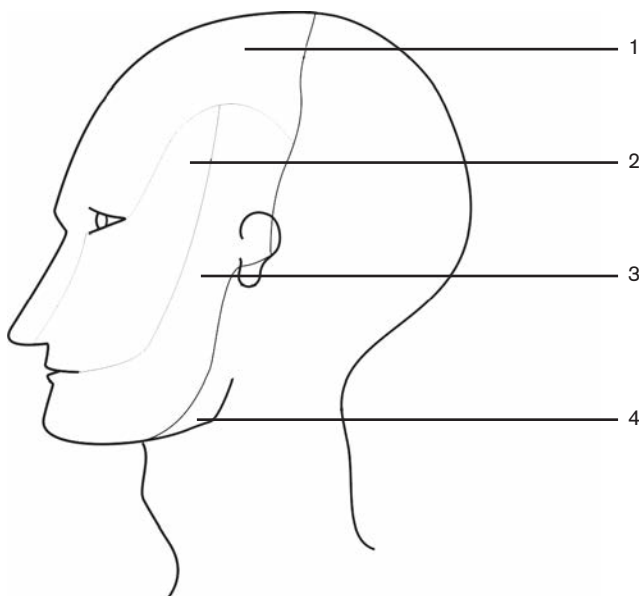
In Figure 3.11 indicate the distribution of the maxillary nerve1 ☐

Figure 3.11 Trigeminal nerve distribution over the face.

1. Ophthalmic division.
2. Maxillary division.
3. Mandibular division.
4. Greater auricular nerve (cervical plexus).

What structures does the maxillary nerve innervate? 2

It is a sensory nerve. It innervates the side of the nose, cheek, upper lip, posterior aspect of the nasal wall and septum, upper teeth and gum, and the palate.

Indicate where the foramen ovale is in the base of the skull (Figure 1.11) 1

What division passes through the foramen ovale? 1

Mandibular nerve.

Total: /20

Trigeminal nerve

The Gasserian ganglion is formed from two roots that exit the ventral surface of the brain stem at the midpontine level. These roots pass in a forward and lateral direction in the posterior cranial fossa. The roots then enter Meckel's cave, a recess, which is formed by an invagination of the dura mater into the middle cranial fossa. The Gasserian ganglion gives rise to three major divisions: the ophthalmic (V1), the maxillary (V2) and mandibular (V3) nerves.

The ophthalmic nerve, apart from providing sensory innervation to the dura and mucosa of the frontal sinus, carries sensory information from the scalp and forehead, the upper eyelid, the conjunctiva and cornea of the eye, the nose (including the tip of the nose), and the nasal mucosa.

The maxillary division is purely a sensory nerve. It exits the middle cranial fossa via the foramen rotundum. Passing through the inferior orbital fissure, it enters the orbit, emerging on the face through the infra-orbital foramen. Apart from providing sensory innervation to the dura and mucosa of the maxillary sinus, the nerve also provides sensory innervation for the

upper teeth and associated oral gingiva, as well as mucous membranes of the cheek. The nasal cavity, lower eye lid, skin of the side of the nose, and the upper lip are also innervated by the maxillary nerve.

The mandibular division has a larger sensory and a smaller motor root. This division leaves the middle cranial fossa via the foramen ovale. Apart from providing sensory innervation to the dura mater and mucosa of the mastoid sinus, the nerve also provides sensory innervation to the skin overlying the muscles of mastication, the tragus and helix of the ear, the chin, the jaw (except the angle of the jaw, which is supplied by C2-3), the dorsal aspect of the anterior two thirds of the tongue and associated mucosa of the oral cavity. The motor branch innervates the muscles of mastication (masseter, temporalis and pterygoid).

Key points

- ◆ The roots of the trigeminal nerve emerge from the midpontine level.
- ◆ The Gasserian ganglion lies in Meckel's cave.
- ◆ The ophthalmic division leaves through the superior orbital fissure, maxillary division through the foramen rotundum and mandibular division through the foramen ovale.
- ◆ The cranial nerve is predominantly sensory in innervation. The mandibular nerve also innervates muscles of mastication.

Station 3.12 History taking: mastectomy

Information for the candidate

A 36-year-old woman has been scheduled to have a mastectomy and reconstruction for carcinoma of her left breast. You will be asked to take a relevant pre-anaesthetic history.

Examiner's mark sheet

		marks
Introduces him/herself and confirms the proposed surgery.	2	
Previous GA for lumpectomy.	1	
Postoperative nausea and vomiting (PONV) after last operation.	1	
Chemotherapy via Hickman line, stopped two months ago.	2	
Now having nausea.	1	
Alopecia due to chemotherapy.	2	
Her sister had a problem with GA; she became very hot during an operation and was admitted to the ICU.	2	
Patient has undergone testing for malignant hyperpyrexia.	1	
Negative for malignant hyperthermia.	1	
Other medical problems: anaemia.	1	
H/O allergy: amoxicillin - skin rash.	2	
Drug history: tamoxifen.	1	
H/O alcohol intake.	1	
Asks about dentures, crowns and caps.	1	
H/O smoking: non-smoker.	1	

Total:	/20

Information for the actor

You had an anaesthetic 3 months ago for removal of a breast lump; you are taking tamoxifen 20mg once daily. Currently, you are not on any other medications. You are allergic to amoxicillin which brings you out in a rash.

Your sister had a problem with an anaesthetic; she became very hot during the operation and subsequently was treated in intensive care for 2 days. You have been tested for malignant hyperthermia, and the test was negative.

Two months ago you underwent chemotherapy for which you had a Hickman line (drip into a big vein in your neck) inserted. Since then you have felt nauseated. Your hair has fallen out. Your red cell count in your blood has dropped. You understand that these are all side effects of chemotherapy.

Key points

- ◆ Follow the order of pre-anaesthetic history taking as described earlier.
- ◆ If the patient is on specific medications, ask about side effects, e.g. in chemotherapy: nausea and vomiting, bone marrow depression, alopecia, infection, etc.
- ◆ While eliciting a history of an allergy to drugs, food or other substances, if the patient gives a positive response, ask further about the nature of the allergic reaction.
- ◆ Even if the patient has had uneventful past anaesthesia, for the sake of completion, do ask about any family history of anaesthesia-related problems.

(For more information please refer to OSCE set 1, station 1.12).

Station 3.13 Simulation: ST depression

Information for the candidate

A 68-year-old male with a history of hypertension and angina is undergoing a hemicolectomy under general anaesthesia. The airway is secured with

an endotracheal tube. General anaesthesia is maintained with oxygen in nitrous oxide and isoflurane.



Figure 3.13a ECG.

Examiner's mark sheet

marks

What does the ECG monitor show?

2

ST depression.

What does that imply?

2

In this patient, in view of the cardiac history, it possibly implies myocardial (subendocardial) ischaemia. ST depression can also be due to other causes such as conduction defects, hypokalaemia, hypothermia and hyperventilation.

How would you manage this suspected intra-operative ischaemia?

1 x 6
=6

- ◆ Correct electrode position and electrode contact.
- ◆ ABC: ensure the endotracheal tube is still in position and that bilateral air entry is equal and adequate.
- ◆ Check the monitor for other parameters: ECG, NIBP, SpO₂, EtCO₂; check ST segment trend.

- ◆ Inform the surgeon - request to stop any surgical stimuli.
- ◆ Call for senior help.
- ◆ If the vital signs are stable and no readily reversible cause is identified, send a blood gas for quick assessment of gas exchange, metabolic and electrolyte status.

The monitor shows a heart rate of 126/minute, a blood pressure of 190/120 mmHg, and a progressive ST segment depression. What would you do?

1 x 4
= 4

- ◆ Increase FIO_2 .
- ◆ Ensure adequate plane of anaesthesia (end-tidal anaesthetic agent concentration; in total intravenous anaesthesia - check for pump, target concentration set and all connections).
- ◆ Ensure analgesia and wearing off from muscle relaxants.
- ◆ Control the ventilation to achieve normocarbida.

Despite the above measures ST segment depression and hypertension persists. Is there any other drug you would consider?

2

Glyceryl trinitrate (sublingual 0.3mg or an intravenous infusion 50mg/50ml of sodium chloride 0.9% - titrate to effect).

Even after optimizing fluid status, balanced anaesthesia and EtCO_2 the heart rate remains high at 140/minute. How would you manage tachycardia?

2

Beta blockade (esmolol: loading dose of 0.5mg/Kg followed by a maintenance dose of 50-150 μg /Kg/minute. Alternatively, metoprolol or labetolol can be used).

How would you manage this patient postoperatively?

2

Further management depends on an obvious reversible cause of ischaemia, severity and duration, associated haemodynamic features and response to treatment. Ideally this patient should be looked after in the HDU. He will require a postoperative 12-lead ECG, surveillance for postoperative myocardial infarction and a cardiologist referral.

Total:	/20

Monitoring ECG

The ECG is a surface recording of the electrical activity of the myocardium. It is recorded by connecting various electrodes through which electrical potentials are measured. The ECG provides information on heart rate, rhythm and some indication of myocardial ischaemia.

The ECG monitoring system consists of the following three components:

- ◆ Skin electrodes detect the electrical activity of the heart.
- ◆ An amplifier to boost the ECG signal.
- ◆ An oscilloscope displays the amplified signal.

The ECG is recorded at a speed of 25mm per second and at a standardisation of 1cm height representing one mV of amplitude. On a standard ECG recording paper, width of a small square (1mm) represents 0.04 seconds and a large square (5mm) 0.2 seconds. Five big squares represent a time scale of 1 second and 300 big squares represent a time scale of 60 seconds or one minute. Hence if the rhythm is regular, heart rate can be calculated by dividing 300 by the number of big squares within one cardiac cycle (between two consecutive R waves).

The ECG lead system

There are 12 conventional leads, 6 in the frontal plane (I, II, III, aVR, aVL, aVF) and 6 in the horizontal plane (V1-V6). The heart is situated in the

centre of the electrical field which it generates. The electrical intensity diminishes as the distance increases from the centre. The lead axes from three standard leads (lead I, II and III) form a triangle known as an Einthoven triangle. In routine practice, monitors with three limb leads are used. Three electrodes are placed as follows:

- ◆ One on the left arm (LA), usually colour coded as yellow.
- ◆ One on the right arm (RA), usually colour coded as red.
- ◆ One on the left leg (LL), usually colour coded as green or black.

For convenience, during intra-operative monitoring a left leg electrode is often placed over the left side of the chest, near the apex beat.

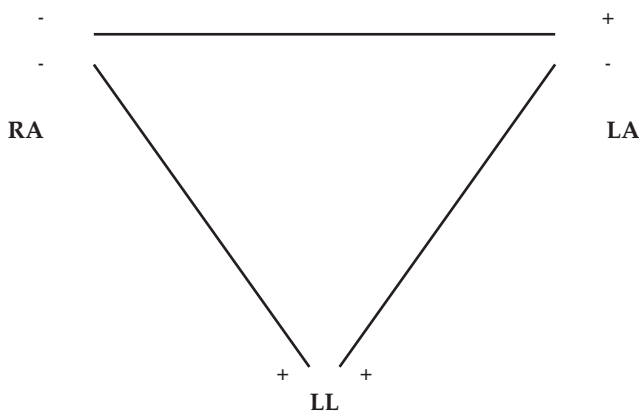


Figure 3.13b Standard lead axes forming the Einthoven triangle.

Lead I measures the potential difference between the right arm electrode and the left arm electrode. Lead II is derived from the negative electrode on the right arm and positive electrode on the left leg, and measures the potential difference between the right arm and left leg electrode. It is usually the best lead for detecting rhythm disturbances. Lead III measures the potential difference between the left arm and left leg. For detecting ischaemic

changes, the ST segment should be monitored in the appropriate leads. The ST segment changes in leads V1-V4 usually monitor the left anterior descending artery territory, V4-V6 the circumflex artery and leads II, III and aVF monitor the right coronary artery territory. When only bipolar leads are used then a modified V5 lead may be used for detecting ischaemia.

CM5 is a modified V5 lead where the right arm electrode of lead I is placed over the manubrium sternum, the left arm electrode is placed over the left anterior axillary line in the 5th intercostal space and a ground electrode is placed on the left shoulder. Electrode positions are shown in Table 3.13.

Table 3.13 Electrode positions for limb leads, augmented leads and a modified CM5 lead.

Lead	RA	LA	LL
I	RA (negative)	LA (positive)	ground
II	RA (negative)	ground	LL (positive)
III	Ground	LA (negative)	LL (positive)
aVR	RA	ground	ground
aVL	ground	LA	ground
aVF	ground	ground	LL
CM5	manubrium	V5	ground

RA = right arm, LA = left arm, LL = left leg

In a normal ECG, the P wave represents atrial depolarisation, the QRS complex represents ventricular depolarisation and the T wave represents ventricular repolarisation. The P-R interval represents the time taken for the depolarisation to travel from the sino-atrial (SA) node to the ventricles (via the AV node and bundle of His/Purkinje system). The QRS duration represents the time taken for depolarisation to travel through the bundle of His/Purkinje system and ventricular muscles.

- ◆ A normal P-R interval is 0.12-0.2 seconds.
- ◆ A normal QRS duration is less than or equal to 0.1 seconds.

- ◆ ST segment depression of more than 2mm represents myocardial ischaemia. The ST segment is elevated in myocardial infarction or myocarditis.

Peri-operative myocardial ischaemia

- ◆ Peri-operative prolonged myocardial ischaemia is associated with adverse cardiac events. Hence, the real time detection of ischaemia allows early therapeutic intervention for a better outcome.
- ◆ For ST segment changes, V5 (or modified versions, e.g. CM5) is chosen. Ensure good electrode position, contact and observe the baseline ST segment position. ST segment changes are the most specific in detecting ischaemic manifestations.
- ◆ Subendocardial ischaemia manifests as ST depression and transmural ischaemia as ST elevation. Apart from myocardial ischaemia and infarction, other causes for ST segment changes include: change in electrode position/contact, conduction defects, digitalis, hypoglycaemia, electrolyte disturbances, hypothermia and hyperventilation.
- ◆ Tachycardia increases myocardial oxygen demand and decreases myocardial oxygen supply. To manage tachycardia, first, treat the common causes such as hypovolaemia, depth of anaesthesia, hypercapnia, etc. Then consider beta blockade. If beta blockade is contra-indicated, calcium channel blockers, such as verapamil, can be used.
- ◆ Once ST depression is noted, identification of the readily reversible causes and management goes hand in hand. Airway (including reconfirmation of endotracheal or other airway position), breathing (including adequacy of ventilation and oxygenation) and circulation (including heart rate, blood pressure, volume and haemoglobin control) should be checked.
- ◆ If ischaemia is associated with hypotension, initially address the treatable causes (fluid, depth of anaesthesia, surgical manipulation, etc). Then consider the judicious use of vasopressors: ephedrine if the heart rate is low or metaraminol/phenylephrine if the heart rate is normal or high.
- ◆ If ischaemia is associated with hypertension, initially address the treatable causes (analgesia, depth of anaesthesia, hypercapnia). Then, treat with the judicious use of glyceryl trinitrate and other antihypertensives.

- ◆ In persistent myocardial ischaemia with haemodynamic instability, more invasive monitoring such as CVP measurement and trans-oesophageal Doppler/echocardiography may be indicated.

Key points

- ◆ ST segment depression implies myocardial (subendocardial) ischaemia.
- ◆ Tachycardia increases myocardial oxygen demand and decreases myocardial oxygen supply.
- ◆ The goal of treating peri-operative myocardial ischaemia involves optimising myocardial oxygen demand and supply.
- ◆ Postoperative monitoring in the HDU and surveillance for cardiac events is advocated.

Station 3.14 Monitoring equipment: pulse oximeter

Information for the candidate

In this station you will be asked about the physics and practical applications of a pulse oximeter.

Examiner's mark sheet

marks

What are the components of the pulse oximeter?

3

It has a probe and a microprocessor unit. The probe has two light-emitting diodes (LEDs). The light passes through blood and other tissues and is detected by a photodetector. The microprocessor unit displays the waveform, oxygen saturation and the pulse rate.

What are the two wavelengths of the source of light?

2

660nm (visible red spectrum) and 940nm (infra-red spectrum).

In Figure 3.14 what do A and B represent?

2

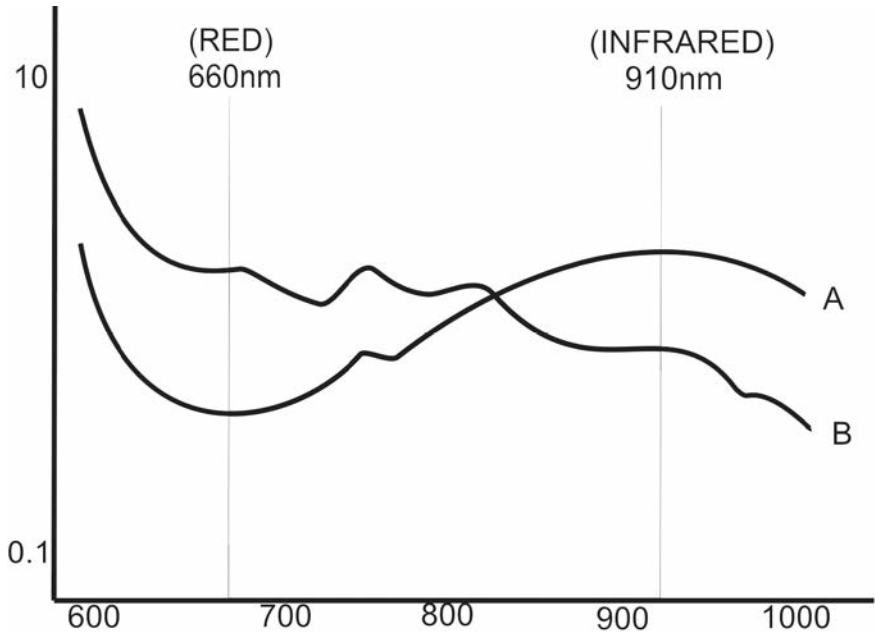


Figure 3.14 Absorbance spectrum.

A represents the oxyhaemoglobin absorbance spectrum. B represents the reduced haemoglobin absorbance spectrum.

What is the name of the point where the absorbance for the two forms of haemoglobin meet?

1

Isobestic point.

What is the principle of a pulse oximeter?

2

Spectrophotometry. Oxygenated haemoglobin absorbs more infrared light and allows more red light to pass through. Deoxygenated haemoglobin absorbs more red light and allows more infrared light to pass through.

What are Beer's law and Lambert's law?

2

- ◆ Beer's law states that the absorption of radiation by a solution is proportional to the concentration of the substance.
- ◆ Lambert's law states that the absorption of radiation by a solution is proportional to the thickness of the absorbing layer.

At what range of oxygen saturation does the pulse oximeter maintain reasonable accuracy?

1

70-100%.

Give four situations where pulse oximeter readings may not be accurate

4

- ◆ Peripheral vasoconstriction (hypotension, shock, peripheral vascular disease).
- ◆ Abnormal haemoglobins (carboxyhaemoglobin, methaemoglobin).
- ◆ Venous pulsation (as in tricuspid regurgitation) and venous congestion.
- ◆ External disturbances such as bright lights, diathermy and shivering.

Does anaemia affect the accuracy of pulse oximetry?

1

☐

No.

How is the 'background noise' such as that due to bright external lights eliminated?

2

☐

By time division multiplexing. Instead of the constant emission of red and infrared lights, they are cycled on and off several times every second. This helps to eliminate disturbance from bright ambient lights such as that from operating room lamps.

Total:	/20

Pulse oximeter

The pulse oximeter works on the basis of spectrophotometry. The physics of the pulse oximeter is described by Beer-Lambert's law. Beer's law refers to the concentration of the substance involved and Lambert's law refers to the thickness of the substance involved. The combined law states that the amount of light absorbed by the solution is directly proportional to the molar concentration and thickness of the solution. In the pulse oximeter, the red and infrared light absorbed by blood depends on the quantities of deoxyhaemoglobin and oxyhaemoglobin present.

One side of the probe has 2 light emitting diodes, one for red (660nm) and another for infrared (940nm). The diodes switch on and off several hundred times a second in sequence with a pause. The pause period is to detect ambient light and compensate for it. The other side of the probe has a photodetector. Light is absorbed by pulsatile arterial blood, as well as non-pulsatile venous blood and other tissues. The microprocessor differentiates light absorbed from these two components.

A co-oximeter is a spectrophotometer that uses four different wavelengths. It can measure total haemoglobin, oxyhaemoglobin, carboxyhaemoglobin

and methaemoglobin. But unlike pulse oximeters, they are not suitable for providing continuous saturation monitoring.

Key points

- ◆ Pulse oximeters measure the oxygen saturation of haemoglobin in arterial blood. The pulse rate, in beats per minute, and saturation values are averaged over 5 to 20 seconds.
- ◆ Anaemia does not appear to affect the accuracy of pulse oximetry. However, in patients with sickle cell anaemia presenting with a vaso-occlusive crisis, a pulse oximeter can be erroneous.
- ◆ Severe hyperbilirubinaemia does not affect the accuracy of pulse oximetry.
- ◆ The presence of carboxyhaemoglobin leads to over-estimation of saturation by the oximeter.
- ◆ In the presence of methaemoglobin the reading is towards 85%, regardless of actual saturation.

Station 3.15 Clinical safety: administration of blood to a patient

Information for the candidate

In this clinical safety station you should demonstrate knowledge of the precautions needed to be taken prior to blood and blood product transfusion to avoid adverse reactions.

Examiner's mark sheet

marks

Can you please transfuse this blood to Mrs K?

Checks the wrist band

2 ☐

Patient details: name, date of birth, hospital number.

Checks the cross-match report form2

Patient details, blood group and unit number.

Checks the blood bag3

- ◆ Patient details.
- ◆ Blood group.
- ◆ Unit number.
- ◆ Expiry date.
- ◆ Volume of blood.

What would you record on the cross-match form?1

Date and time blood administered and signature.

What parameters would you monitor during transfusion?3

Pulse, blood pressure and temperature.

During general anaesthesia how would you recognise a transfusion reaction in this patient?2

Rash, tachycardia, hypotension, a rise in temperature, bronchospasm.

How would you manage a transfusion reaction?5

- ◆ Stop transfusing.
- ◆ ABC, 100% oxygen, supportive measures, vasopressors.
- ◆ Notify surgeon and call for help.
- ◆ Double check the blood; send remaining blood in the bag to the blood bank.
- ◆ Steroids.
- ◆ Monitor urine output and check for haemoglobinuria; if present, proceed to diuresis with mannitol.

What are the indications for cryoprecipitate?2

- ◆ Fibrinogen level less than 1g/L: hypofibrinogenaemia.
- ◆ Disseminated intravascular coagulation.
- ◆ Liver disease.

Total:	/20

Blood transfusion

Transfusion of ABO-incompatible blood is most commonly due to errors in taking or labelling the sample, collecting the wrong blood from the fridge, or failure to carry out the required checks immediately before transfusion. Collecting the wrong blood component from the fridge is one of the most common causes for incorrect transfusion.

These checks should be as follows:

- ◆ Once the blood component from the blood bank has arrived, take a form with the patient's identification details. Match these with the label on the blood component: first name, surname, date of birth, patient identification number; check the compatibility label or tie-on tag against the patient's wristband.
- ◆ Check that the blood group and donation number on the compatibility label are identical to the blood group and donation number on the blood component label.
- ◆ Check the expiry date and inspect the pack for any signs of discoloration, clumping, leaks, etc.
- ◆ Sign the form to confirm that pre-transfusion checks have been completed and record the date and time for the start and completion of each unit transfused.

Acute life-threatening complications of transfusion are: acute haemolytic transfusion reaction, reaction to infusion of a bacterially contaminated unit, transfusion-related acute lung injury (TRALI), acute fluid overload and severe allergic reaction or anaphylaxis.

If red cells are mistakenly administered to the wrong patient, the chance of ABO incompatibility is about one in three. The reaction is more severe if group A cells are transfused to group O patients.

Acute haemolysis may also occur following infusion of plasma-rich components, usually platelets or FFP, containing a high titre of anti-red cell antibodies, usually anti A or B.

If the patient is under anaesthesia or unconscious, the first sign of a reaction may be bleeding, tachycardia, hypotension or hypertension.

Once an acute transfusion reaction is suspected, immediately stop the transfusion, resuscitate with crystalloids, monitor urine output and consider vasopressors/inotropes. Take a blood culture and samples for culture from the component pack and inform the blood bank. Seek urgent critical care and haematology advice. In severe reactions, the patient should be transferred to ICU/HDU for further management.

(For further reading please refer to the *Handbook of Transfusion Medicine*, 4th ed. Mclelland DBL. United Kingdom Blood Services, 2007).

Key points

- ◆ Transfusion of the wrong blood product is the most common cause for ABO incompatibility.
- ◆ Check the wrist band, cross-match report form and blood bag.
- ◆ Record that the blood has been checked and document the date and time of administration.

Station 3.16 Radiology: CT scan of the head

Information for the candidate

In this station you will be asked to interpret the findings on CT scans of patients in a neurosurgical unit.



Figure 3.16a CT scan of the head.

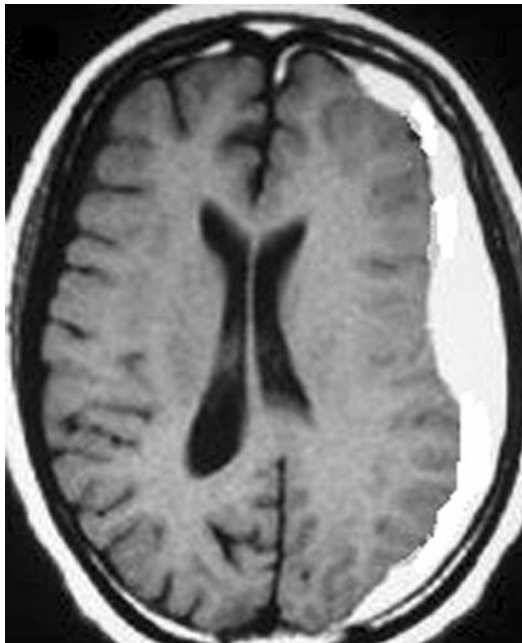


Figure 3.16b CT scan of the head.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

In Figure 3.16a, the CT scan of the head belongs to a middle-aged man admitted to the neurosurgical unit for observation following head injury.

1. The findings are suggestive of an extradural haematoma.	True	False	2	☐
2. Extradural haematoma is usually due to arterial bleeding.	True	False	2	☐
3. Dexamethasone has an important role in the management of this patient.	True	False	2	☐
4. It may present following a lucid interval.	True	False	2	☐
5. The haematoma is temporo-parietal in location.	True	False	2	☐

In Figure 3.16b, the CT scan of the head belongs to a female admitted to the neurosurgical unit with left-sided weakness. Her past medical history includes atrial fibrillation for which she was on aspirin and warfarin.

6. The scan shows a subdural haematoma.	True	False	2	☐
7. This patient may present with ipsilateral pupil dilatation.	True	False	2	☐
8. There are findings suggestive of an increase in intracranial tension.	True	False	2	☐
9. This presentation is more common in younger patients.	True	False	2	☐
10. Haematoma is from venous bleeding.	True	False	2	☐

Total:	/20

Answers

1. True.
2. True. The middle meningeal artery is commonly involved.
3. False. Dexamethasone is used in oedema associated with brain tumours.

4. True.
5. True.
6. True.
7. True.
8. True. There is a midline shift towards the right.
9. False. Common in the elderly.
10. True.

Haematomas

Extradural haematomas arise between the dura and the inner table of the skull. As the attachment between the dura and skull is strong, the haematoma is confined with a well defined margin and has a characteristic biconvex shape. It is usually temporo-parietal in location and commonly results from injury to the middle meningeal artery or its branches. There may be an associated fracture of the adjacent temporal bone. Often there is a history of head injury. Symptoms of extradural haematomas usually develop within minutes to several hours after the injury and consist of increasing headache, a decreased level of consciousness, hemiparesis, and pupillary dilation with loss of light reactivity. Patients may present with primary obtunded consciousness or following a lucid interval.

Subdural haematomas arise between the dura and arachnoid mater. The ruptured veins crossing this space contribute to the haematoma. Subdural haematomas are common in old age as atrophy of the brain enlarges the space. Unlike extradural haematomas, subdural haematomas spread widely in the space and have a crescent-shaped appearance with an irregular inner margin. They are associated with more severe high velocity trauma with a poor outcome.

Other than trauma, the risk factors for a chronic subdural haematoma include chronic alcoholism, epilepsy, coagulopathy, arachnoid cysts, anticoagulant therapy, hypertension, thrombocytopenia and diabetes.

In acute subdural haematomas, blood clot on the CT scan appears as a high attenuation (bright) area. In chronic subdural haematomas, the patient presents with a progressive neurological deficit, more than two weeks

after the trauma. In chronic subdural haematomas, the clotted blood liquefies and appears as an isodense or hypodense (dark) area.

Key points

- ◆ Extradural haematomas commonly result from injury to the middle meningeal artery.
- ◆ On a CT scan, extradural haematomas have a characteristic biconvex shape.
- ◆ On a CT scan, acute subdural haematomas appear as a crescent-shaped hyperdense area.
- ◆ On a CT scan, chronic subdural haematomas may appear as an isodense or hypodense area.

Station 3.17 History taking: hernia repair

Information for the candidate

You are the anaesthetist allocated for a day-unit surgical list. You will be asked to take a 5-minute history as part of a pre-anaesthetic visit from a 60-year-old male patient. He is scheduled to have a hernia repair on your day-case list.

Examiner's mark sheet

marks

Introduces him/herself to the patient, confirms that he/she is talking to the right person and confirms the proposed surgery. 2

Previous anaesthetic history: appendicectomy. 1

Asks about cardiovascular disease

Chest pain: no. 1

Light-headedness/syncope/dizzy spells. 2

Shortness of breath on exertion. 1

Exercise tolerance (walks for half a mile, one flight of stairs). 2

Previous hospital admission for blackout. 1

Details of treatment for blackout (includes pacemaker). 2

Asks for the pacemaker card/details.	1	
Specifically asks for where and when recently tested.	2	
Hypertension.	1	
H/O smoking: 10 cigarettes a day.	1	
Smoker's cough.	1	
H/O alcohol intake: bottle of wine at weekends.	1	
H/O heartburn/reflux.	1	
Total:		/20

Information for the actor

You are 60 years old. You have been waiting for a hernia operation (lump in your left groin) for the past 2 years. You are scheduled to have the operation today. You will be interviewed by an anaesthetist. You are concerned that the hernia has started aching recently. You are hoping that it will be sorted out today.

Five years ago, following severe dizziness, you were admitted to hospital. As the heart was beating too slowly, a heart specialist inserted a pacemaker. Since then you never had any trouble with your heart, although you also have high blood pressure. You can walk for about half a mile before feeling short of breath. You live in a house and manage to climb upstairs at your own pace.

Your pacemaker was checked a year ago. You have smoked 10 cigarettes per day for the past 20 or more years. Consequently, you cough every morning and bring up some white phlegm.

When you were young you underwent an appendix operation with an uneventful general anaesthetic.

Key points

- ◆ Elicit the history of dizziness and ask for the details on investigations or treatment.
- ◆ Establish the reason for inserting the pacemaker.
- ◆ To ensure that the pacemaker is functioning normally, ask about regular follow-up checks.

(For more information please refer to OSCE set 1, station 1.12).

Station 3.18 Anaesthetic equipment: entonox valve

Information for the candidate

This is a station on physics and equipment used in anaesthetic practice.



Figure 3.18.

Examiner's mark sheet

marks

Identify this equipment

1

Entonox valve.

What is the pressure in the entonox cylinder?

1

137 bar (13700 kPa).

State how entonox is formed

2

Oxygen gas is bubbled through liquid nitrous oxide; during the process nitrous oxide vaporises and a gaseous mixture is formed.

What is the critical temperature of the gas mixture in this cylinder?

1

The critical temperature of the mixture is decreased to -7°C (pseudocritical temperature); below this temperature liquefaction and separation of the two components occur.

What is the Poynting effect?

1

The effect describes the process of dissolving oxygen in nitrous oxide liquid. The gaseous oxygen is bubbled through the liquid nitrous oxide. Liquid nitrous oxide vaporises to form a gaseous oxygen-nitrous oxide mixture. This is called the Poynting effect. The critical temperature and pressure of a gas may be affected when it is mixed with another gas. In a cylinder of entonox, the new critical temperature of the mixture (known as the pseudocritical temperature) changes to approximately -5.5 to -7°C .

What would the problem be of storing the cylinder at a very low temperature, e.g. -10°C ?

2

The gases separate; initially a high concentration of oxygen is delivered and later a high concentration of nitrous oxide is delivered.

At what temperature would these gases separate in a pipe line at 4 bar?

1

Even lower; -30°C .

What precautions should be taken during storage of this cylinder? 2 ☐

It should be stored horizontally, at a temperature above 5°C for 24 hours before use. (The purpose of the horizontal position is to enhance the area for diffusion. Alternatively, the cylinder can be used before 24 hours by repeated inversion).

How does this pressure relief valve differ from others? 2 ☐

It is a two-stage pressure demand regulator valve. The first one is a pressure-reducing valve and the second one is a demand valve which allows gas to flow when the pressure is reduced below atmospheric level.

Name some clinical uses of entonox 2 ☐

Labour analgesia, pain relief in casualty (ureteric colic, sickle crisis, prehospital analgesia), wound dressing in burns.

What advice would you give for its use during labour? 2 ☐

It takes about 30 seconds to act and the analgesic effect lasts for 60 seconds after discontinuing. The mother should inhale when the contraction begins, to ensure the peak effect at the height of the contraction.

What are the contra-indications for its use? 2 ☐

Bowel obstruction, pneumothorax, intracranial air (early postoperative period following craniotomy), and vitamin B12 deficiency (as prolonged use can cause bone marrow suppression).

What is the maximum recommended concentration of nitrous oxide in the theatre atmosphere? 1

25 ppm.

Total: /20

Entonox

Entonox is 50% oxygen and 50% nitrous oxide by volume. The mixture is prepared by bubbling oxygen through liquid nitrous oxide. The cylinders are coloured blue with blue-white quartered shoulders. They are supplied at a pressure of 137 bar.

The critical temperature is the temperature above which a gas cannot be liquefied, however much pressure is applied. The critical pressure is the minimum pressure that causes liquefaction at a critical temperature. The critical temperature of oxygen is -18°C and of nitrous oxide is 36.5°C . The pseudocritical temperature is the temperature at which the gas mixture separates into their component parts. For an entonox cylinder (at 137 bar) this is -7°C ; for an entonox pipeline (at 4 bar) it is -30°C . Hence, the cylinders must be stored above the pseudocritical temperature (-7°C) to prevent liquefaction of nitrous oxide. As the gases separate, initially an oxygen-rich mixture will be delivered followed by nitrous oxide rich gas. Warming and thorough mixing of the constituents can avoid this problem.

Entonox is useful in labour analgesia, during a change of dressings for burns and other minor procedures. As nitrous oxide can quickly occupy and enlarge air-containing cavities, it should be avoided in the presence of a pneumothorax, bowel obstruction, etc. Prolonged use of entonox is not encouraged in view of the effect of nitrous oxide on the methionine synthase system and on bone marrow.

Key points

- ◆ Entonox is a compressed gas mixture containing 50% oxygen and 50% nitrous oxide by volume.
- ◆ The valve for entonox is a special two-staged pressure demand regulator.
- ◆ Below the pseudocritical temperature, liquefaction of nitrous oxide and separation of the two components can occur.
- ◆ Fast onset and short duration of action has made it popular for short-term pain relief. It is not recommended for prolonged use.

Station 3.19 Technical skill: intra-osseous infusion

Information for the candidate

In this station your technical skill on using an intra-osseous needle will be tested.

Examiner's mark sheet

marks

What is the indication for intra-osseous infusion of fluids?

2

In children under the age of approximately 6 years, when venous access is difficult (more than 3 attempts), the intra-osseous route is an option for resuscitation.

Can you demonstrate how you would perform intra-osseous puncture?

1 x 8
=8

- ◆ Checks appropriate needle (intra-osseous needle or bone marrow aspiration needle).
- ◆ Position: sufficient padding under the knee and about 30° flexion of the knee.

- ◆ Puncture site: anteromedial surface of the proximal tibia; one fingerbreadth below the tibial tubercle.
- ◆ Local anaesthetic to the puncture site.
- ◆ Needle insertion: initially inserts the needle at 90° to skin; after approaching the bone redirects the needle 45° to 60° caudally.
- ◆ Uses a twisting motion to enter the bone marrow.
- ◆ Removes the stylet and attaches the needle to a 10ml syringe.
- ◆ Aspirates bone marrow and injects saline.

Why should the needle be directed caudally?

1

This direction is to avoid the epiphyseal growth plate.

How would you confirm the correct placement of the needle?

3

- ◆ Aspiration of bone marrow.
- ◆ Needle is firm and remains upright.
- ◆ On injecting saline, there is no resistance and no evidence of swelling.

What are the complications?

4

- ◆ Subcutaneous and subperiosteal infusion.
- ◆ Epiphyseal plate injury.
- ◆ Haematoma.
- ◆ Infection.
- ◆ Pressure necrosis of the skin.

State two relative contra-indications for intra-osseous infusion

2

- ◆ Fracture of the involved bone.
- ◆ Osteomyelitis.

Total: /20

Intra-osseous infusion

Intra-osseous infusion is one of the quickest ways to establish access for the rapid infusion of fluids, drugs and blood products in emergency situations as well as for resuscitation. It is popular in paediatric resuscitation. The marrow cavity is in continuity with the venous circulation and can therefore be used to infuse fluids and drugs, and to take blood samples for cross-match. Placement of an intra-osseous needle is indicated when vascular access is needed in life-threatening situations in infants and children under the age of 6 years. It is indicated when attempts at venous access fail (3 futile attempts or more than 90 seconds). Although principally advocated for use in young children, it has been successfully used in older children where the iliac crest may also be used. It is advised not to use the technique in a fractured bone and in the presence of osteomyelitis.

An intra-osseous infusion needle or bone marrow needle is used to access the space. Although there are different needle sizes, 14 and 16G are generally used. The best site to use is the flat anteromedial aspect of the tibia. The anterior aspect of the femur and the superior iliac crest can also be used. The tibia is preferred since the anteromedial aspect of the bone lies just under the skin and is easily identified.

To perform the technique, palpate the tibial tuberosity. The site for cannulation lies 1-3cm below this tuberosity on the anteromedial surface of the tibia. Take all aseptic precautions. If the child is awake, inject local anaesthetic in the skin and infiltrate down to the periosteum. Flex the knee and have a support behind the knee. Insert the intra-osseous needle at 90° to the skin (perpendicular) and slightly caudal to avoid the epiphysial growth plate. Advance the needle using a drilling motion. Feeling a 'give' implies penetration of the cortex of the bone. Remove the trochar and confirm the position by aspirating blood. Inject saline 0.9% to ensure there is no resistance and there is no local swelling. The needle is secured in place with a sterile dressing.

Notable complications are tibial fracture, haematoma, osteomyelitis and skin necrosis. The longer the needle is left in place, the higher the risks will be. But, in general, it is a safe and life-saving technique. Fluids can be

infused manually by injecting through a 50ml syringe or through a pressurised infusion bag.

Key points

- ◆ Intra-osseous infusion is a life-saving temporary emergency measure.
- ◆ It is indicated in emergency situations when intravenous access fails.
- ◆ Use an aseptic technique.
- ◆ The anteromedial aspect of the upper tibia is often used.
- ◆ The port can be used to aspirate blood for investigations and to infuse fluids for resuscitation.
- ◆ Complication rates are low if aseptic precautions are taken, but remove it as soon as possible once definitive venous access is secured.

Station 3.20 Technical skill: intravenous regional anaesthesia

Information for the candidate

A 60-year-old female patient is scheduled for manipulation of a Colles' fracture of the left wrist. You will be asked to describe the steps in performing Bier's block (intravenous regional anaesthesia).

Examiner's mark sheet

	<i>marks</i>
Rules out contra-indications for Bier's block (allergy to drugs local anaesthetics, sickle cell disease).	2
Ensures that resuscitation facilities are available (airway equipment, drugs).	2
Monitors ECG, SpO ₂ , NIBP.	2

Inserts the intravenous cannula in the opposite arm.	2	
Inserts the cannula in the same arm.	2	
Measures baseline blood pressure.	2	
Exsanguinates the arm.	2	
Inflates the tourniquet to a pressure 100mmHg above systolic blood pressure.	2	
Injects the calculated amount of local anaesthetic (prilocaine or lidocaine).	2	
Deflates the tourniquet only after 20 minutes at least.	2	

Total:	/20

Intravenous regional anaesthesia (IVRA)

IVRA is indicated for any procedure on the upper limb below the elbow or lower limb below the knee that can be completed within 45-60 minutes. With this technique the onset of anaesthesia is rapid. The technique is best avoided if a tourniquet cannot be used safely, as in vascular insufficiency and sickle cell disease. As with all other local anaesthetic blocks, resuscitation equipment should be immediately available.

The recommended drug for IVRA is prilocaine, as among the local anaesthetics it has minimal toxicity and a high therapeutic index. Lidocaine is an acceptable alternative. Adrenaline should not be added. Bupivacaine is not suitable in view of cardiotoxicity. A suitable dose to use in an arm is about 40ml of 0.5% prilocaine or 0.5% lidocaine. The maximum recommended dose for prilocaine is 3-6mg/Kg and it is 3mg/Kg for lidocaine.

Prior to performing the block, the patient's baseline blood pressure is measured. Intravenous cannulae are secured, one for the block and another one for vascular access in case of any complication. Vital signs are monitored. The tourniquet is then applied to the upper arm or thigh over a layer of cotton roll. Exsanguination of blood from the limb prior to inflation of the tourniquet aids in a better block. This is done with an Esmarch rubber bandage or by simple elevation of the limb with the corresponding artery compressed. The tourniquet is then inflated to a pressure of 50-100 mm Hg above the systolic blood pressure.

After about 5-10 minutes, patients may start experiencing tourniquet pain due to pressure from the tourniquet. This may be avoided by using a double tourniquet technique. In this method two tourniquets are placed on the patient's arm or thigh. Initially, the more proximal (upper) tourniquet is inflated and the local anaesthetic is injected. After about 5 minutes, the distal (lower) tourniquet is inflated (over the numb area) and then the proximal one is deflated.

When used with routine precautions, IVRA is a safe technique with few complications. The most important complication is the risk of local anaesthetic toxicity in the event of inadvertent deflation of the tourniquet soon after the local anaesthetic has been injected. These will range from light-headedness and tinnitus to muscle twitching, loss of consciousness and convulsions. Serious cardiac side effects are rare.

Key points

- ◆ Ensure the patient is fasted and other routine pre-anaesthetic assessments are performed.
- ◆ Ensure a minimum standard monitoring.
- ◆ Resuscitation drugs and equipment should be prepared.
- ◆ The double-tourniquet technique helps to minimise tourniquet pain.
- ◆ Prilocaine 0.5% or lidocaine 0.5% are commonly used.
- ◆ It is a safe technique provided the correct dose of local anaesthetic is used, tourniquet pressure is carefully monitored and resuscitation equipment is immediately available.

OSCE

set 4

Station 4.1 Anaesthetic equipment: Bain breathing system

Information for the candidate

You are performing an anaesthetic machine check, as you do routinely at the beginning of a list. In this station you will be asked to assemble all the components of a breathing system and to check the system to ensure that it is safe to use.



Figure 4.1a Components of a breathing system.

Examiner's mark sheet

	marks
Connects all the components correctly.	3
Connects the proximal end to the common gas outlet.	1
Visually inspects the outer tubing.	1
Sets the fresh gas flow (FGF) on the anaesthetic machine at 5L/minute.	1
Confirms the flow into the system by occluding the tube at the patient end and ensures that the reservoir bag fills, turns off the flow meter and ensures that the reservoir bag does not collapse.	2
Makes sure that the inner tube is not disconnected, sets the gas flow at 5L/min, then occludes the inner tube using a plunger of a 2ml syringe, and the bobbin should dip due to back pressure.	2
Checks the function of the APL valve.	2
Checks the filter and angle piece for any defect or blockage.	2
What happens if the inner tube is disconnected at the machine end?	2
This increases the dead space resulting in hypercapnia and hypoxaemia.	
What is the FGF required for spontaneous ventilation for avoiding re-breathing?	2
A fresh gas flow of 150-250ml/Kg or 2-3 times a minute ventilation is required during spontaneous ventilation to prevent re-breathing.	

What should be the FGF during controlled ventilation to maintain normocapnia?

2

During controlled ventilation, a flow of 70-100ml/Kg/minute is required to maintain normocapnia.

Total: /20

Information for the examiner

The anaesthetic machine has already been checked. The Bain breathing system needs to be correctly assembled. The candidate is expected to connect the gas sampling line correctly in the breathing filter.



Figure 4.1b Assembled Bain breathing system.

Bain breathing system

The Bain breathing system is a coaxial version of the Mapleson D system. The components of the Bain breathing system include an inner tube, outer tube, APL valve and a reservoir bag. The inner tube (7mm internal diameter) carries fresh gas flow and the outer tube (22mm internal diameter) carries expired gas. Disconnection of the inner tube at the machine end leads to increased dead space and kinking of the inner tube results in obstruction to the flow of fresh gas. The amount of rebreathing depends on the fresh gas flow. Fresh gas flow must be high enough to purge the exhaled gas from the outer tubing and to supplement the stored fresh gas in the outer tube so that during the next inspiration, mixed gas from the reservoir bag does not reach the patient.

The breathing system should be checked for integrity and any obstruction of both the inner and outer tubes. In order to check the integrity of the inner tube, the lumen of the inner tubing should be occluded with a finger or the plunger of a 2ml syringe. A rise in gas pressure within the anaesthetic circuit leads to downward movement of the bobbin in the flow meter. Another test that can be used for ensuring the integrity of the inner tube is the Pethick test. The APL valve should be closed, the reservoir bag and breathing system should be filled using an oxygen flush, and the patient end of the breathing system should be occluded. While activating the oxygen flush, the occlusion at the patient end should be released. Due to the Venturi effect at the patient end, fresh gas flow from the outer tubing and reservoir bag is entrained. Therefore, the reservoir bag collapses.

The Bain breathing system is less efficient for spontaneous ventilation as it requires high fresh gas flow. During controlled ventilation, a longer expiratory phase and expiratory pause, allows the outer tube to be filled with fresh gas flow. A fresh gas flow of 70-80ml/Kg/minute (6-7L/minute) will maintain a normal arterial CO₂ tension (normocapnia) and a flow of 100ml/Kg/minute is required for mild hypocapnia.

The Bain breathing system has low dead space and offers low resistance to breathing. Fresh gas in the inner tube is warmed up to some extent as it passes through the expiratory limb (outer tube).

Key points

- ◆ The Bain breathing system is a coaxial version of the Mapleson D system.
- ◆ Disconnection of the inner tube leads to increased dead space and hypercapnia.
- ◆ It is an efficient system for controlled ventilation.

Station 4.2 Data interpretation: lung function tests

Information for the candidate

In this station you will be assessed on your knowledge and understanding of interpretation of lung function tests.

A 70-year-old female patient is scheduled to have a total knee replacement. She smokes 10-20 cigarettes per day and gives a history of shortness of breath on exertion. As part of her pre-operative assessment, the following lung function tests are performed.

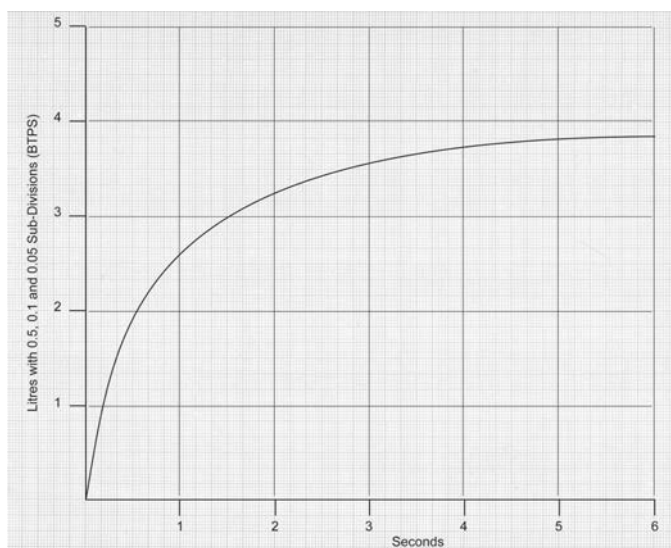


Figure 4.2a Lung function test.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. The graph shown is a vitalograph.	True	False	2	☐
2. FVC is 3.8L.	True	False	2	☐
3. FEV1 in this graph is 2.6L.	True	False	2	☐
4. From this graph one can derive PEF.	True	False	2	☐
5. This patient has a severe obstructive lung disease.	True	False	2	☐
6. Total lung volume can be derived from this graph.	True	False	2	☐
7. This patient needs regular bronchodilators.	True	False	2	☐

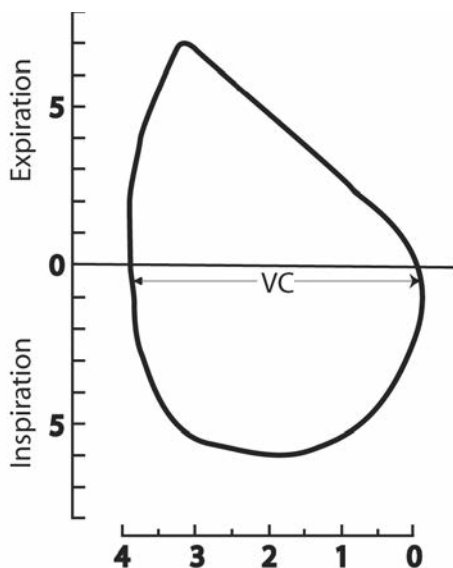


Figure 4.2b Flow-volume loop.

8. There is an extrathoracic airway obstruction.	True	False	2	☐
9. This is suggestive of severe asthma.	True	False	2	☐
10. A helium/oxygen mixture is useful in this patient.	True	False	2	☐

Total:	/20

Answers

1. True. This graph is a vitalograph; time in seconds is represented on the x axis and volume in litres is represented on the y axis.
2. True.
3. True. FEV1 is 2.6L.
4. True.
5. False. The ratio of FEV1 to FVC is 68%.
6. False. Total lung volume can be measured using body plethysmography or a helium dilution technique.
7. False. The vitalograph and flow volume loop do not indicate small airway obstruction.
8. False. In Figure 4.2b this is a flow volume loop; the inspiratory flow pattern is normal.
9. False. In asthma, the end-expiratory part of the flow volume loop will have a concave shape due to reduced expiratory flow.
10. False.

Vitalograph

The vitalograph is a type of dry spirometer, and is portable and suitable for bedside use. FEV1 is the volume recorded at the end of the first second during forced expiration and the FVC is the total volume recorded at the end of forced expiration following a deep inspiration.

The vitalograph is useful in distinguishing obstructive lung disease from restrictive lung disease. In restrictive lung disease, both FEV1 and FVC are reduced; therefore the ratio of FEV1: FVC remains normal or high. In obstructive lung disease, FEV1 is reduced in comparison to FVC resulting in a low FEV1: FVC ratio.

The peak expiratory flow rate (PEFR) can be calculated from the initial gradient of the trace. PEFR is usually normal in restrictive lung disease. PEFR is reduced in obstructive lung disease, such as asthma and chronic obstructive airway disease.

The flow volume loop helps to distinguish obstructive lung disease from restrictive lung disease in addition to distinguishing intrathoracic airway obstruction from extrathoracic airway obstruction.

In fixed obstruction of a large airway, the maximum airflow is limited both in inspiration and expiration; both phases are flattened (Figure 4.2c).

In variable intrathoracic airway obstruction, as in asthma, narrowing of the airway is maximal in expiration. The flow-volume loop shows a greater reduction of flow in the expiratory phase (Figure 4.2d).

In variable extrathoracic airway obstruction, narrowing of the airway is maximal during inspiration. The flow volume loop shows a greater reduction of flow in the inspiratory phase.

The density of helium is lower than that of nitrogen or oxygen; it reduces the Reynolds number and therefore should alter the flow from turbulent to laminar in the larger airways. It effectively overcomes the airway resistance and improves the flow in upper airway obstruction. Recent research supports its use in COAD and asthma.

Heliox is supplied as a mixture of 21% oxygen and 79% helium in a black cylinder with white and brown quarters on the shoulder of the cylinder.

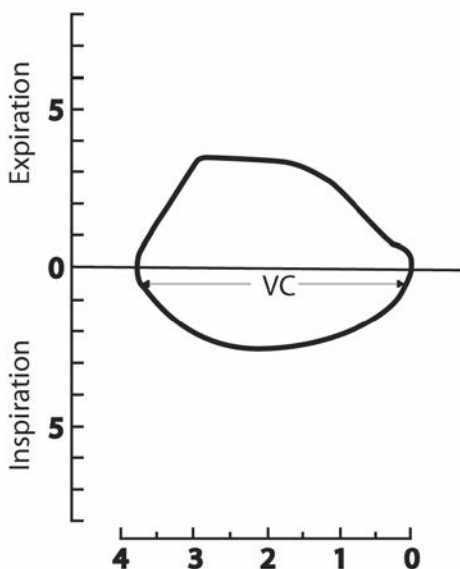


Figure 4.2c Fixed large airway obstruction.

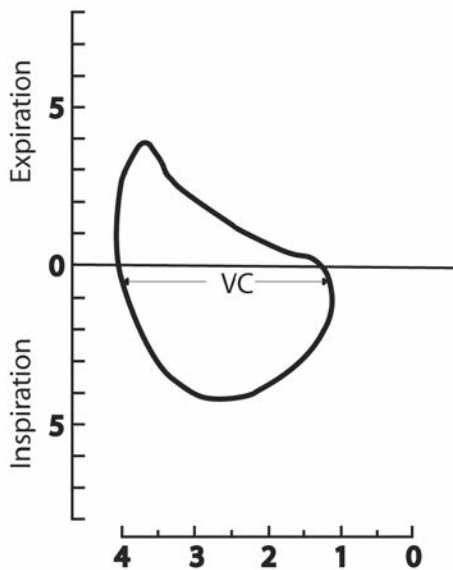


Figure 4.2d Variable intrathoracic airway obstruction.

Key points

- ◆ FEV1 and FVC can be measured using the vitalograph.
- ◆ PEFR can be calculated from the initial gradient of the vitalograph.
- ◆ The characteristics of the flow volume loop can be used to distinguish between intrathoracic and extrathoracic airway obstruction.
- ◆ Heliox has a low density and is useful in improving the flow in airway obstruction.

(For further details on lung function tests refer to OSCE set 5, station 5.2).

Station 4.3 Data interpretation: ECG

Information for the candidate

A 70-year-old male is listed for arthroscopy of the left knee under general anaesthesia as a day-case procedure. He has a history of non-insulin-dependent diabetes and angina. The patient had an episode of chest pain the day before admission. In this station you will be presented with an ECG which was taken on admission to the day unit.

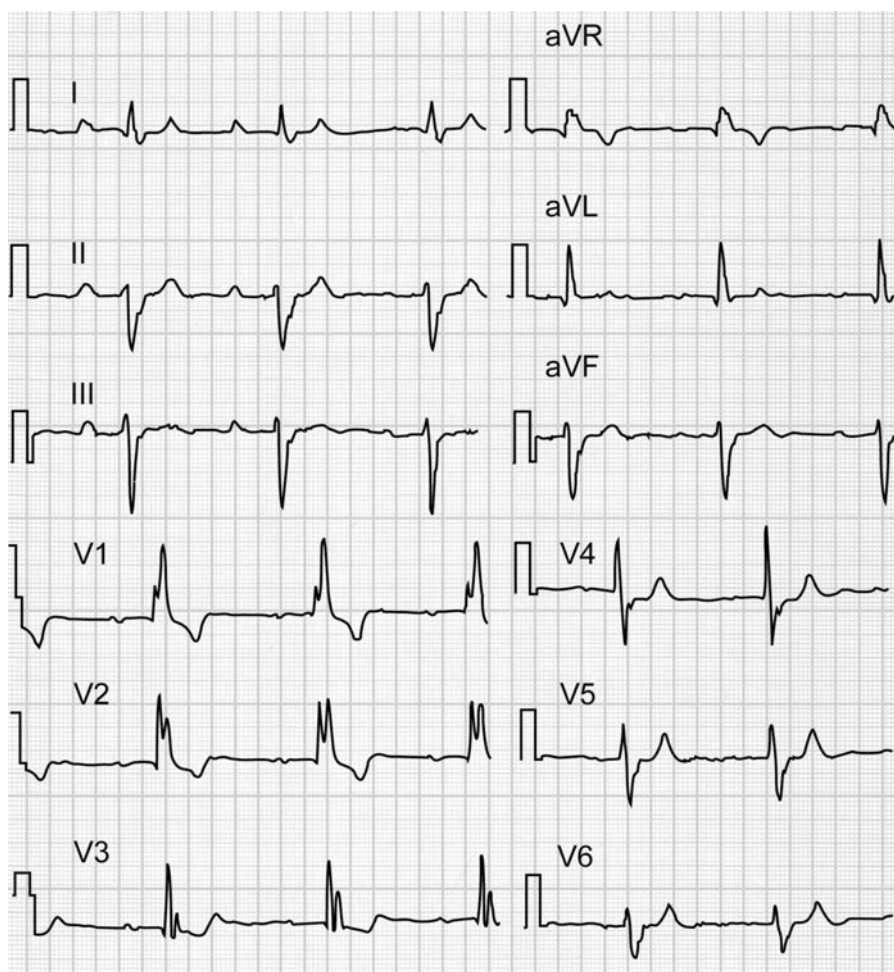


Figure 4.3 ECG.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. The heart rate is 75 beats per minute.	True	False	2	☐
2. This patient has first degree heart block.	True	False	2	☐
3. There is left axis deviation.	True	False	2	☐
4. This abnormality could be due to ischaemic heart disease.	True	False	2	☐
5. There is a right bundle branch block.	True	False	2	☐
6. This patient can undergo proposed surgery without further investigations.	True	False	2	☐
7. This patient needs a pacemaker to be inserted prior to surgery.	True	False	2	☐
8. The ECG features are compatible with ischaemic heart disease.	True	False	2	☐
9. There is left ventricular hypertrophy.	True	False	2	☐
10. This patient needs immediate thrombolysis.	True	False	2	☐

Total:	/20

Answers

- False. It is about 50 beats per minute.
- True. The PR interval is more than 0.20 seconds, suggesting first degree heart block.
- True.
- True.
- True. The QRS is widened in leads V1 and V2.

6. False. As this patient has had an angina episode, first degree heart block, right bundle branch block and left anterior hemiblock, he needs a cardiology review and further investigations to assess left ventricular function and coronary ischaemia.
7. False.
8. True. The ECG shows T wave inversions in leads V1 to V3 and conduction defects.
9. False.
10. False.

The abnormal findings noted on the given ECG are a prolonged PR interval, right bundle branch block and T wave inversion in V1 to V3.

Atrioventricular (AV) block

An AV block is due to the delay in conduction of the atrial impulse through the atrioventricular node and bundle of His. The PR interval is measured from the beginning of the P wave to the beginning of the QRS complex. A normal PR interval is 0.12 to 0.20 seconds. A prolonged PR interval reflects the delay in the conducting system. This is first degree AV block. In first degree AV block, all P waves are followed by a QRS complex. Causes of first degree heart block include ischaemic heart disease, digoxin and beta blockers.

Second degree AV block is characterised by the intermittent absence of QRS complexes. In Mobitz Type I AV block, the PR interval progressively increases and finally a QRS complex is absent. This is known as the Wenckebach phenomena. In Mobitz Type II AV block, there is a fixed drop in the QRS complex with a variable ratio of P wave to QRS complex (2:1, 3:2 or 3:1). This type of block is always pathological and can frequently progress to complete heart block.

Third degree AV block is characterised by complete block of all atrial impulses. Atrial and ventricular rhythms are independent and asynchronous. It is characterised by atrioventricular dissociation (P waves bear no relation to the QRS complexes), abnormal QRS complexes and a slow ventricular rate. (For further details refer to OSCE set 2, station 2.2).

Right bundle branch block

In right bundle branch block, activation of the right ventricle is delayed. The right ventricle is stimulated by impulses from the left bundle branch through the septum, distal to the level of the block.

The following sequences result in changes seen in the QRS complex in leads orientated to the right ventricle (leads V1 and V2):

- ◆ Left to right depolarisation of the septum produces an r wave of the QRS complex.
- ◆ Right to left depolarisation of the left ventricle produces an S wave of the QRS complex.
- ◆ Depolarisation of the right ventricle produces an R wave of the QRS complex.

All the above sequences result in a widened QRS complex (rSR or M-shaped pattern).

- ◆ Delayed and abnormal depolarisation of the right ventricle results in a broad, slurred S wave in leads orientated to the left ventricle (V5, V6, lead 1).

ECG features of right bundle branch block include:

- ◆ A wide QRS of more than 0.1 second in leads V1, V2.
- ◆ A secondary R wave in lead V1.
- ◆ A delayed S wave in lead 1.

Right bundle branch block may be normal in some individuals. Causes of right bundle branch block include ischaemic heart disease, acute myocarditis and an atrial septal defect.

Left bundle branch block

Normally, left to right depolarisation of the septum produces a small q wave followed by a tall R wave due to right to left depolarisation of the free wall of the left ventricle (larger mass than the right ventricle) in leads orientated to the left ventricle.

In left bundle branch block the left ventricle is activated from the right bundle branch which passes to the left side of the septum distal to the block. The sequence is as follows:

- ◆ Right to left depolarisation of the septum produces an R wave of the QRS complex.
- ◆ Depolarisation of the right ventricle produces a slight downward deflection (slurred component of the R wave) of the QRS complex.
- ◆ Delayed right to left depolarisation of the left ventricle results in another upward deflection (R') of the QRS complex.

The above sequence produces a wide (W-shaped) QRS complex with a wide notched R wave in leads V5 and V6. A wide and notched QS complex is produced in leads orientated to the right ventricle (V1 and V2).

ECG features of left bundle branch block include:

- ◆ A wide QRS of more than 0.1 second in leads V5 and V6.
- ◆ A wide notched R wave in leads I, V5 and V6.
- ◆ A prominent, notched QS complex in lead V1.
- ◆ An absence of a Q wave in leads V5 and V6.

Complete left bundle branch block is commonly seen in ischaemic heart disease, hypertensive heart disease or dilated cardiomyopathy.

Block of the left anterior hemi-fascicle is characterised by left axis deviation in the absence of inferior myocardial infarction or other cause of left axis deviation. Block of the left posterior hemi-fascicle is characterised by right axis deviation. Bifascicular block is the combination of right bundle branch block and left anterior or posterior hemiblock. Bifascicular block in association with first degree heart block is known as trifascicular block.

ECG criteria for left ventricular hypertrophy

- ◆ Depth of the S wave in V1 and height of the R wave in V5 or V6 should be more than 35mm.
- ◆ R wave in V4, V5 or V6 more than 30mm.
- ◆ S wave in V1, V2, V3 more than 30mm.
- ◆ R wave in aVL more than 13mm.

Indications for implantation of a permanent pacemaker

The following are indications where there is evidence and/or general agreement that pacing is beneficial:

- ◆ Third degree AV block associated with bradycardia, documented asystole of more than 3 seconds or an escape rate <40bpm.
- ◆ Second degree AV block associated with symptomatic bradycardia.
- ◆ Sinus node dysfunction with documented symptomatic bradycardia.
- ◆ Symptomatic bifascicular or trifascicular heart block.
- ◆ Persistent second degree AV block or third degree AV block following acute myocardial infarction.

Blood supply

The right coronary artery provides blood supply to the SA node in 60% of patients and the AV node in 80% of patients. The left bundle branch usually receives blood from the left anterior descending branch of the left

coronary artery. The right bundle branch receives most of its blood from septal perforators of the left anterior descending artery. There may also be a collateral blood supply from the right coronary artery or left circumflex artery.

Key points

- ◆ A prolonged PR interval of more than 0.2 seconds indicates first degree heart block.
- ◆ A widened QRS complex with a rSR pattern in leads V1 and V2 is seen in right bundle branch block.
- ◆ The left bundle branch receives blood supply from the left anterior descending artery.
- ◆ Left bundle branch block indicates organic heart disease.
- ◆ Right bundle branch block with left anterior hemiblock is the commonest form of bifascicular block.

Station 4.4 Data interpretation: vital parameters

Information for the candidate

A 64-year-old female underwent an elective left hemicolectomy 3 days ago. Her blood pressure is low and peripheral oxygen saturation is 91% while on 40% oxygen supplementation. Patient controlled analgesia (PCA) with morphine has been prescribed postoperatively. On clinical examination, the respiratory rate is 22 per minute, heart rate is 120/minute, and blood pressure is 90/40 mmHg. You are now presented with a set of charts and blood results on the ward.

- ◆ Urea: 12.4mmol/L, creatinine: 118μmol/L, Na⁺: 142mmol/L, K⁺: 4.8mmol/L.

24 HOUR FLUID BALANCE CHART

Date		Name		Hospital No		Ward		Instructions for next 24 hours											Previous days fluid balance =										
INTAKE															OUTPUT														
WT	TIME	ORAL		INTRAVENOUS			NG/NAIPEG OTHER			URINE		ASPIRATE OR VOMIT		STOMA / BOWELS		OTHER		TIME											
		FLUID		VOLUME	TOTAL	FLUID	VOLUME	TOTAL	FLUID	VOLUME	TOTAL	VOLUME	TOTAL	VOLUME	TOTAL	VOLUME	TOTAL												
	01.00				5% DEXTROSE	500					70	0						01.00											
	02.00					100					80	0						02.00											
	03.00					120					90	80						03.00											
	04.00					80					30	120						04.00											
	05.00					100					40	80						05.00											
	06.00					100	1000				20	330	130	410				06.00											
	07.00				Nacl 0.9%	80					20	50						07.00											
	08.00					80					10	80						08.00											
	09.00					60					30	100						09.00											
	10.00					60					20	120						10.00											
	11.00					60					15	80						11.00											
	12.00					60					0	110						12.00											
	13.00					80	1480				0	425	0	950				13.00											
	14.00					80					10	90						14.00											
	15.00					60					15	110						15.00											
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TOTAL =											TOTAL =		TOTAL =		TOTAL		TOTAL =												

TOTAL INTAKE =

TOTAL OUTPUT =

FLUID BALANCE =

Figure 4.4b 24-hour fluid balance chart.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. The most likely cause of low oxygen saturation is opioid-induced respiratory depression.	True	False	2	☐
2. This patient is likely to be hypovolaemic.	True	False	2	☐
3. This patient has had adequate pain relief during the last six hours.	True	False	2	☐
4. Renal parameters suggest pre-renal renal failure.	True	False	2	☐
5. Intravenous furosemide should be given immediately.	True	False	2	☐
6. Arterial blood gas will reveal respiratory acidosis.	True	False	2	☐
7. At 13:00 hours the measured fluid loss is 1915ml.	True	False	2	☐
8. Urine osmolality is likely to be less than 320mOsm/Kg.	True	False	2	☐
9. Inspired oxygen concentration should be increased to 100% immediately.	True	False	2	☐
10. This patient is likely to need a laparotomy.	True	False	2	☐

Total: /20

Answers

- False. The pain score indicates that the patient is in pain. The PCA chart (not available) would indicate total dose of morphine received.
- True. Total intravenous fluid intake over 17 hours is 1780ml and the measured output is 1815ml. The patient is pyrexial, there will be further insensible loss and therefore this patient is in negative fluid balance.
- False. The pain score varies between 1 to 2 (mild to moderate).
- True. A raised serum urea level and hypovolaemia suggests pre-renal renal failure.

5. False. Intravascular fluid volume and renal perfusion should be optimised.
6. False. An arterial blood gas will reveal respiratory alkalosis.
7. False. At 13:00 hours the measured fluid loss is 1375ml.
8. False. In pre-renal type renal failure osmolality is normal (more than 450mOsm/Kg). Urine osmolality is likely to be less than 310mOsm/Kg in renal tubular acidosis.
9. True. Inspired oxygen concentration should be increased to 100% immediately.
10. True.

This patient underwent major abdominal surgery and is hypotensive, hypoxic and oliguric during the postoperative period. Causes of hypotension in this patient could be hypovolaemia, peripheral vasodilation from a systemic inflammatory response or sepsis, and a reduced cardiac output due to myocardial depression.

The observation chart indicates that the patient has mild to moderate pain. Her respiratory rate is high. Therefore, the patient is more likely to have respiratory alkalosis rather than respiratory acidosis. Hypotension and a reduced tissue perfusion can result in metabolic acidosis.

Key points

- ◆ Careful evaluation of the observation chart and fluid balance chart is essential prior to making decisions.
- ◆ The majority of surgical patients are likely to be hypovolaemic during the early postoperative period.
- ◆ Patients with sepsis require optimum fluid therapy and vasopressor/inotropic support to improve organ function.

Station 4.5 Anatomy: the orbit and ophthalmic anaesthesia

Information for the candidate

In this station you will be asked questions on the anatomy of the orbit and the technical skill of performing eye blocks will be assessed.

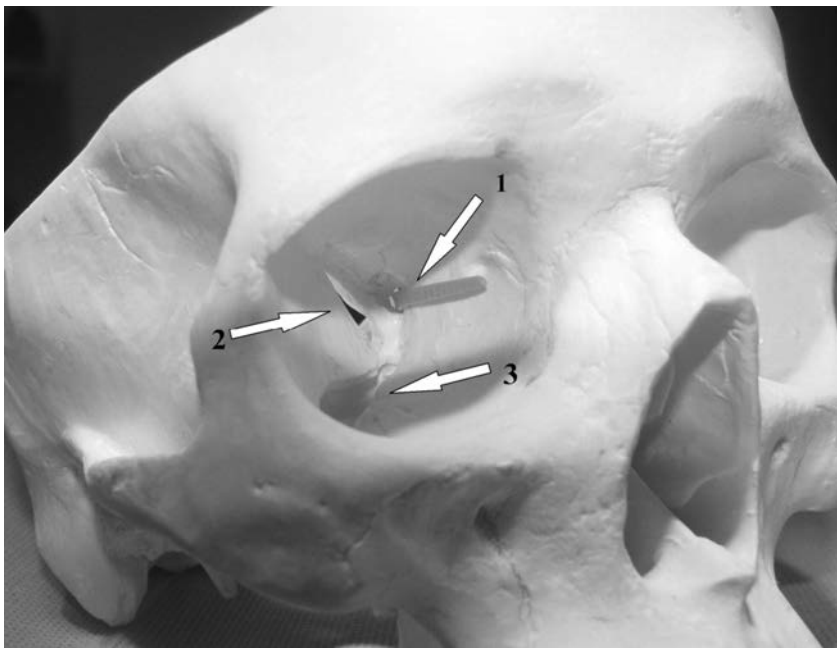


Figure 4.5a Anatomy of the orbit.

Examiner's mark sheet

marks

Name the foramen labelled 1 in Figure 4.5a

1

Optic foramen.

What structures pass through this foramen?

1

Optic nerve and ophthalmic artery.

Name the structure labelled 2 in Figure 4.5a

1

Superior orbital fissure.

What structures pass through this fissure?

3

Lacrimal, frontal, nasociliary, oculomotor, trochlear and abducens nerves, and the superior ophthalmic vein.

Name the structure labelled 3 in Figure 4.5a

1

Inferior orbital fissure.

What is the normal axial length of the eye ball and what is the significance?

2

Normal axial length is 22-26mm. An axial length of more than 26mm suggests a large eye and hence there is a risk of globe puncture during peribulbar and retrobulbar block.

Describe the motor nerve supply to the extra-ocular muscles

2

- ◆ Lateral rectus is supplied by the abducens nerve.
- ◆ Superior oblique is supplied by the trochlear nerve.
- ◆ Other extraocular muscles: medial rectus, inferior rectus, superior rectus and inferior oblique are all supplied by the oculomotor nerve.

What are the various regional techniques available in providing anaesthesia for eye surgery? 4

- ◆ Topical anaesthesia.
- ◆ Peribulbar block.
- ◆ Retrobulbar block.
- ◆ Sub-Tenon's block.

Can you describe the procedure of sub-Tenon's block? 2

- ◆ Preparation includes an explanation to the patient, local anaesthetic agents, an equipment check, intravenous access and monitoring (oxygen saturation, ECG and non-invasive blood pressure).
- ◆ Topical anaesthesia is achieved by applying benoxinate or an amethocaine solution on the conjunctiva.
- ◆ The sub-Tenon's space is accessed by dissecting at the inferonasal quadrant.
- ◆ 3-5ml of local anaesthetic is injected using a sub-Tenon's cannula.

Where would you inject the local anaesthetic? 1

Local anaesthetic solution is injected into the sub-Tenon's space (space between the Tenon's capsule and sclera).

What local anaesthetic would you use and what volume is needed? 1

2% lidocaine with 1:200,000 epinephrine and 7.5 units/ml of hyaluronidase is injected. Usually 3-5ml of local anaesthetic is adequate.

Why is hyaluronidase used?1

Hyaluronidase facilitates the diffusion of local anaesthetic solution within the orbit; therefore, it improves the effectiveness and quality of the block.

Total:	/20

Anatomy of the orbit

The orbit is separated into two major compartments: the intraconal space and the extraconal space. The intraconal space is bounded by four rectus muscles and extends from the annulus of Zinn at the orbital apex to their penetration through the Tenon's capsule. The extraconal space is outside the muscle cone within the bony orbit.

Tenon's capsule invests the globe and extra-ocular muscles in the anterior central orbit. It extends from the corneal limbus anteriorly to the optic nerve posteriorly. Anteriorly it is penetrated by the four rectus muscles and by two oblique muscles, prior to their insertion to the sclera.

The superior orbital fissure carries the lacrimal, frontal, nasociliary (branches of the ophthalmic division of the trigeminal nerve), oculomotor, trochlear and abducens nerves, and the superior ophthalmic vein. Lacrimal, frontal and trochlear (LFT) nerves lie outside the muscle cone.

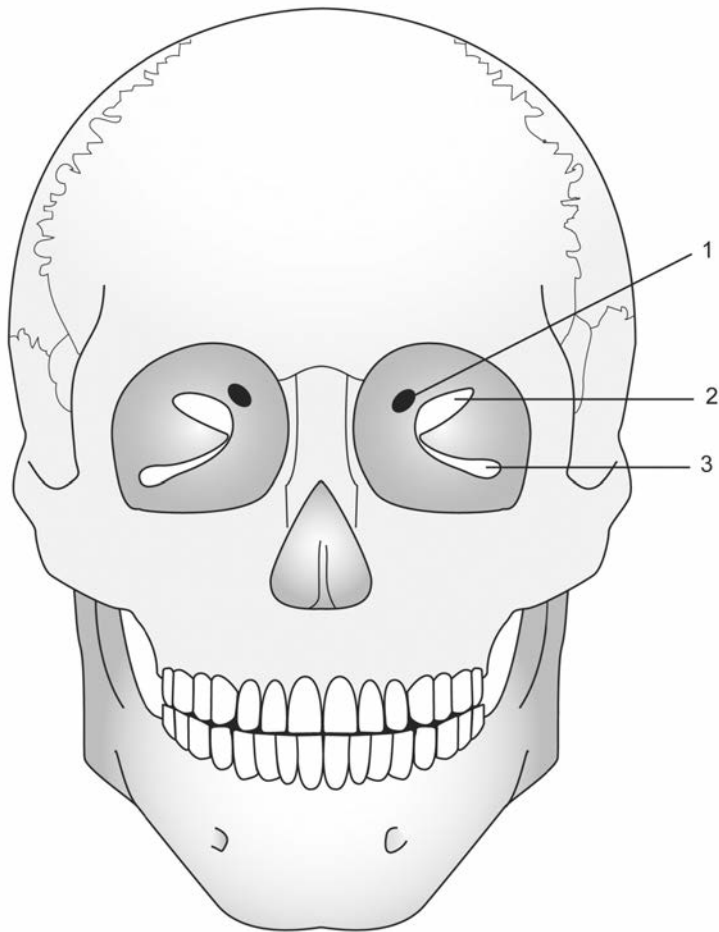


Figure 4.5b Anatomy of the orbit.

1. Optic foramen; 2. Superior orbital fissure; 3. Inferior orbital fissure.

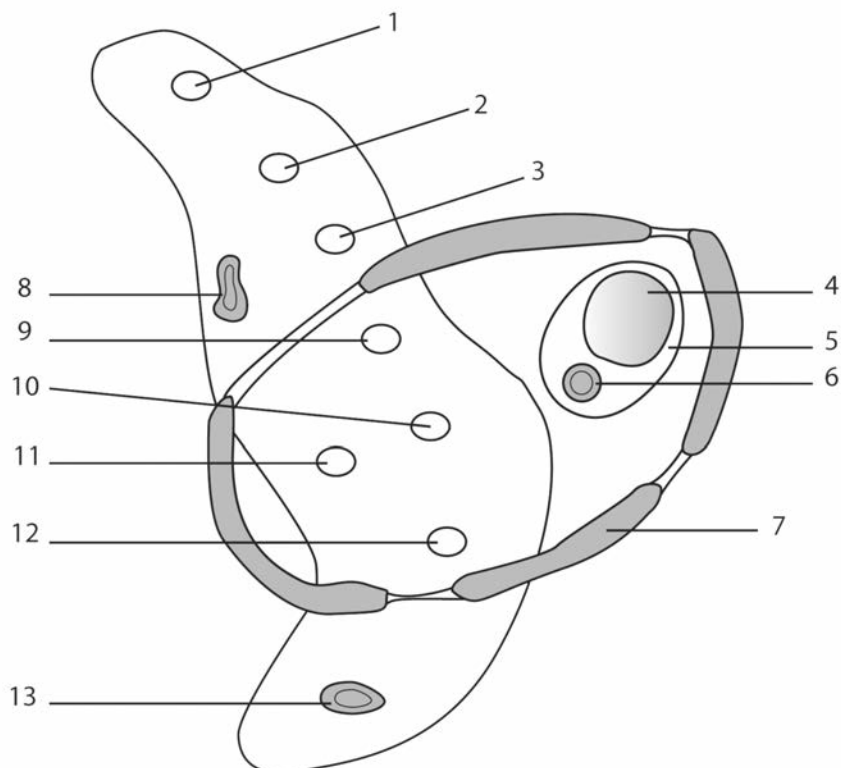


Figure 4.5c Contents of the superior orbital fissure.

1. Lacrimal nerve; 2. Frontal nerve; 3. Trochlear nerve; 4. Optic nerve; 5. Optic foramen; 6. Ophthalmic artery; 7. Ring formed by muscle tendons; 8. Superior ophthalmic vein; 9. Superior oculomotor nerve; 10. Nasociliary nerve; 11. Abducens nerve; 12. Inferior oculomotor nerve; 13. Inferior ophthalmic vein.

The axial length of the eyeball is measured from the external corneal surface to the retina. An axial length of more than 26mm denotes a large eye and increases the risk of globe perforation during peribulbar block.

The motor nerve supply to the extra-ocular muscles is by the 3rd, 4th and 6th cranial nerves. The superior oblique is supplied by the 4th cranial nerve and the lateral rectus is supplied by the 6th cranial nerve. The remainder of the muscles are supplied by the 3rd cranial nerve. A mnemonic is LR6 SO4.

Eye blocks

In retrobulbar block, the needle is inserted into the intraconal space behind the globe. As the local anaesthetic is deposited close to the motor and sensory nerves, a small volume (1.5-4ml) of local anaesthetic is adequate to produce a satisfactory block.

In peribulbar block, the needle is placed outside the muscle cone, further away from the apex. A larger volume of local anaesthetic (6-10ml) is required to produce satisfactory block.

In sub-Tenon's block, Tenon's capsule is elevated from the sclera and local anaesthetic is deposited into the sub-Tenon's (episcleral) space.

Local anaesthetic drugs

Lidocaine hydrochloride 2% and bupivacaine hydrochloride 0.5-0.75% are the commonly used local anaesthetics. Duration of lidocaine can be prolonged by the addition of epinephrine. Longer duration of bupivacaine provides postoperative pain relief.

Benoxinate 0.4% solution and amethocaine 0.5% solution are used for topical anaesthesia.

Epinephrine causes vasoconstriction, delays the absorption of local anaesthetic and prolongs the duration of action. The preferred concentration is 1:200,000 (5µg/ml). The total dose should not exceed 0.2mg.

Hyaluronidase breaks down the collagen bonds and facilitates diffusion of local anaesthetic across the connective tissue septal barriers. It is used in a concentration of 7.5 to 15 units/ml.

Complications of sub-Tenon's block include pain on injection, subconjunctival haemorrhage, chemosis and the potential for damaging one of the vortex veins. Peripheral orbit anaesthesia may be incomplete with sub-Tenon's block.

Complications related to ophthalmic regional block

- ◆ Retrobulbar haemorrhage.
- ◆ Subconjunctival haemorrhage.
- ◆ Subconjunctival oedema (chemosis).
- ◆ Optic nerve damage.
- ◆ Globe perforation.
- ◆ Intravascular injection.
- ◆ Central spread of local anaesthetic: clinical features include drowsiness, vomiting, convulsions, cardiorespiratory arrest.
- ◆ Oculocardiac reflex due to traction on the eye, rapid distension of tissues by local anaesthetic or by haemorrhage.

Key points

- ◆ The optic nerve, ophthalmic artery and central retinal vein pass through the optic foramen.
- ◆ Lacrimal, frontal and trochlear (LFT) nerves pass through the superior orbital fissure and lie outside the muscle cone.
- ◆ The inferior orbital fissure transmits the infra-orbital (maxillary) nerve, infra-orbital artery and infra-orbital vein.

Station 4.6 Communication: Jehovah's Witness

Information for the candidate

In this station you will meet a 65-year-old male patient who is a Jehovah's Witness and is scheduled to have a right total hip replacement next week. He is anaemic with a haemoglobin of 11g/dl. He summarily has refused to receive any blood products.

Examiner's mark sheet

	marks
Introduces him/herself to the patient and confirms that he/she is talking to the right person.	1
Confirms non-acceptability of blood transfusion.	1
Verifies whether certain blood products are acceptable (FFP, platelets).	1
Confirms preference for death rather than to receive transfusion.	1
Explains why blood transfusion may be needed (average blood loss between 500 to 1000ml, Hb is 11gm/dl. However, blood loss can be more than average).	2

Risks of not transfusing blood

◆ Immediate: bleeding and need for postoperative ventilation, and death as rare possibility.	2
◆ Later: delayed wound healing, organ failure, increased risk of infection.	2

Alternatives for blood transfusion

- ◆ Pre-operative: postpone surgery by 4-6 weeks; iron therapy to increase haemoglobin and erythropoietin, to increase oxygen-carrying capacity. 2
 - ◆ Use of drugs (such as aprotinin, tranexamic acid, DDAVP) to minimise blood loss. 2
 - ◆ Additional care during the procedure (such as positioning, epidural, experienced surgeon) to minimise blood loss. 2
 - ◆ Check whether cell saver, with continuity of blood in circulation, is acceptable. 2
- Special consent form to be signed. 1
- Postoperative critical care and oxygen therapy explained. 1

Total:	/20

Information for the actor

For the past 2 years you have suffered from arthritis of both hips. Your right hip is worse than the left. As a result of arthritis you suffer from pain, are not able to walk, and you have been on regular pain killers for the past year. You now feel that they are not helping you much. You have been told that your right hip is badly damaged and needs a joint replacement operation.

You are scheduled to have a total hip replacement next week. You are a Jehovah's Witness and you would not accept any blood or blood products. You accept all the risks including death. You are happy to try alternative methods to reduce the need for blood transfusion. Your blood test shows a haemoglobin level of 11g/dl, which is low.

Now you are waiting to be seen by an anaesthetist who will talk to you regarding the effects of blood loss and the risks of refusing blood transfusion. You are willing to take some medicines that help to increase the blood count (haemoglobin). You will accept the cell savers, as long as

the blood collected from the wound has continuity with your vein all the time. You are also interested to know any measures that can be taken to reduce the blood loss (drugs and or any special anaesthetic techniques).

Anaesthetic management for Jehovah's Witnesses

In general, Jehovah's Witnesses will not accept transfusion of blood or blood products, such as fresh frozen plasma, packed cells and platelets. Some accept acute normovolaemic haemodilution and intra-operative cell salvaging, as long as the blood continuously remains in contact with the patient's circulation.

Some Jehovah's Witnesses give a copy of their advance directive to their general practitioner. In an elective scenario, as in total hip replacement, blood transfusion against their wishes is unlawful and can lead to legal proceedings against the doctor.

Pre-operative management

Anaemia can be addressed with appropriate nutrient supplementation. Erythropoietin may be useful, but it takes a few weeks to show a response. Pre-operative autologous blood collection and storage for reinfusion during surgery is not acceptable to Jehovah's Witnesses.

Intra-operative management

Regional anaesthesia may be better to minimise blood loss; meticulous positioning to avoid venous congestion reduces blood loss. An experienced surgeon should perform the operation to reduce blood loss. Use of drugs such as aprotinin, tranexamic acid and desmopressin can reduce bleeding; avoiding NSAIDs is also recommended. Some may accept the use of plasma protein fraction, albumin and immunoglobulins, and should be individually discussed. The role of hypotensive anaesthesia is controversial.

Postoperative management

Includes oxygen supplementation and continuing iron and erythropoietin. High dependency care is required for monitoring vital signs and blood loss in the drain. Hyperbaric oxygen therapy may be needed in extreme cases.

Key points

- ◆ Clearly explain the role of haemoglobin in oxygen transport. All the body tissues need a continuous oxygen supply.
- ◆ Bleeding and severe anaemia can jeopardise the supply, resulting in failure of vital organs.
- ◆ When in doubt, involve the haematologist.
- ◆ A specific consent form must be signed.
- ◆ In an elective scenario like this, the anaesthetist has the right to refuse to anaesthetise.

Station 4.7 Technical skill: laryngeal mask airway (LMA) insertion

Information for the candidate

A 32-year-old fit and healthy male patient is scheduled for arthroscopy and repair of the medial meniscus of the left knee. He has no history of reflux. His weight is 65Kg and height is 165cm.

Examiner's mark sheet

marks

Can you choose a correct size of LMA for this patient? 2

The candidate should choose a size 4 LMA.

Can you insert the LMA on this manikin? 7

- ◆ Checks the tube and the cuff.
- ◆ Deflates the cuff.
- ◆ Lubricates appropriately.
- ◆ Head tilt manoeuvre is done with care.
- ◆ Passes gently along the palato-pharyngeal axis.
- ◆ Inflates the cuff with a correct volume of air.
- ◆ Checks the ventilation.

What material is used in manufacturing these masks? 2

A standard reusable LMA (LMA Classic) is manufactured from medical grade silicon rubber. The majority of disposable LMAs are manufactured from medical grade polyvinylchloride.

Does it contain latex? 1

No, it is latex-free.

What are the advantages of LMA over tracheal intubation? 2

- ◆ The use of an LMA avoids laryngoscopy and, therefore, complications associated with laryngoscopy and tracheal intubation.
- ◆ Muscle relaxants can be avoided.
- ◆ There is less invasion of the respiratory tract, as compared to a tracheal tube.
- ◆ An LMA is better tolerated during emergence and is associated with a lower incidence of coughing, straining and breath holding during emergence from anaesthesia.

What are the limitations of an LMA? 2

- ◆ Gastric insufflation is possible with an LMA.
- ◆ An LMA does not protect against aspiration from the stomach. Tracheal intubation is considered as a more secure airway.
- ◆ An LMA does not prevent airway obstruction at the level of the glottis or subglottis.

What size of LMA would you choose in a 2-year-old child weighing 13Kg? How much air would you use to inflate it? 2

LMA of size 2. The maximum volume of air required to inflate the cuff is 10ml.

What is the function of mask aperture bars?

2

Mask aperture bars prevent the folding of the epiglottis into the lumen of the LMA tube.

Total:	/20

Laryngeal mask airway

The LMA consists of a flexible curved tube connected to a distal elliptical mask with an inflatable rim which forms a low pressure seal around the glottis. Proximally the tube is joined to a standard 15mm connector. An inflation tube (pilot tube) and a self-sealing pilot balloon are connected to the inflatable rim.

The standard LMA (LMA Classic) is reusable up to a maximum of 40 times and is sterilised by steam autoclaving to a temperature of 134°C. Single-use, disposable laryngeal masks are increasingly used.

The following pre-use checks should be carried out:

- ◆ Examine the inside to ensure that there is no blockage.
- ◆ Flex the tube to bend around 180° and ensure that it doesn't kink.
- ◆ Deflate the cuff and then completely inflate the cuff, checking for leak.

Key points

- ◆ While ventilating through the LMA, ensure that the peak airway pressure does not exceed about 20cmH₂O to avoid leakage of ventilated gas and insufflation of the stomach.
- ◆ In an unanticipated difficult airway, the LMA has an important role.
- ◆ Tracheal intubation can be performed through the LMA using one of the following techniques:
 - a long microlaryngeal tube of less than size 6 can be passed blindly through the LMA;
 - using a fiberoptic scope and Aintree catheter, tracheal intubation can be performed through the LMA.

Station 4.8 Clinical examination: airway examination

Information for the candidate

A 75-year-old male patient has presented for an inguinal hernia repair as a day-case surgical procedure. As part of the pre-operative assessment you have been asked to perform a clinical examination of the airway.

Examiner's mark sheet

	marks
Introduces him/herself to the patient and explains his/her role.	1
Inspects the front and side of the neck.	2
Elicits mouth opening and measures inter-incisor distance.	2
Asks the patient to protrude their mandible (forward movement of the lower jaw).	1
Performs the Mallampati test.	1
Correctly measures the sternomental distance.	1
Correctly measures the thyromental distance.	1
Assesses the full range of neck movements.	2
Checks for patency of nasal passages.	1
What would you see and what information would you obtain from a Mallampati test?	4

Depending on the pharyngeal structures visualised, four classes are described:

- ◆ Class 1: faucial pillars, soft palate and uvula seen.
- ◆ Class 2: faucial pillars and soft palate seen. The base of the tongue masks the uvula.

- ◆ Class 3: only the soft palate is visible.
- ◆ Class 4: even the soft palate is not visible; only the hard palate is seen.

Class 3 and 4 are caused by difficulty in extending the head, opening the mouth or by a large tongue. A higher score indicates a possible difficult laryngoscopy.

What are the risk factors included in Wilson risk sum scoring?

3

It includes 5 predictive factors, each scored on a three-point scale (0-2): weight, head and neck movement, jaw movement, receding mandible and buck teeth.

What is the significance of this scoring system?

1

A total score of 2 or more is associated with an increased incidence of difficult intubation.

Total:	/20

Airway assessment

Airway assessment includes history, examination and investigation. This is a clinical examination station and you are asked to assess the airway as part of the pre-anaesthetic assessment.

On inspection any gross abnormality of the face, mouth, head and neck should be obvious. Inspect both from the front and sides of the patient. Any scars from previous surgery and swelling around the head neck region should be noted.

On fully opening the mouth, the distance between the incisors varies from 4-6cm. A rough estimate is the patient's own two or three fingers aligned vertically to accommodate the gap.

The Mallampati test is subject to inter-observer variability; therefore, it should be performed according to the recommended technique. The patient sits opposite the anaesthetist with their head in a neutral position, the mouth open as wide as possible and the tongue protruded maximally.

Thyromental distance is measured from the tip of the chin (mentum) to the uppermost aspect (thyroid notch) of the thyroid cartilage with the neck fully extended. In a normal adult the distance should be more than 6.5cm; less than 6cm suggests a difficult laryngoscopy.

Sternomental distance is measured from the tip of the chin to the sternal notch with the neck in a fully extended position. In a normal adult the distance should be more than 12.5cm; less than 12cm suggests a difficult laryngoscopy.

Movement at the atlanto-occipital joint is important for head extension. Extension and flexion of the cervical spine is also important when performing laryngoscopy. Wilson and colleagues examined a combination of risk factors and devised a scoring system to predict difficult intubation. Each factor scored between 0-2; the maximum possible score is 10.

Radiological examination of the cervical spine, atlanto-occipital gap and a CT scan of the neck region (when laryngeal, pharyngeal pathology is suspected) are useful in predicting a difficult intubation.

Key points

- ◆ Inspect the front and side of the neck for any obvious abnormality.
- ◆ The Mallampati test should be performed according to the recommended technique.
- ◆ Normal thyromental distance is >6.5cm.
- ◆ Normal sternomental distance is >12.5cm.

Station 4.9 Measuring equipment: Bourdon gauge

Information for the candidate

In this station you will be presented with equipment used for measuring pressure.



Figure 4.9.

Examiner's mark sheet

	marks
Identify this equipment	2 ☐
This is a Bourdon gauge.	
What is the use of a Bourdon gauge?	1 ☐
It is used for measuring the pressure in a cylinder.	
Can this be used for measuring blood pressure?	1 ☐
No, a Bourdon gauge has low precision; therefore it can be used only for measuring high pressures, i.e. above 1 bar.	

What pressure does this measure - gauge or absolute?

1

It measures gauge pressure.

What pressure does a mercury barometer measure?

2

It measures absolute pressure.

What is the difference between absolute and gauge pressure?

2

- ◆ Gauge pressure is the measured pressure above the atmospheric pressure, whereas absolute pressure includes atmospheric pressure.
- ◆ Absolute pressure = gauge pressure + atmospheric pressure; at sea level, atmospheric pressure is 1 bar (100 kPa).

What is the principle of measuring pressure in a Bourdon gauge?

2

It consists of a coiled tube, one end of the tube is connected to the source of pressure, whereas the other end is closed and attached to a needle pointer which moves across the dial. When pressure is applied, the tube expands and the curvature is partly straightened out, moving the needle across the dial.

What units are used to measure cylinder pressure?

2

Bar, kilo Pascal (kPa), pounds per square inch (PSI).

What is the pressure in a full oxygen cylinder?

2

It is 1980 PSI, 137 bar or 13700 kPa.

What factors affect the pressure in an oxygen cylinder?

3

Pressure in the cylinder depends on the mass or weight of gas, ambient temperature and critical temperature.

What are the uses of an aneroid gauge?

2

An aneroid gauge is used to measure blood pressure, airway pressure and pressure inside the tracheal tube cuff or LMA cuff pressure.

Total:	/20

Measurement of pressure

Pressure is defined as the force per unit area. The SI unit of pressure is Newton per square metre or Pascal.

Liquid manometer

The height of the fluid column indicates the pressure. The height of the column supported by any given pressure is dependent on the density of the liquid. The mercury sphygmomanometer and mercury barometer are two examples. Mercury is 13.6 times denser than water, hence 1mm of Hg equals 13.6mm H₂O. In the mercury barometer there is a virtual vacuum above the mercury, hence the height of the mercury column indicates the absolute pressure. In the mercury sphygmomanometer, the top is open to the atmosphere and hence it measures the gauge pressure. Surface tension exerted by the liquid can result in an error in measurement in liquid manometers.

Pressure gauges

These include the Bourdon gauge, aneroid gauge and diaphragm gauge. The Bourdon gauge is used for measuring cylinder pressures, whereas the aneroid gauge is used for measuring smaller pressures such as blood pressure. The aneroid gauge contains metal bellows; expansion of the bellows is detected by a lever mechanism which amplifies the movement and moves the pointer across the dial. In the diaphragm gauge, movement of a diaphragm (stretch of diaphragm) can be sensed directly or indirectly using a transducer.

A full oxygen cylinder has a gauge pressure of 137 bar. When the gauge pressure is zero, the cylinder still contains some oxygen at atmospheric pressure. Absolute pressure includes atmospheric pressure. Absolute

pressure of a full oxygen cylinder is 138 bar. In clinical practice we read most of the pressures such as blood pressure, airway pressure and cylinder pressure as gauge pressure.

Key points

- ◆ The Bourdon gauge is robust and withstands high pressures.
- ◆ Pressure can also be measured using a liquid manometer, such as a mercury barometer.
- ◆ Gauge pressure means the pressure above atmospheric pressure.

Station 4.10 Resuscitation: broad complex tachycardia

Information for the candidate

You have been called to see a 76-year-old man in the high dependency unit who had a total hip replacement 12 hours ago. He has a history of ischaemic heart disease and is now complaining of feeling unwell. The nurse has printed out an ECG rhythm strip.

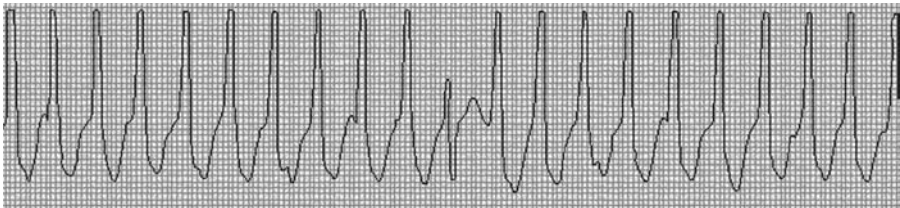


Figure 4.10 ECG.

Examiner's mark sheet

marks

What is this rhythm in Figure 4.10?

2

Broad complex tachycardia.

How would you treat this patient?

3

- ◆ Assess the patient.
- ◆ Assess whether the airway is patent.
- ◆ Administer high concentration oxygen; 15L/minute through a facemask with a reservoir bag.
- ◆ Assess breathing by checking respiratory rate, shortness of breath, auscultation of the chest and checking the peripheral oxygen saturation.
- ◆ Assess the circulation by checking the heart rate, blood pressure and capillary refill.

What clinical features will help you in deciding whether this patient is stable or unstable?

2

- ◆ Consciousness level.
- ◆ Chest pain.
- ◆ Systolic blood pressure <90 mmHg.
- ◆ Heart failure.

This patient is maintaining an airway, he is conscious, doesn't have chest pain and systolic blood pressure is 105 mmHg. How would you treat this patient?

2

Amiodarone 300mg intravenously over 20-60 minutes and then 900mg over 24 hours.

How would you dilute amiodarone?

2

It should be diluted in 5% dextrose.

What is the maximum dose of amiodarone in 24 hours?

1

Maximum dose is 2g per 24 hours.

What are the adverse effects of amiodarone?

2

It causes hypotension and bradycardia.

What is the differential diagnosis?

2

Supraventricular tachycardia with bundle branch block.

How would you treat previously confirmed supra-ventricular tachycardia (SVT) with bundle branch block?

2

Adenosine 6mg intravenous rapid bolus; if unsuccessful, 12mg bolus; if still unsuccessful, administer a further 12mg.

If this patient is unstable what treatment would you instigate?

2

Unstable SVT is treated with synchronised cardioversion, starting with 200J monophasic or 120-150J biphasic energy. If this fails, increase the energy in increments (360J for monophasic, 200J or higher with biphasic).

Total:	/20

Management of broad complex tachycardia

In broad complex tachycardia, the QRS complexes are more than 0.12 seconds in duration. Regular broad complex tachycardia is most likely ventricular tachycardia or SVT with bundle branch block. In a stable patient it should be treated with amiodarone and in an unstable patient it should be treated with synchronised cardioversion.

Irregular broad complex tachycardia is more likely AF with bundle branch block. Another possible cause is AF with ventricular pre-excitation (Wolff-Parkinson-White syndrome).

Amiodarone is used to treat stable ventricular tachycardia (VT), polymorphic VT, broad complex tachycardia of uncertain origin, paroxysmal SVT uncontrolled by other measures and to control ventricular rate in pre-excited atrial arrhythmias. The loading dose of amiodarone is 300mg given over 20-60 minutes, and can be followed by infusion of 900mg over 24 hours. An additional dose of 150mg can be repeated as required to a maximum daily dose of 2g. Major adverse effects are hypotension and bradycardia which can be prevented by reducing the rate of infusion. Amiodarone causes thrombophlebitis when administered through peripheral veins. Whenever possible it should be given through a central venous catheter.

In ventricular pre-excitation, drugs that block AV conduction should be avoided. These include adenosine, digoxin, verapamil and diltiazem.

Key points

- ◆ Broad complex tachycardia in an unstable patient should be treated with synchronised cardioversion.
- ◆ Broad complex tachycardia in a stable patient can be treated with amiodarone.
- ◆ The maximum dose of amiodarone is 2g in 24 hours.

Station 4.11 Anatomy: larynx

Information for the candidate

In this station you will be asked questions on the anatomy of the larynx.

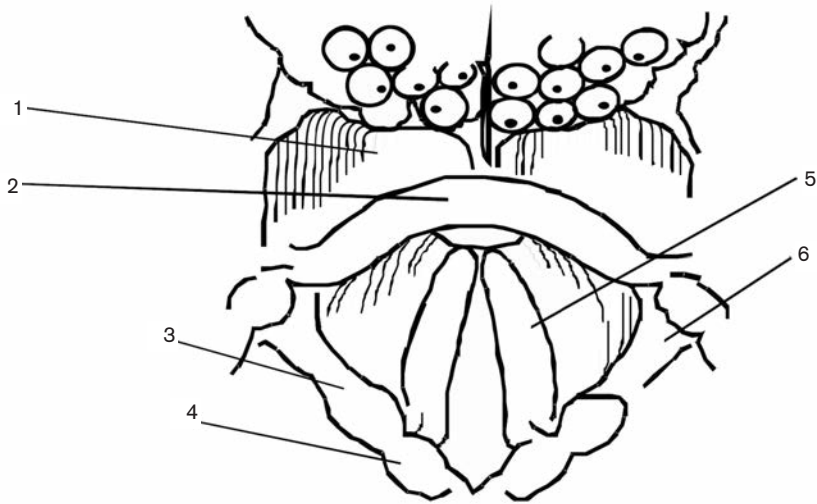


Figure 4.11a Laryngoscopic view of the larynx.

Examiner's mark sheet

marks

Name the structures labelled 1-6 on Figure 4.11a

6

1. Vallecula.
2. Epiglottis.
3. Cuneiform cartilage.
4. Corniculate cartilage.
5. Vocal cord.
6. Aryepiglottic fold.

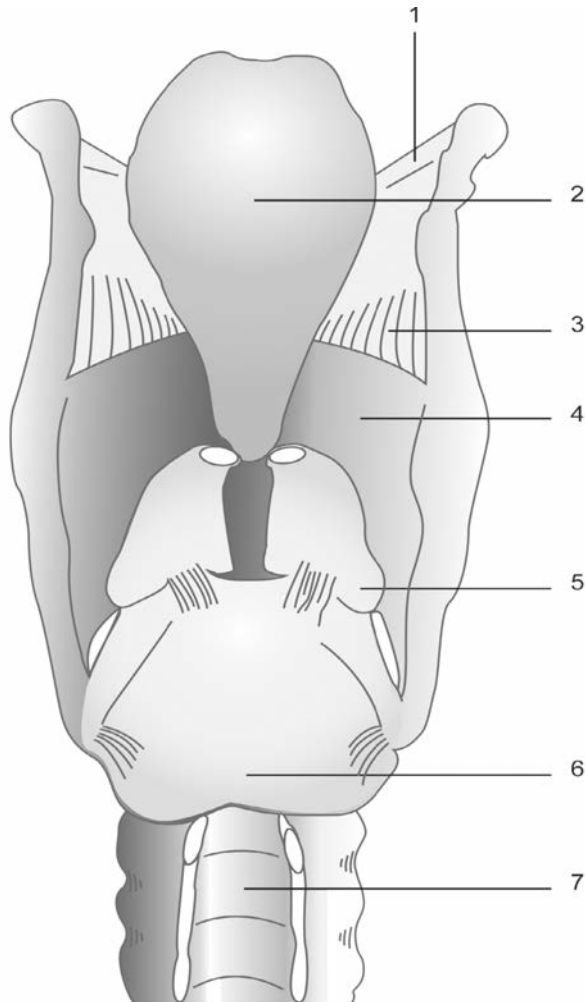


Figure 4.11b Posterior view of the larynx.

Name the structures labelled 1-5 in Figure 4.11b

5

1. Hyoid bone.
2. Epiglottis.
3. Thyrohyoid membrane.
4. Thyroid cartilage.

5. Arytenoid cartilage.
6. Cricoid cartilage.
7. Trachea.

Name the intrinsic muscles of the larynx3

- ◆ Posterior crico-arytenoid.
- ◆ Lateral crico-arytenoid.
- ◆ Vocalis.
- ◆ Cricothyroid.
- ◆ Interarytenoid.
- ◆ Thyro-arytenoid.

What is the nerve supply to the larynx?4

Sensory innervation: the internal laryngeal nerve (branch of the superior laryngeal nerve) provides sensory innervation above the level of the vocal cords. The recurrent laryngeal nerve provides sensory innervation below the level of the vocal cords.

Motor nerve supply: the external laryngeal nerve (branch of the superior laryngeal nerve) supplies the cricothyroid muscle. Motor innervation of all the other intrinsic muscles is by the recurrent laryngeal nerve.

What happens if the unilateral recurrent laryngeal nerve is damaged?2

Unilateral recurrent laryngeal nerve damage leads to paralysis of the ipsilateral posterior crico-arytenoid muscle and unilateral vocal cord paralysis. This produces a hoarseness of the voice.

Bilateral complete nerve injury causes paralysis of both the vocal cords and the cords lie in the neutral position. During quiet respiration there may be adequate airflow. Increasing respiratory effort results in stridor and airway obstruction.

Bilateral partial nerve injury is more likely to cause airway obstruction and stridor.

Total:	/20

Anatomy of the larynx

There are three unpaired and three paired cartilages in the larynx. Unpaired cartilages are the epiglottis, thyroid and cricoid. Paired cartilages are the arytenoid, cuneiform and corniculate.

The laryngeal inlet is bounded anteriorly by the epiglottis, posteriorly by a membrane between the arytenoid cartilages and laterally by the aryepiglottic folds. The aryepiglottic fold contains the cuneiform and corniculate cartilage.

The muscles of the larynx and their action are shown in Table 4.11.

Table 4.11 Muscles of the larynx and their action.

Muscle	Action
Cricothyroid	Tenses the vocal cords
Posterior crico-arytenoid	Abducts the vocal cord
Lateral crico-arytenoid	Adducts the vocal cord
Thyro-arytenoid	Relaxes the vocal cord
Transverse arytenoid	Closes rima glottidis
Oblique arytenoid	Closes rima glottidis
Vocalis	Alters vocal folds

The superior laryngeal nerve branches from the vagus in the upper part of the neck, passes behind the internal and external carotid arteries, and at the level of the hyoid bone it divides into a large internal branch and a small external branch. The large internal branch (internal laryngeal nerve) pierces the thyrohyoid membrane along with the superior laryngeal artery and provides sensory supply above the level of the vocal cords. The external laryngeal nerve carries motor fibres to the cricothyroid muscle.

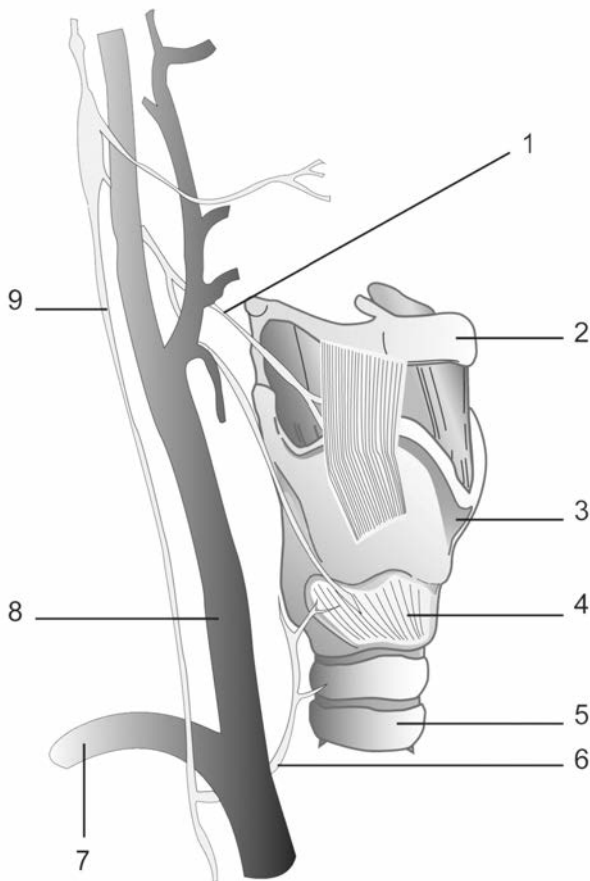


Figure 4.11c Lateral view of the larynx with its nerve supply.

1. Internal laryngeal nerve; 2. Hyoid bone; 3. Thyroid cartilage; 4. Cricothyroid muscle; 5. Trachea; 6. Recurrent laryngeal nerve; 7. Subclavian artery; 8. Common carotid artery; 9. Vagus nerve.

The recurrent laryngeal nerve, a branch of the vagus nerve, ascends upwards in the tracheo-oesophageal groove, pierces the cricothyroid membrane and provides sensory supply to the larynx below the level of the vocal cords.

Techniques of anaesthetising the larynx for awake intubation

For awake fibreoptic intubation, the lower airway can be anaesthetised either with topical anaesthesia or with nerve blocks, topical anaesthesia being more popular.

With the spray as you go technique, 4% lidocaine is injected via the working channel of the fibreoptic scope. An epidural catheter is passed down the working channel of the scope. This allows direct visualisation and application of anaesthetic solution over the epiglottis and the laryngeal mucosa both above and below the level of the vocal cords.

Following topical anaesthesia to the nasal passage and oropharynx, the fibreoptic scope is advanced until the base of the tongue and epiglottis are seen. 1-2ml of 4% lidocaine should be sprayed onto the base of the tongue and epiglottis; a further 1-2ml of local anaesthetic is sprayed onto the glottis and vocal cords. Then the fibreoptic scope is advanced closer to the glottis; an additional 1ml of local anaesthetic is sprayed through the vocal cords onto the trachea. A total of 3-6ml of 4% lidocaine may be required.

An internal laryngeal nerve block (branch of the superior laryngeal nerve) can be performed either by an internal or external approach. The hyoid bone is located directly above the thyroid cartilage. At the lateral most part of the hyoid bone, the greater horn is located which lies close to the carotid artery. The superior laryngeal nerve can be blocked by walking a 25G needle inferiorly off the greater horn and injecting 2ml of 2% lidocaine. Accidental arterial injection is a possible complication.

The internal laryngeal nerve runs just under the mucous membrane covering the pyriform fossa, where it can be easily blocked by applying a cotton wool ball soaked in 2% lidocaine using Krause's forceps. The

oropharynx and posterior two thirds of the tongue need to be anaesthetised before performing this block.

With translaryngeal anaesthesia, the skin over the cricothyroid membrane is infiltrated with local anaesthetic. Then a needle or cannula attached to a syringe containing normal saline is inserted through the cricothyroid membrane; the needle should be directed backwards and caudad to avoid trauma to the vocal cords. Correct placement is confirmed by aspiration of air via the needle. 2-4ml of 4% lidocaine should be injected at the end of inspiration. During the process the patient coughs and anaesthesia should spread both above and below the cords. Complications such as a haematoma, a broken needle and infection have been reported as a result of nerve block, but they are rare.

Key points

- ◆ In infants, the glottis is situated opposite the 3rd and 4th cervical inter-vertebral space.
- ◆ In children it is located opposite the 4th and 5th cervical inter-vertebral space.
- ◆ In adults, the glottis is situated at the level of the 5th cervical vertebra.
- ◆ In adults, the cricoid cartilage is located at the level of the 6th cervical vertebra.
- ◆ If the recurrent laryngeal nerve is partially damaged, adductors override the abductor and the vocal cord becomes fixed in the midline.
- ◆ Bilateral damage of the recurrent laryngeal nerve may result in complete airway obstruction.

Station 4.12 History taking: tympanoplasty

Information for the candidate

In this station you will be asked to take a history from a patient who is scheduled to have a tympanoplasty.

Examiner's mark sheet

	marks
Introduces him/herself, explains his/her role and confirms that he/she is talking to the right person.	1 ☐
Confirms the nature and reason for the proposed surgery (hearing loss).	1 ☐
Previous anaesthetic history.	1 ☐
Details about previous operation.	1 ☐
Elicits past H/O sarcoidosis.	1 ☐
Enquires about progression of sarcoidosis and presence of cough.	1 ☐
Exercise tolerance.	2 ☐
Asks about lung function tests.	1 ☐
Past medical H/O CVA.	1 ☐
Further details on CVA (investigations, full recovery).	2 ☐
H/O hypertension.	1 ☐
Drug history: steroids: prednisolone, stopped a year ago.	2 ☐
Aspirin 75mg per day; antihypertensive: perindopril 4mg once a day.	2 ☐
Social history: smoking/alcohol.	1 ☐

Asks about dentures, crowns and caps.

1

A structured approach of gathering information.

1

Total: /20

Information for the actor

You are 65 years old. You have been having a problem with your left ear for some time. You had an ear infection 2 years ago which left you with a hole in the ear drum of your left ear. You have been waiting to have an operation on the left ear.

You also have a few other health-related problems; they are not your concern now, so do not volunteer further information unless the doctor asks you specific questions. You had a mild stroke 5 years ago; however, you have recovered completely. You have been suffering from sarcoidosis (a condition that produces tiny lumps of cells in various organs of the body, mainly involving the lungs; diagnosed 10 years ago). Your lungs have been mildly affected and you feel perfectly alright now. In the past you were taking steroid tablets (prednisolone) for the sarcoidosis, but your doctor asked you to stop these tablets a year ago. You do not have a cough any more and you feel fit and healthy, except for the trouble with your hearing.

You also suffer from high blood pressure; you have a regular blood pressure check with your doctor and it is under control. You take tablets called perindopril 4mg every day for the blood pressure.

History taking

(refer to OSCE set 1, station 1.12).

Initial approach

Greet the patient and introduce yourself by name, making sure you are talking to the right patient.

History of presenting complaint

Ask the patient what he knows about the operation and details of his presenting complaint. In this case his main problem is hearing loss in the left ear. You should ask about the cause for hearing loss and previous infection.

Always try to explore the reason for the proposed surgery and causes for the presenting pathology. In a patient presenting for a cataract operation, you should elicit the causes for a cataract. Diabetes mellitus or steroid use may be the cause of a cataract.

Past medical history

The patient may not volunteer the history of sarcoidosis since he is asymptomatic now. Certain past medical problems can only be elicited after asking specific questions during a system review. Therefore, a structured approach is more important. In this scenario, the patient may answer specific questions, such as did you have any chest problems in the past? Do you or did you suffer from shortness of breath or cough? Once you have elicited that the patient had sarcoidosis, you must ask further details on progression of the disease and treatment.

Sarcoidosis involves the eyes, bones, joints and heart (cardiomyopathy and conduction defect). It can also cause hypercalcaemic nephropathy and renal calculi. Active disease is treated with oral prednisolone and steroid eye drops.

Considering the patient's age you must ask the history of cardiovascular disease and cerebrovascular disease.

Key points

- ◆ Always follow a structured approach to gather information from the patient.
- ◆ Try to elicit the cause for the presenting surgical pathology.
- ◆ Remember to ask details on current and past medications.

Station 4.13 Simulation: post-induction hypotension

Information for the candidate

A 28-year-old female patient with diagnosis of a ruptured ectopic pregnancy is anaesthetised for a laparotomy.

On entering the station:

General anaesthesia was induced with etomidate and suxamethonium. The laryngoscopy view was grade 1 and the trachea has been intubated and ventilated. You are asked to take over the anaesthetic care soon after induction.

- ◆ Pre-operative BP: 110/84 mmHg, HR: 98 per minute, capillary refill: 4 seconds.

Soon after taking over, the monitor displays a heart rate of 110 and systolic blood pressure of 70 mm Hg.

Examiner's mark sheet

	<i>marks</i>
Identifies hypotension.	2
Checks the heart rate, saturation and EtCO ₂ .	2
Increases inspired oxygen concentration.	2
Rapidly infuses intravenous fluid.	2
Continues volatile anaesthetic.	2
Administers vasoconstrictors.	2
Tilts the table.	2

Informs the surgeon and asks for help. 2

Ensures that blood is available. 2

Manages this incident using a methodical approach. 2

Total:	/20

Information for the examiner

Following pre-oxygenation, general anaesthesia was induced using a rapid sequence induction technique with etomidate and suxamethonium. The trachea was intubated and handed over to the candidate for further management of this patient. Soon after induction, the blood pressure decreases to 70 mm Hg and the heart rate increases to 110 per minute.

The monitor should display: HR: 110 per minute, BP: 70/30 mmHg, SaO₂: 96%, EtCO₂: 3.5 kPa and end-tidal isoflurane: 1.1%.

Hypotension following induction of general anaesthesia

A decrease in blood pressure is commonly observed after induction of general anaesthesia. This is due to vasodilatation and myocardial depression caused by most of the anaesthetic agents used at induction. In hypovolaemic patients, elderly patients and in patients with cardiovascular disease, a significant decrease in blood pressure is anticipated.

This patient was hypovolaemic prior to induction. On induction, vasodilatory and myocardial depressant effects of induction agents led to severe hypotension. There is also a possibility of ongoing blood loss. Immediate management includes measures to increase cardiac output and to maintain tissue perfusion. To control haemorrhage this patient needs immediate surgical intervention; therefore, in this situation it is advisable to proceed with the surgery.

Management of this critical incident involves an airway, breathing and circulation approach. In this scenario the airway is secured with a tracheal tube; correct placement should be confirmed by auscultating the chest and observing EtCO₂. Inspired oxygen concentration should be increased to 100%. Bilateral air entry and adequacy of ventilation is confirmed by auscultation of the chest and EtCO₂. Reduced EtCO₂ may reflect reduced pulmonary perfusion as a result of reduced cardiac output.

On recognising hypotension and tachycardia, other vital parameters should be observed, inspired oxygen concentration should be increased to 100% and the volatile anaesthetic agent should be maintained at 1 MAC level. A low blood pressure reading on the NIBP should be confirmed by feeling the radial or brachial pulse. If a peripheral pulse is not felt, then feel the carotid pulse to rule out pulseless electrical activity.

Management of hypotension at induction of general anaesthesia

Elevation of the legs shifts blood from the lower limbs to the central compartment, thus increasing the preload. Ensure that venous access is secured with two wide-bore (16-14G) intravenous cannulae. A litre of warm Hartmann's solution or colloid solution should be infused rapidly; use the pressure bag or rapid infusion device if needed.

Vasopressor (e.g. metaraminol or phenylephrine) and sympathomimetic amine (e.g. ephedrine) administration maintains the blood pressure until hypovolaemia is corrected.

Hypovolaemic shock unresponsive to fluid resuscitation and significant blood loss, with the haemoglobin less than 8gm/dl, warrants blood transfusion.

In a similar situation where the patient is hypovolaemic due to bleeding, the surgeon should be scrubbed, gowned and ready prior to induction of general anaesthesia. The only way to control haemorrhage is by clamping the bleeding vessel.

Key points

- ◆ After recognition of hypotension, immediately check for other vital parameters.
- ◆ Follow a structured approach to managing post-induction hypotension: ABC, replenishing circulating volume (with fluids), maintaining perfusion (with vasopressors), increasing oxygen-carrying capacity (blood transfusion) and surgical control of bleeding.
- ◆ Ask for help and inform the surgeon to proceed to laparotomy to control the bleeding.

Station 4.14 Monitoring equipment: oxygen analyser

Information for the candidate

In this station you will be presented with equipment used in routine practice for monitoring oxygen concentration.

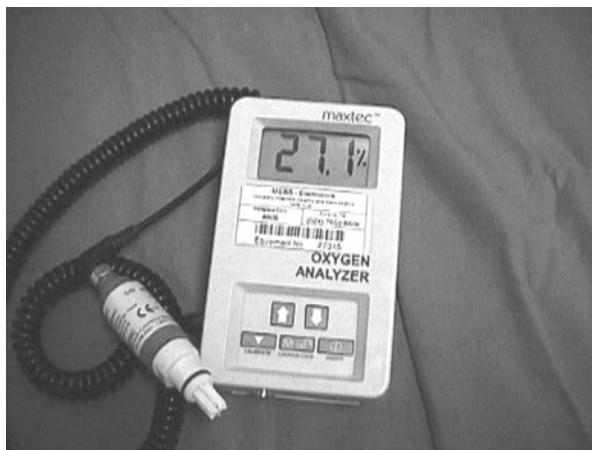
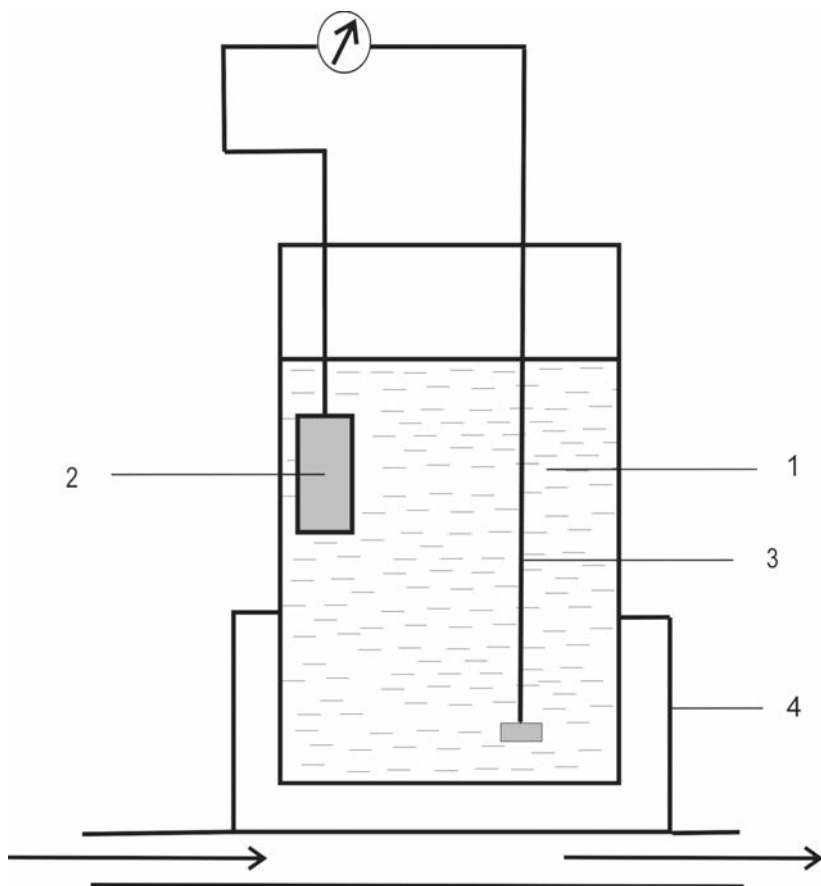


Figure 4.14a.

Examiner's mark sheet**marks****Name the equipment in Figure 4.14a**2

Oxygen analyser - a Galvanic fuel cell.

**Figure 4.14b.**

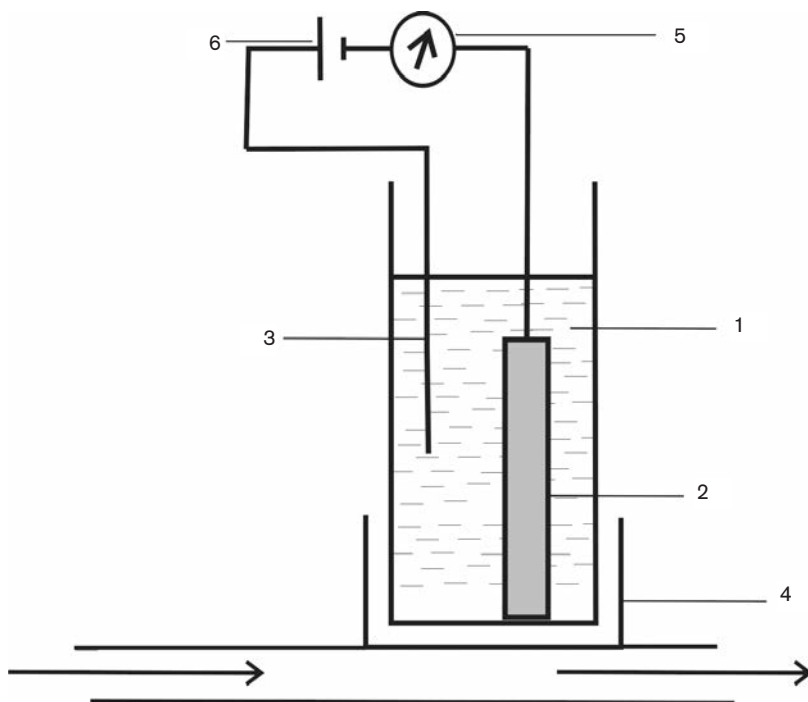


Figure 4.14c.

Indicate which one of these figures (Figure 4.14b or Figure 4.14c) best matches the above equipment in Figure 4.14a

1 ☐

Figure 4.14b is a fuel cell.

Name the parts labelled 1-3 in Figure 4.14b

3

1. Electrolyte: KOH or KHCO_3 solution.
2. Lead anode.
3. Gold cathode.
4. Plastic membrane.

Name the parts labelled 1-6 in Figure 4.14c

6

This is a polarographic Clark electrode.

1. Electrolyte, buffered KOH, KCl or NaCl.
2. Platinum cathode.
3. Anode (silver/silver chloride).
4. Plastic membrane.
5. Galvanometer.
6. Battery.

How would you check the calibration of this equipment?

2

The fuel cell is first exposed to room air and should read 21%. It is then connected to the fresh gas flow outlet of the anaesthetic machine; oxygen flow is set at 5L/minute. It should read 100%.

Explain the principle of oxygen measurement used in a fuel cell

2

At the anode, the combination of hydroxyl ions from the potassium hydroxide electrolyte solution with the lead produces electrons. At the cathode, oxygen combines with electrons and water giving rise to hydroxyl ions. This process generates current which is proportional to the number of electrons consumed at the cathode which in turn is proportional to the number of oxygen molecules available at the cathode.

Can you use this equipment for breath to breath analysis of FiO_2 ?

1

No.

List some other methods of measuring oxygen

3

- ◆ Paramagnetic oxygen analyser.
- ◆ Mass spectrometer.
- ◆ Polarographic Clark electrode.

Total:	/20

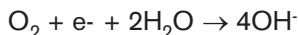
Measurement of oxygen

Concentration of oxygen in a gas mixture can be measured using the following methods:

- ◆ Galvanic fuel cell.
- ◆ Paramagnetic analyser.
- ◆ Mass spectrometer.

Fuel cell

The fuel cell consists of a gold or silver cathode, lead anode and potassium bicarbonate buffer solution. Oxygen molecules diffuse through the membrane and combine with the electrons and water at the cathode to give hydroxyl ions.



The fuel cell produces voltage and hence acts as a battery. Like any other battery it has a shelf life which depends on the duration of exposure to oxygen. The life span is usually limited to 6-12 months.

The fuel cell is compact and does not require a power supply. It is not affected by nitrous oxide. It has a relatively slow response time of around 30 seconds. Hence, it cannot measure breath to breath changes in oxygen concentration.

Paramagnetic oxygen analyser

Oxygen contains two unpaired electrons in the outermost orbit, hence it is attracted towards a magnetic field. Substances attracted by the magnetic field are known as paramagnetic and substances repelled by the magnetic field are known as diamagnetic. Nitrogen and most gases used in anaesthesia are weakly diamagnetic and are repelled by the magnetic field.

In the Pauling paramagnetic analyser, the paramagnetic effect of oxygen displaces the glass spheres connected in a dumb bell arrangement. The degree of rotation of the dumb bell is proportional to the concentration of oxygen in the chamber.

In the null deflection type paramagnetic analyser, the current required to keep the dumb bells in a neutral position is a measure of oxygen concentration.

In a pulsed-field paramagnetic analyser, reference (room air) and sample gas are delivered as separate streams to a magnetic field. These two streams are separated by a pressure-sensitive transducer. The pressure difference across the transducer is proportional to the oxygen concentration.

Mass spectrometer

A mass spectrometer can analyse oxygen from a given gas mixture. Sample gas is ionised by a beam of electrons and the charged ions are then deflected by a magnetic field. Detector plates located at various positions detect the ions according to their charge: mass ratio. It has a rapid response time and can be used for breath to breath analysis of oxygen concentration.

Polarographic Clark electrode

The polarographic Clark electrode is commonly used for measuring the partial pressure of oxygen from a blood sample; when used for gas mixture it gives a lower reading due to the blood: gas factor. The principle is similar to the fuel cell. It consists of a silver/silver chloride anode, platinum

cathode, electrolyte solution and a battery. A membrane permeable to oxygen separates the electrode from the blood sample.

Key points

- ◆ The fuel cell generates a current proportional to the concentration of oxygen.
- ◆ The fuel cell has a slow response time; therefore, it cannot be used for breath to breath analysis of oxygen concentration.
- ◆ The paramagnetic oxygen analyser can measure both inspired and expired oxygen concentration on a breath to breath basis.

Station 4.15 Clinical safety: peripheral nerve injury

Information for the candidate

This station will assess your knowledge and skills in preventing peripheral nerve damage during general anaesthesia.



Figure 4.15a.

Examiner's mark sheet**marks****Identify the problems in Figure 4.15a with regard to positioning of the patient****2**

- ◆ The arm is hyperabducted.
- ◆ The neck is rotated to the other side.

What nerves are likely to be damaged in this position?**4**

Both these factors related to positioning can cause traction on the brachial plexus. Rotation of the neck results in stretch of roots of the brachial plexus, particularly the upper nerve roots. This causes sensory loss over the outer aspect of the arm.

The ulnar nerve can be damaged at the elbow, behind the medial epicondyle (cubital groove).

What precautions would you take to avoid nerve damage?**5**

- ◆ Head should be maintained in the neutral position.
- ◆ Arms should not be abducted $>90^\circ$.
- ◆ Arms should be level with the shoulder.
- ◆ Elbows should be well padded.
- ◆ Forearm should be semipronated.

**Figure 4.15b.**

What nerves are likely to be damaged in the position shown in Figure 4.15b?

4

This patient is in the prone position. The nerves that are likely to be damaged are:

- ◆ Supra-orbital nerve.
- ◆ Infra-orbital nerve.
- ◆ Ulnar nerve at the elbow.
- ◆ Femoral nerve in the inguinal region.



Figure 4.15c.

Identify the problems in Figure 4.15c

2

- ◆ The tracheal tube is not fixed and can be accidentally extubated.
- ◆ The eyes are not protected and are prone to damage.



Figure 4.15d.

What nerve injuries can be expected in Figure 4.15d? 3

- ◆ The mask is pressing on the eye ball, which results in pressure on the optic nerve.
- ◆ Supra-orbital nerve damage results in ptosis.
- ◆ Damage to the buccal branch of the facial nerve results in drooping of the lip.

Total:	/20

Peripheral nerve injury

Seddon's classification is a scheme for describing nerve injury:

- ◆ Neurapraxia: pressure on the affected nerve with no loss of continuity.
- ◆ Axonotmesis: neural tube intact, but the axons are disrupted. These nerves are likely to recover.
- ◆ Neurotmesis: the neural tube is severed. These injuries are likely to be permanent without repair and will likely only achieve partial recovery at best.

Neurapraxia is concussion of the nerve, due to stretching or compression of the intact nerve fibres without any anatomical discontinuity of the fibres. Hence, there is complete recovery of sensory and motor function. Most cases recover in 6 weeks but it may be prolonged for up to 6 months.

Axonotmesis is rupture of the nerve fibres within an intact sheath. Initial clinical features resemble neurapraxia but the recovery of function is incomplete.

Neurotmesis is produced by either partial or complete division of the sheath and nerve fibre, which requires surgical treatment to restore function.

The usual mechanisms of nerve damage in an anaesthetised patient include stretch or compression. Peripheral nerves are subjected to compression between the bone and a hard surface, such as the operating table. Extreme positions of arms and limbs result in stretch of the nerves.

The brachial plexus is most vulnerable to damage as a result of positioning. The brachial plexus has a long, mobile and superficial course in the axilla, between points of fixation. The proximal point of fixation is the vertebral and prevertebral fascia, and the distal point of fixation is the axillary fascia. Rotation and extension of the neck, abduction, external rotation and extension of the arm cause stretching of the plexus. More often, upper roots of the brachial plexus (C5 and C6) are involved, resulting in Erb's palsy. The arm is internally rotated, the forearm is extended and the hand is pronated. Muscles paralysed are the deltoid, biceps, brachioradialis and supinator brevis. Involvement of lower roots (C8, T1) results in paralysis of small muscles of the hand and weakness of finger flexion (Klumpke's palsy). Sensory loss is observed over the inner aspect of the forearm and the medial three and a half fingers.

The ulnar nerve at the elbow is at risk of direct compression with any hard surface when the patient is supine with the arm pronated. Sensory loss is observed over the medial one and a half fingers and medial aspect of the palm. Flexor carpi ulnaris and the medial half of flexor digitorum profundus are paralysed, resulting in hyperextension of the little and ring fingers at the metacarpophalangeal joints. The patient cannot grip a piece of paper placed between the fingers due to paralysis of the small muscles of the hand. If the patient is asked to pinch a piece of paper between the thumb and the other fingers, the thumb assumes a fixed flexed position, as weakness of adductor pollicis brevis permits overaction of the long flexors of the thumb (refer to OSCE set 5, station 5.15, for peripheral nerve injury and resulting sensory loss).

The median nerve can be injured as a consequence of a prolonged tourniquet at the arm; the radial nerve can also be involved. This results in sensory loss over the thumb and medial two and a half fingers. The index finger and thumb cannot be flexed due to the paralysis of flexor carpi radialis and flexor pollicis longus. The muscles of the thenar eminence will be paralysed and wasted.

The radial nerve may be injured at the radial groove due to compression against the hard surface of an operating table. Sensory loss is observed over the dorsum of the forearm and dorsum of the thumb. Paralysis of extensors of the wrist and fingers results in wrist drop.

Key points

- ◆ While positioning the patient for surgery, appropriate care should be taken to prevent nerve damage.
- ◆ A common mechanism of nerve damage is either stretch or compression of the nerve against a hard object.
- ◆ The brachial plexus is most vulnerable to damage at the head and neck region.

Station 4.16 Radiology: chest X-ray

Information for the candidate

A 55-year-old female patient is listed for arthroscopy of the knee joint. She is 165cm tall and weighs 82Kg. She smokes 20 cigarettes per day and has a history of cough. Her current medication includes lansoprazole and paracetamol. A chest X-ray taken during the pre-operative assessment is displayed at this station.

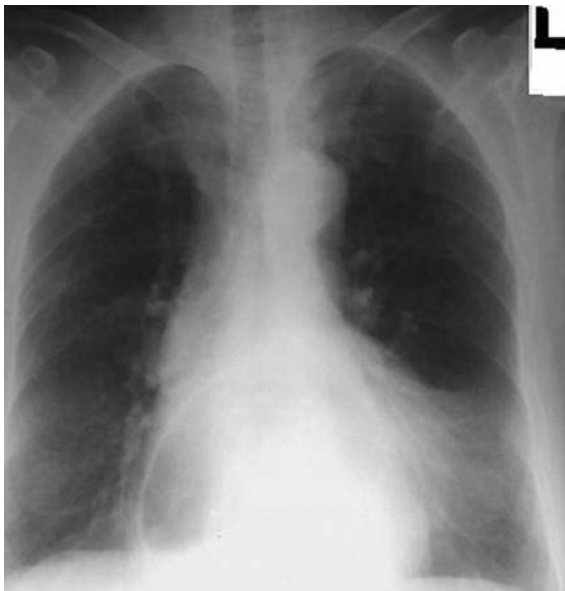


Figure 4.16 Chest X-ray.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. This is a PA view.	True	False	2	☐
2. The trachea is deviated to the right.	True	False	2	☐
3. There is a right-sided pleural effusion.	True	False	2	☐
4. There are radiological features suggesting an upper lobe diversion of pulmonary blood flow.	True	False	2	☐
5. This patient has a loculated pericardial effusion.	True	False	2	☐
6. This patient is likely to have heartburn.	True	False	2	☐
7. This patient needs pre-medication with a H ₂ receptor antagonist.	True	False	2	☐
8. This patient is not suitable for a day-case surgical procedure.	True	False	2	☐
9. A laryngeal mask airway with positive pressure ventilation can be used safely in this patient.	True	False	2	☐
10. Endoscopic examination of the upper gastrointestinal tract is indicated.	True	False	2	☐

Total:	/20

Answers

1. True. This is a PA view because the scapulae are completely away from the lung field and the lateral ends of the clavicles are directed upwards indicating that the arms are abducted during the exposure of the X-ray.
2. False. The trachea is in a central position; a tracheal shadow is equidistant from the the medial ends of the clavicles.
3. False.
4. False.

5. False. A shadow from a segment of the stomach is super-imposed on the heart shadow. In a loculated pericardial effusion the radiolucent shadow will lie on the periphery of the cardiac border.
6. True. Heartburn is one of the common symptoms of hiatus hernia.
7. True. An H₂ receptor antagonist, such as ranitidine, reduces hydrochloric acid production and reduces the pH of the gastric content.
8. False. Surgery can be performed as a day-case procedure, provided other criteria for day-case surgery are fulfilled.
9. False. This patient has an increased risk of aspiration; therefore, rapid sequence induction with tracheal intubation should be performed in this patient.
10. True. A barium meal or endoscopy is useful in assessing the size and severity of the hernia.

Hiatus hernia

Hiatus hernia occurs when a part of the stomach protrudes through the diaphragmatic hiatus into the thoracic cavity. A sliding hiatal hernia interferes with the normal anti-reflux mechanisms. As the lower oesophageal sphincter moves into the chest, the normal anatomical sphincter mechanism is lost. Therefore, regurgitation of gastric contents is more likely to occur. This also results in reflux oesophagitis.

In para-oesophageal hiatus hernia, a small part of the stomach rolls upwards into the chest through the hernia alongside the oesophagus. On an erect chest X-ray the hernia may be seen as a retrocardiac mass with or without an air-fluid level. The hernia is usually positioned to the left of the spine; however, larger hernias may extend beyond the cardiac confines and even mimic cardiomegaly.

Common symptoms include heartburn and water brush (acid taste in the mouth with reflex salivation) and dyspepsia. A barium meal or endoscopy

should be performed to confirm the diagnosis. Retrosternal chest pain caused by reflux may sometimes mimic myocardial ischaemia.

Key points

- ◆ On an erect chest X-ray a hiatus hernia can be seen as a retrocardiac shadow.
- ◆ A hiatus hernia increases the risk of regurgitation of gastric contents.
- ◆ Appropriate measures should be taken to prevent regurgitation and aspiration of gastric contents.

Station 4.17 History taking: total hip replacement

Information for the candidate

In the following station you will be asked to take a history from a 70-year-old male patient who is scheduled to have a total hip replacement.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient and confirms that he/she is talking to the right person	1 ☐
Confirms the proposed surgery.	1 ☐
Enquires as to the reason for the proposed surgery.	1 ☐
Enquires about details of involvement of other joints.	1 ☐
Asks about neck pain and range of movement.	1 ☐
Elicits the impact on physical activity.	2 ☐

Elicits H/O depression and treatment.	1	☐
Elicits H/O heartburn.	1	☐
Enquires about investigations, e.g. endoscopy or barium meal to rule out a hiatus hernia.	2	☐
Asks about the treatment for heartburn and confirms that there is no reflux.	2	☐
Previous anaesthetic history.	1	☐
Specific questions regarding PONV and elicits the severity of PONV.	2	☐
Asks details about previous operation.	1	☐
Elicits full drug history, including an allergy to penicillin.	2	☐
Allows patient to explain the problems, seeks appropriate clarification and summarises at the end.	1	☐

Total: /20

Information for the actor

You are in hospital for an operation on your right hip (total hip replacement, a new artificial hip joint). Your surgeon told you that due to wear and tear in your right hip you need a new joint. The pain in your right hip has been getting worse over the last 3 years and you have been waiting for more than a year to have this operation. You are not able to walk much because of your arthritis and pain in both hips, especially the right. You also have some neck pain due to arthritis, but you can move your neck without much difficulty. You are a little concerned about having a general anaesthetic, since you were very sick last time following a hernia operation 5 years ago.

You also suffer from occasional heartburn when you eat a heavy meal. This settles with Gaviscon (antacid). Recently you underwent endoscopy (camera through the food pipe) and a hiatus hernia was ruled out. You are a bit depressed, mainly due to this crippling arthritis. You also take tablets for high blood pressure. Your doctor regularly checks your blood pressure; it has always been under control.

You are taking the following medications:

- ◆ Prozac (fluoxetine) 20mg at night for depression.
- ◆ Gaviscon (antacid) for heartburn.
- ◆ Atenolol 50mg twice daily for blood pressure.
- ◆ Cocodamol 2 tablets 4 times a day and tramadol 1 tablet twice a day for pain.

Key points

- ◆ If there is a history of arthritis remember to ask about involvement of other joints, in particular the neck. Find out more about the range of movement of the neck and any neurological deficits in the upper limbs due to neck involvement.
- ◆ Exercise tolerance can be limited by arthritis.
- ◆ If there is a history of heartburn, find out whether there is any history of a position-related reflux.

(For more information please refer to OSCE set 1, station 1.12).

Station 4.18 Communication: labour analgesia

Information for the candidate

In this station you will meet a 36-week pregnant patient. She would like to discuss her concerns about epidural analgesia.

Examiner's mark sheet**marks**

Introduces him/herself and greets the patient.	1	
Elicits the patient's concern about the epidural.	2	
Asks details about previous epidural (duration, resiting).	2	
Asks details about backache and any neurological problems.	2	

Procedure

◆ After inserting the initial needle, a small thread-like tube is inserted into the epidural space, and then the needle is removed.	2	
◆ A local anaesthetic (numbing medicine) infusion or a top up is given through a catheter to relieve the pain.	2	
◆ There is a small risk of headache and it may cause a drop in blood pressure. The numbness and heavy legs will last for the duration of epidural analgesia.	2	

Complications

◆ Effect of epidural on the progression of labour.	1	
◆ Failure to provide complete analgesia.	2	
◆ Failure of technique.	2	
Uses clear language and avoids jargon.	1	
Provides adequate reassurance, empathises and maintains good eye contact.	1	

Total:	/20

Information for the actor

You are 36 weeks pregnant. This is your second pregnancy. You had an epidural during your previous delivery; it was not successful. After 6 hours, another epidural was inserted, which worked but you delivered soon afterwards. Nobody explained to you why the first epidural failed.

This time you would like to have an epidural, but you are concerned that the same experience will happen again. You also suffer from backache. You are worried that it may get worse after having an epidural.

Technique of epidural anaesthesia

To obtain a patient's consent and co-operation, it may be useful for the patient to know the following information.

An intravenous cannula (a drip) is sited usually on the back of the hand and the procedure is performed with full aseptic precautions. The epidural is performed in the lateral or sitting position. The patient needs to keep still during the procedure and should indicate if they are experiencing pain or contractions. Fetal heart rate monitoring will be continued without interruption during the procedure.

First, numbing medicine is applied to the skin. Then, with a needle, the epidural space is located. A small tube, a catheter, is passed into the epidural space; the catheter should be secured well. Continuous infusion or intermittent top-ups of local anaesthetic are used to provide labour pain relief.

Epidural analgesia produces numbness and heaviness of the legs lasting for a few hours after the last top-up of the epidural. The possibility of global failure or missed segments should be explained. The anaesthetist or midwife will be checking the block. Blood pressure is checked at regular intervals. It usually takes about 15-20 minutes to provide pain relief after an initial dose. Occasionally, if the pain relief is incomplete, some adjustments of the dose and tube position (catheter may need to be withdrawn slightly) may be needed; rarely it has to be resited.

Complications of epidural analgesia

Immediate complications include hypotension, accidental intravascular injection, total spinal, dural puncture and headache.

An element of motor block is inevitable which may result in a prolonged second stage of labour and a higher incidence of instrumental delivery; urinary retention may be present, necessitating catheterisation of the bladder.

Backache is common during pregnancy and often continues afterwards. Epidurals do not appear to cause long-term backache. There may be some tenderness over the insertion site for a day or two.

Delayed complications are epidural haematoma, infection and neurological complications.

Key points

- ◆ Ask for the details about any previous epidurals and the patient's concerns.
- ◆ Explain the procedure and side effects clearly.
- ◆ Appropriate reassurance should be given to the patient.

Station 4.19 Clinical skill: cricoid pressure

Information for the candidate

A 25-year-old male patient has presented for an emergency appendicectomy. Rapid sequence induction of general anaesthesia is planned. In this station you will be asked to demonstrate application of cricoid pressure on a manikin.

Examiner's mark sheet**marks**

Ensures that the procedure has already been explained to the patient.

2

Correctly locates the cricoid cartilage on the manikin.

2

Uses the correct method of applying pressure.

2

What is the purpose of cricoid pressure?

2

Correctly applied cricoid pressure occludes the oesophagus between the cricoid cartilage and cervical vertebrae, and prevents aspiration.

Why is the cricoid cartilage chosen?

2

The cricoid cartilage is chosen because it is a complete cartilaginous ring, so the force applied to the front of the cricoid will occlude the oesophagus between the posterior aspect of the cartilage and the body of cervical vertebra.

How much pressure should you apply?

2

Recommended pressure is 30-40 N (equivalent to 3-4Kg).

Who first described the technique and when?

2

Sellick described the technique in 1961.

What are the complications of this technique?

2

If applied during active vomiting it can lead to oesophageal rupture. Cricoid pressure restricts the movement of the hyoid bone and therefore may result in a difficult laryngoscopy.

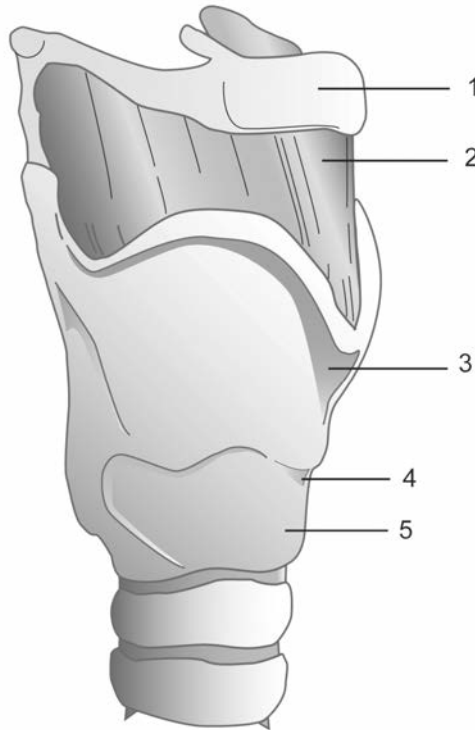


Figure 4.19a Lateral view of the larynx.

Name the parts labelled in Figure 4.19a

4

1. Hyoid bone.
2. Thyrohyoid membrane.
3. Thyroid cartilage.
4. Cricothyroid membrane.
5. Cricoid cartilage.

Total:	/20

Information for the examiner

This patient is on the table, intravenous access is secured and standard monitoring is attached. The patient is now pre-oxygenated and is ready to be induced.

Cricoid pressure

Cricoid pressure was described by Sellick in 1961 to reduce the risk of aspiration syndrome. Correctly applied cricoid pressure occludes the oesophagus between the cricoid cartilage and cervical vertebra. The key to success of cricoid pressure is the proper application until the airway is protected using a cuffed tracheal tube. It is recommended to use 10N (1Kg) of pressure while the patient is awake and then to increase to 30N as the patient loses consciousness. More than 20N generally prevents passive aspiration and more than 40N may cause airway obstruction and a difficult laryngoscopy. Cricoid pressure can protect against aspiration, even in the presence of a nasogastric tube.

To identify the cricoid cartilage (refer to OSCE set 1, station 1.7), use the index finger to identify the thyroid notch and then follow the finger downwards in the midline; a dip is felt below the thyroid cartilage. This is the cricothyroid space. The prominent structure felt immediately below this is the cricoid cartilage. Once identified, it should be fixed between thumb and middle finger.

When applying the pressure, firm backward pressure is applied on the cricoid cartilage using the thumb and middle finger. The index finger should be placed on the thyroid cartilage to ensure that the cricoid ring is fixed in the midline position.



Figure 4.19b Method of applying cricoid pressure.

The appropriate technique and correct amount of pressure can be practised on cricoid pressure simulators. The amount of pressure required can be practised in pounds or kilogram weight on a weighing scale.

Key points

- ◆ The cricoid cartilage is a complete cartilaginous ring situated at the level of the 6th cervical vertebra in adults.
- ◆ Rapid sequence induction and the correct application of cricoid pressure reduces the risk of aspiration.

Station 4.20 Anatomy: caudal block

Information for the candidate

In the station you will be asked to demonstrate the technique of caudal block. A 6-year-old child weighing 20Kg is scheduled for an inguinal hernia repair.

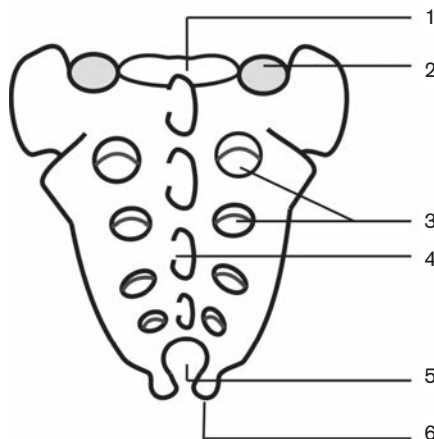


Figure 4.20 Posterior surface of the sacrum.

Examiner's mark sheet

marks

Name the structures labelled 1 to 3 on Figure 4.20

3

1. Sacral promontory.
2. Superior articular process.
3. Posterior sacral foramina.
4. Median crest.
5. Sacral hiatus.
6. Sacral cornu.

How is the sacral hiatus formed?

2

By failure of fusion of the 5th (occasionally the 4th as well) sacral laminar arch, resulting in a gap which is the sacral hiatus.

At what level do the spinal cord and dura end?

2

The spinal cord ends at the level of the L2 vertebra in children.
The dura ends at the level of the S2 vertebra.

Describe the technique of performing a caudal block in this child

5

- ◆ Ensure that the patient (parent) has been consented.
- ◆ Ensure that venous access is secured.
- ◆ Under general anaesthesia.
- ◆ Aseptic technique.
- ◆ Lateral position.
- ◆ Identify the sacral hiatus.
- ◆ 22G needle or cannula introduced at a 45° angle to the skin.
- ◆ Puncture the sacro-coccygeal membrane.
- ◆ Flatten the needle and advance 1-2cm.
- ◆ Stabilise the needle.
- ◆ Negative aspiration.
- ◆ Inject the local anaesthetic. 12-16ml of 0.25% bupivacaine can be used in this patient (maximum 2mg/Kg of bupivacaine, ropivacaine or levobupivacaine).

What volume would you use in adults?

2

20-30ml of 0.25% to 0.5% of bupivacaine is used in adults.

What are the benefits of caudal block in this child?

2

It supplements general anaesthesia and provides both intra-operative and postoperative analgesia.

What are the complications of caudal block?

4

Bleeding, intravascular injection, subarachnoid injection, inadequate analgesia, failure of the technique.

Total:	/20

Anatomy of the caudal epidural space

The sacrum is a large triangular bone. The apex articulates with the coccyx and the base articulates with the 5th lumbar vertebra. On the dorsal surface of the sacrum in the midline is the middle sacral crest, surmounted by 3 or 4 tubercles, the rudimentary spinous processes of the upper 3 or 4 sacral vertebrae. The laminae of the 5th sacral vertebra, and sometimes those of the 4th, fail to meet and thus a deficiency occurs in the posterior wall of the sacral canal. This is called the sacral hiatus. The tubercles which represent the inferior articular processes of the 5th sacral vertebra are named the sacral cornua. The sacral hiatus is covered by a sacro-coccygeal membrane. The sacral canal contains areolar connective tissue, fat, sacral nerves, lymphatics, the filum terminale and a rich venous plexus.

Caudal block

In children, caudal block is generally performed after inducing general anaesthesia. Important landmarks to be identified are the sacral hiatus and the two posterior superior iliac spines which form an equilateral triangle. The sacral cornua are felt on either side of the hiatus. Under aseptic

technique, a 20 or 22G needle or cannula is inserted through the sacral hiatus in a slightly cranial direction to pierce the sacrococcygeal membrane. A click is felt as the needle passes through the membrane. Because of rich vascularity and the possibility of anatomical variation in attachment of the dura, the need for careful negative aspiration cannot be overemphasized. After negative aspiration, the calculated mixture of local anaesthetic should be injected slowly. At times, ketamine (at a dose of 0.5mg/Kg body weight) is added in the mixture to improve the quality and duration of postoperative analgesia. In view of the technical ease involved and relatively free epidural space with minimal fat, a catheter can be introduced upwards to provide analgesia even for upper abdominal and thoracic procedures.

The volume of 0.25% bupivacaine or levobupivacaine used depends on the site of surgical procedure:

- ◆ Lumbosacral block - 0.5ml/Kg.
- ◆ Thoracolumbar block - 1.0ml/Kg.
- ◆ Mid-thoracic block - 1.25ml/Kg.

As the maximum dose of bupivacaine is 2mg/Kg, to make up the volume 0.9% saline can be added.

Key points

- ◆ A caudal epidural is an important regional technique used to provide intra-operative and postoperative analgesia in paediatric surgery.
- ◆ Adjuncts such as clonidine or ketamine are added to the mixture to improve quality and duration of analgesia.
- ◆ In view of vascularity, inadvertent intravascular injection and local anaesthetic toxicity are possible.

OSCE

set 5

Station 5.1 Anaesthetic equipment: airway equipment

Information for the candidate

In this station you will be shown some photographs of airway equipment and asked further questions related to tracheal intubation.

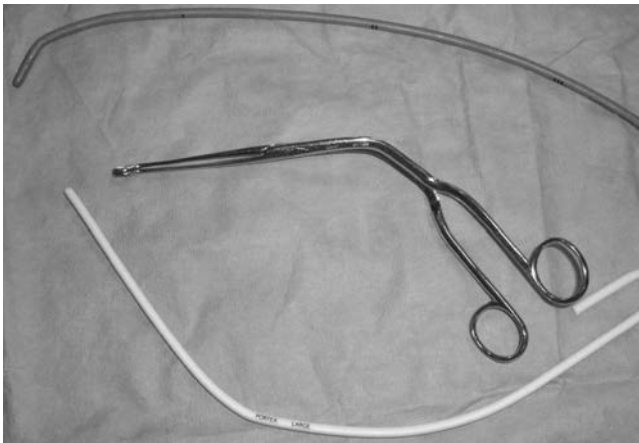


Figure 5.1a.

Examiner's mark sheet

marks

Name the equipment in Figure 5.1a

3

- ◆ Gum elastic bougie (Eschmann tracheal tube introducer).
- ◆ Magill's forceps.
- ◆ Intubating stylet.

What are Magill's forceps used for?2

Magill's forceps are used as an aid for nasotracheal intubation, to insert a throat pack, to pass a nasogastric tube and to remove a foreign body from the oropharynx.

What is the bougie used for?1

It is used as an aid in difficult intubation to facilitate tracheal intubation.

How would you grade the laryngoscopic view?4

Cormack and Lehane's classification of laryngoscopic view:

- ◆ Grade 1: most of the glottis is seen.
- ◆ Grade 2: only the posterior part of the glottis is seen.
- ◆ Grade 3: only the epiglottis is visible.
- ◆ Grade 4: even the epiglottis is not visible.

What manoeuvres are useful in improving the laryngoscopic view?3

- ◆ Optimum sniffing position.
- ◆ BURP: backward, upward, right-ward pressure on the thyroid cartilage.
- ◆ In rapid sequence induction, excessive force applied during cricoid pressure may worsen the laryngoscopic view; a transient release of cricoid pressure may improve the laryngoscopic view.

What signs would indicate that the bougie is in the trachea rather than in the oesophagus?2

When the angled tip of the bougie slides down the trachea, the tracheal rings can be felt as clicks. A distal hold up is sensed as a slight resistance when the tip enters the bronchial tree. If the patient is not fully paralysed, the patient is likely to cough as the bougie enters the trachea.

What are the complications of using a bougie?

2

Insertion of a bougie can be associated with complications, such as soft tissue trauma and bronchial rupture.

What should you do if the bougie is in the correct place, but the tube is caught at the laryngeal inlet?

1

A 90° anticlockwise rotation of the tube facilitates passage of the tube into the trachea.



Figure 5.1b A laryngoscope.

Name the laryngoscope in Figure 5.1b and state its clinical use

2

The McCoy laryngoscope is a levering laryngoscope. The blade has a tip which when levered lifts the epiglottis and can convert Cormack and Lehane's grade 3 view into a grade 2 or a grade 2 into a grade 1 view.

Total: /20

Key points

- ◆ A gum elastic bougie is a useful device in managing difficult intubation. It is more effective than an intubating stylet when the laryngoscopic view is grade 3.
- ◆ A McCoy laryngoscope has a levering tip which moves anteriorly and lifts the epiglottis.

Station 5.2 Data interpretation: lung function tests

Information for the candidate

A 62-year-old male patient is scheduled for total hip replacement. He has smoked 10-15 cigarettes per day for the past 30 years. He also gives a history of shortness of breath and cough. Table 5.2a shows the results of lung function tests performed during the pre-operative assessment.

Table 5.2a Results of lung function tests.

Spirometry Age: 62 years, Height: 170cm, Weight: 68Kg, Sex: male.

	Predicted value	Observed value		Observed value	
		Pre	% pred	Post	% pred
FVC L	3.8	3.4	89	3.3	87
FEV1 L	2.9	1.8	62	1.9	66
FEV1/FVC %	76	55	-	58	-
FEF 25-75 L/S	2.8	1.2	43	-	-
PEFR L/S	7.5	3.5	47	3.8	51

Lung volumes

FRC L	2.7	4.2	156%
VC L	3.8	3.5	92%
RV L	2.1	3.2	152%
TLC L	6.2	7.2	116%

Pre: prior to bronchodilator therapy

Post: after bronchodilator therapy

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. These results are compatible with restrictive lung disease.	True	False	2	☐
2. The FEV1 is normal for this patient.	True	False	2	☐
3. This patient is likely to have emphysema.	True	False	2	☐
4. The FVC is the volume of air breathed out in the first second during forced expiration.	True	False	2	☐
5. The most common cause is acute asthma.	True	False	2	☐
6. Bronchodilators are useful in this patient.	True	False	2	☐
7. The FRC can be measured using spirometry.	True	False	2	☐
8. The ECG may show abnormal P waves.	True	False	2	☐
9. This patient may benefit from steroids.	True	False	2	☐
10. Carbon monoxide transfer would be increased in this patient.	True	False	2	☐

Total:	/20

Answers

- False. The FVC is normal and FEV1 is markedly reduced in this patient. The ratio of FEV1/FVC is reduced, suggestive of obstructive lung disease. In restrictive lung disease, the FVC would be reduced and the ratio of FEV1/FVC would be increased or may remain normal.
- False. The FEV1 is reduced. It is 62% of actual predicted value.
- True. Increased total lung capacity (TLC) and increased residual volume (RV) suggest emphysema.
- False. Forced expiratory volume in 1 second (FEV1) is the volume of air breathed out in the first second, whereas forced vital capacity (FVC) is the volume of air breathed out during forced expiration following a deep inspiration.

5. False. Asthma is a reversible obstructive airway disease which improves with bronchodilator therapy, therefore post-test results should show more than a 15% increase in the FEV1 value.
6. False. The test shows no significant improvement in results following administration of bronchodilators.
7. False. The functional residual capacity (FRC) can be measured using a nitrogen wash-out or helium dilution technique.
8. True. As a result of obstructive airway disease, the resulting hypoxic pulmonary vasoconstriction can lead to cor pulmonale. Tall and wide P waves are seen in right atrial enlargement secondary to cor pulmonale.
9. True. In COAD, a trial of inhaled steroids are given; if they are found to be of benefit in reducing the symptoms then they are continued; otherwise they are cautiously withdrawn.
10. False. Carbon monoxide transfer is reduced in emphysema.

Lung function tests

This patient's lung function tests are suggestive of obstructive airway disease. Measured FEV1 is markedly reduced; the ratio of FEV1/FVC is 55%. Lung volumes suggest hyperinflation (raised TLC) and gas trapping (raised RV).

Lung function tests are interpreted by comparing the observed values with predicted values. Predicted values depend on the patient's age, sex and height. Spirometry is the simplest of all the lung function tests. It is a measure of airflow and lung volumes during forced expiration following a full inspiration. FEV1, FVC and the ratio of FEV1/FVC are the 3 basic measurements obtained from spirometry. These 3 parameters are useful in distinguishing obstructive lung disease from restrictive lung disease.

In obstructive airway disease (asthma and COAD), airflow during expiration is reduced resulting in a reduced FEV1. A FEV1/FVC ratio less than 70% indicates obstructive airway disease; the FEV1 indicates the severity of airway obstruction. In severe obstructive airway disease, FEV1 is less than 40% of the predicted value.

In restrictive airway disease, FVC is reduced; the absolute value of FEV1 is less than predicted, but the ratio of FEV1/FVC is normal or may be high. Restrictive disorders are caused by reduced compliance of the chest wall (obesity, kyphoscoliosis) or by interstitial lung fibrosis.

The above is summarised in Table 5.2b.

Table 5.2b Lung function tests.		
Test	Restrictive lung disease	Obstructive lung disease
FEV1	Reduced	Reduced
FVC	Reduced	Normal/Increased
FEV1 / FVC	Normal/Increased	Decreased

A forced expiratory flow between 25-75% of the FVC (maximum mid-expiratory flow) can also be obtained from spirometry, indicating airflow in medium and small airways. It is reduced in asthma.

To assess the reversibility of airway obstruction, spirometry is repeated 15-30 minutes after bronchodilator therapy. An improvement of 15% of FEV1 or FVC is considered as significant reversibility. A significant improvement in spirometry following bronchodilator therapy suggests asthma. Airflow obstruction in COAD is irreversible.

The carbon monoxide transfer factor (TLCO) is the product of the two primary measurements during breathholding: the CO transfer coefficient (KCO) and the alveolar volume (VA).

Because of a non-linear increase in pulmonary capillary oxygen tension, calculation of the transfer factor for oxygen is difficult. Carbon monoxide is a gas with 230 times more affinity for haemoglobin when compared to that of oxygen. The calculation of TLCO is based on the assumption that plasma CO tension is negligible. Several methods have been developed to measure TLCO, the commonly used ones being single breath (gold standard), and multiple breath tests. The values are expressed as mmol/min/kPa. The size of TLCO will depend on a variety of parameters, including the amount of available haemoglobin, the volume of ventilated alveoli and perfused lung capillaries, and their relation to each other. Values for TLCO decrease with age and increase with physical activity and increased lung volumes. A decreased TLCO will be found in both restrictive and obstructive lung disorders.

Key points

- ◆ A reduced FEV1 with a reduced FEV1/FVC ratio suggests obstructive airway disease.
- ◆ A reduced FVC with a normal or high FEV1/FVC ratio suggests restrictive lung disease.
- ◆ An increase in FVC or FEV1 by more than 15% following bronchodilators suggests significant reversibility.

Station 5.3 Data interpretation: statistics

Information for the candidate

In this station you will be provided with a set of statistical data. Read the given data and answer the questions as true or false on the marking sheet.

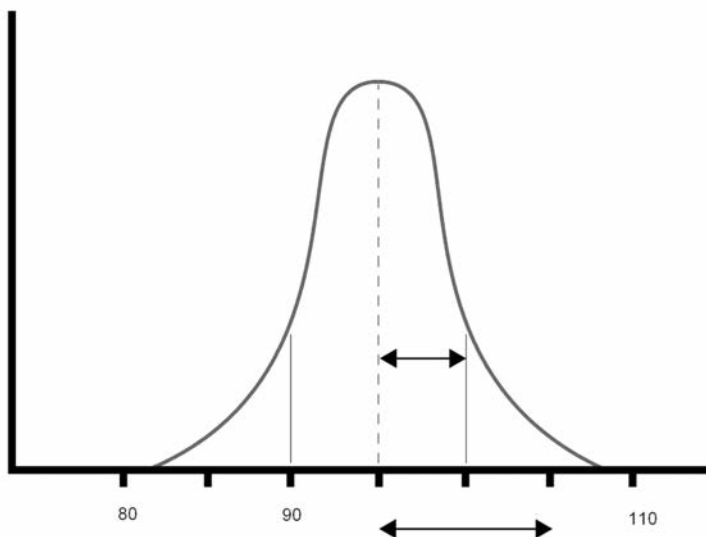


Figure 5.3a Represents the heart rate of 100 ASA 1 children on admission to a day-surgery unit (x axis: heart rate, y axis: number of children).

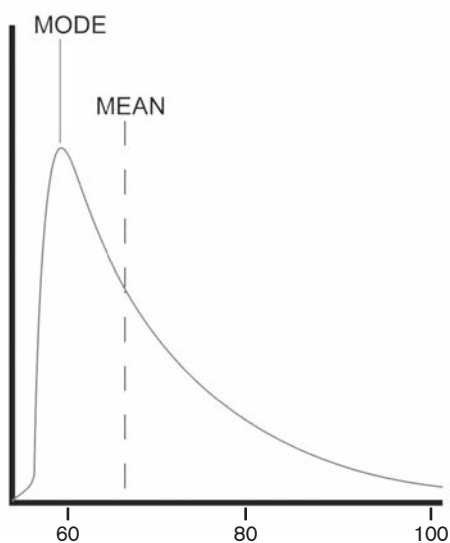


Figure 5.3b Represents the heart rate of 100 patients (age varying from 30-70 years and ASA 1-4) 5 minutes after administration of $1.5\mu\text{g/Kg}$ of fentanyl (x axis: heart rate, y axis: number of patients).

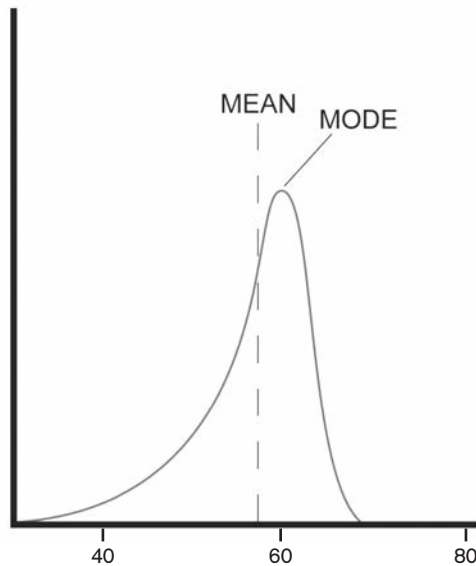


Figure 5.3c Represents the heart rate of 100 hypertensive patients 2 weeks after starting a new beta blocker (x axis: heart rate, y axis: number of patients).

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. Figure 5.3a represents a Gaussian distribution of data. True False 2 ☐
2. Parametric tests can be used for the data in Figure 5.3a. True False 2 ☐
3. In Figure 5.3a, the mean is usually greater than the median. True False 2 ☐
4. Figure 5.3a also represents a positively skewed distribution. True False 2 ☐
5. In Figure 5.3a, 95% of the observations fall within one SD. True False 2 ☐
6. In Figure 5.3b, data are normally distributed. True False 2 ☐

7. In Figure 5.3c, data are negatively skewed. True False 2 ☐
8. A student's t-test may be used to compare the parametric data. True False 2 ☐
9. A Chi-square test is used for analysing the qualitative data. True False 2 ☐
10. A $p < 0.01$ means that the results are significant at the 5% level. True False 2 ☐

Total:	/20

Answers

1. True. This is a symmetrical bell-shaped distribution where mean, median and mode are all equal. In quantitative data, variation is expressed around the central tendency.
2. True.
3. False. As explained in 1 above.
4. False. This represents a normal distribution.
5. False. In a normal distribution, 68% of the observations fall within one standard deviation (SD). 95% of the observations fall within two SD and 99.7% of the observations fall within three SD.
6. False. It is positively skewed; distribution is not symmetric. It has a longer tail towards higher values. In general, in a skewed distribution, the median and interquartile range are more appropriate.
7. True. It has a longer tail towards lower values.
8. True. A student's t-test may be used to compare two sets of normally distributed data. If the two sets of data belong to the same group of patients, a paired t-test is used. A set of blood pressure readings before/after administering propofol can be compared using a paired t-test. Two separate series of results can be compared using an unpaired t-test.

9. True.

10. False. It means that the results are significant at the 1% level.

Statistical values

In many physiological measurements the shape of frequency distribution approaches the normal distribution curve. The central location can be described by a mean which is the same as the mode and median. The variability from the central location is described in terms of standard deviation. A normal distribution has the characteristic bell curve. In a normal distribution, 68% of all observations fall within a range of ± 1 standard deviation, 95% within ± 2 standard deviation and 99.99% within ± 4 standard deviation.

When the frequency distribution curve is not symmetrical, the distribution is skewed. In a skewed distribution mean, the median and mode have different values. If one of the values or observations increases, the mean of the sample increases without changing the mode and median. The standard deviation will have a large value, usually more than half the mean in a skewed distribution. The variability of values is better described by percentiles (interquartile range). The difference between the first and third quartiles is known as the interquartile range.

In a positive skew, the mode is at the top of the curve, the median is higher than that, and the mean is higher than the median. In a negative skew, the mode is at the top of the curve, the median is lower than it, and the mean is lower than the median.

Key points

- ◆ A normal distribution has the characteristic bell curve.
- ◆ In a normal distribution, the mean, median and mode all have the same value.
- ◆ In a normal distribution, variability is described in terms of standard deviation.

Station 5.4 Data interpretation: arterial blood gas result

Information for the candidate

In this station you will be presented with a set of arterial blood gas results. Read the results and answer the questions as true or false.

A 76-year-old lady, with a weight of 50Kg, undergoing intra-medullary nailing of the femur developed ST segment depression and a few ventricular ectopics, and sustained a cardiac arrest. Following intense resuscitation for 5 minutes, cardiac output was established. Her blood pressure is now 90/50 mmHg and HR is 130/minute. A set of blood results obtained at this stage has been listed below in Table 5.4 (she is ventilated with a FiO_2 of 0.5). Her past medical history includes hypertension and ischaemic heart disease.

Table 5.4 Blood gas results.

pH: 7.19	PCO_2 : 4.8 kPa	PO_2 : 20 kPa
BE: -12.1mmol/L	tCO_2 : 11mmol/L	HCO_3^- : 10mmol/L
Na^+ : 140mmol/L	K^+ : 3.0mmol/L	Hb: 5.0g/dL
SaO_2 : 100%	Cl ⁻ : 110mmol/L	

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. The above results show metabolic acidosis.	True False 2	☐
2. There is compensatory respiratory alkalosis.	True False 2	☐
3. The anion gap is increased.	True False 2	☐
4. The cause of cardiac arrest could be fat embolism.	True False 2	☐
5. 150mmol of sodium bicarbonate should be given immediately.	True False 2	☐
6. Hypokalaemia in this patient can be due to acidosis.	True False 2	☐

7. This patient needs a blood transfusion.	True	False	2	☐
8. The standard bicarbonate value is directly measured by a blood gas analyser.	True	False	2	☐
9. The base excess in this sample is calculated by adding base to the blood sample to restore the normal pH.	True	False	2	☐
10. Arterial oxygen content is about 12ml/100ml.	True	False	2	☐

Total:	/20

Answers

1. True. The pH suggests acidosis. The bicarbonate level is markedly low and PCO_2 is within normal limits.
2. False. This blood gas result is suggestive of primary metabolic acidosis without any metabolic compensation. Compensation to metabolic acidosis is achieved by hyperventilation which lowers the PCO_2 .
3. True. The normal anion gap is 12-18, which can be calculated as $(\text{Na}^+ + \text{K}^+) - (\text{HCO}_3^- + \text{Cl}^-)$; $(140 + 3 - 10 + 110) = 23$.
4. True. As this patient is undergoing intra-medullary nailing of the femur, fat embolism could be possible. Another possible cause of cardiac arrest in this patient could be a massive pulmonary embolism.
5. False. Sodium bicarbonate should be administered if the pH is less than 7.1. There are several disadvantages to administering sodium bicarbonate. Sodium bicarbonate is converted into CO_2 which may cause further acidosis. NaHCO_3^- administration results in extracellular alkalosis, with a resulting shift of the oxygen dissociation curve to the left which reduces oxygen delivery to the tissues.
6. False. In acidosis, extracellular H^+ concentration is increased; H^+ enters the cell and potassium ions move out of the cells resulting in hyperkalaemia.

7. True. This patient has a low haemoglobin and hence needs a blood transfusion, which would improve oxygen delivery to the tissues, including the myocardium.
8. False. The blood gas analyser directly measures pO_2 , pCO_2 , and pH. The actual bicarbonate, standard bicarbonate, and base excess are calculated from the pH and pCO_2 using the Siggard-Anderson nomogram.
9. False. Although that is the definition of a base excess, in this sample it is calculated as described above in 8.
10. False. It is 6.7ml/100ml.

Interpretation of blood gas results

Arterial blood gas interpretation should be considered in conjunction with the patient's clinical history:

- ◆ The first step is to determine whether there is an acid base disorder. First read the pH; a normal value is 7.36-7.44; a pH lower than 7.36 suggests acidosis and a pH more than 7.44 suggests alkalosis.
- ◆ The second step is to determine the primary acid base disorder. The primary acid base disorder will go in the same direction of pH. The compensatory mechanism will not overcorrect the primary disorder. Then read the $PaCO_2$ and bicarbonate values. An abnormal $PaCO_2$ value (normal $PaCO_2$ is 4.6-5.6kPa) indicates a respiratory disorder and an abnormal bicarbonate value (normal is 22-26mmol/L) indicates a metabolic disorder.
- ◆ The next step is to determine the compensatory mechanism. The compensatory mechanism will bring the pH back towards normal but will not overcorrect. In the given sample, the pH and bicarbonate are low; hence, metabolic acidosis is the primary disorder. The $PaCO_2$ value is normal and hence there is no respiratory compensation. Metabolic acidosis is compensated by hyperventilation, which by lowering $PaCO_2$, increases the pH.
- ◆ The standard base excess is the amount of acid or alkali required to restore the normal pH at a PCO_2 of 5.3kPa and temperature of 37°C.

The base excess is negative in metabolic acidosis and positive in metabolic alkalosis.

- ◆ The anion gap is the measure of unmeasured anions in the plasma. The negatively charged plasma proteins account for 10% of the anions and account for the majority of unmeasured anions. The acid anions produced during metabolism, such as lactate and acetoacetate, are not usually measured. The anion gap is measured using the formula: $\text{anion gap} = (\text{Na}^+ + \text{K}^+) - (\text{HCO}_3^- + \text{Cl}^-)$.
- ◆ Oxygen content of the blood sample can be calculated by $\text{Hb} \times 1.34 \times \text{SaO}_2/100$. In the above blood gas sample; $5 \times 1.34 \times 1 = 6.7\text{ml}/100\text{ml}$ of arterial blood, ignoring the small amount of dissolved oxygen. Dissolved oxygen content is calculated by $0.023 \times \text{PaO}_2 = 0.46\text{ml}/100\text{ml}$.

Key points

- ◆ Sodium bicarbonate is indicated only when the pH is less than 7.1.
- ◆ A compensatory mechanism will not overcorrect the pH.
- ◆ The anion gap is a measure of unmeasured anions in the plasma.

Station 5.5 Anatomy: sciatic nerve block

Information for the candidate

In this station you will be asked questions to assess your knowledge of anatomy of the nerve supply to the lower limb, and skill in performing sciatic nerve block.

Examiner's mark sheet

marks

Name the nerve supplying the following areas in 8

Figure 5.5

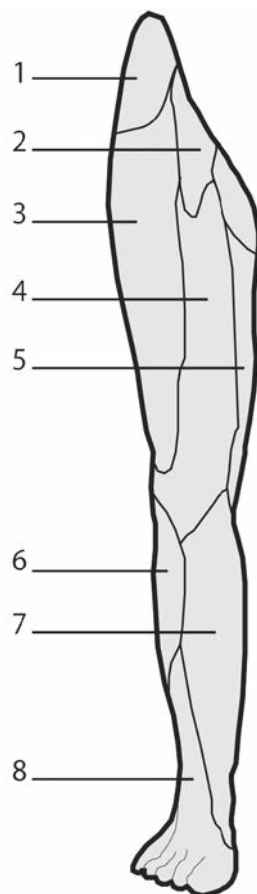


Figure 5.5 Sensory nerve supply of the lower limb.

1. Lateral cutaneous branch of the subcostal nerve (T12).
2. Femoral branch of the genito-femoral nerve (L1, 2).
3. Lateral cutaneous nerve of the thigh (L2, 3).
4. Femoral nerve (intermediate and medial cutaneous nerves of the thigh).
5. Obturator nerve (L2, 3, 4).
6. Common peroneal nerve (lateral cutaneous nerve of the leg).
7. Saphenous nerve.
8. Superficial peroneal nerve (musculocutaneous nerve).

Describe the origin of the sciatic nerve and its relations in the gluteal region

4

☐

The sciatic nerve is formed by the fusion of two nerve trunks. The tibial component is formed from the anterior branches of the ventral rami of L4, 5 and S1, 2, 3 nerve roots. The peroneal component is formed from the posterior branches of the same nerve roots. It enters the gluteal region through the greater sciatic foramen below the piriformis muscle. In the gluteal region, it lies anterior to the gluteus maximus muscle and posterior to the obturator internus and quadratus femoris muscles. Here the nerve is approximately at the midpoint between the ischial tuberosity and the greater trochanter. It continues downward along the posteromedial aspect of the femur. At the apex of the popliteal fossa it divides into the tibial and common peroneal nerves.

Name the various approaches to blocking the sciatic nerve

2

☐

There are several approaches to blocking the sciatic nerve. These include a posterior (Labat's), anterior, lateral and inferior approach in the supine lithotomy position.

Describe the technique of sciatic nerve block using the classic posterior approach

3

☐

- ◆ Position: lateral with the side to be blocked uppermost.
- ◆ Landmarks: posterior superior iliac spine (PSIS) and the greater trochanter (GT).
- ◆ A straight line is drawn from the PSIS to the upper border of the GT. From the midpoint of this line a perpendicular line is drawn caudally.
- ◆ Needle insertion: 5cm from the midpoint, along the perpendicular line, the needle is inserted perpendicular to the skin in all planes (this point will lie on the line joining the sacral hiatus and the GT).

What is the desired motor response after placement of the stimulator needle, while performing a sciatic nerve block?

2

When the tibial component is stimulated, plantar flexion of the foot or toes is observed; stimulation of the peroneal component results in dorsiflexion or eversion of the foot.

How much local anaesthetic is required for an effective block?

1

10-20ml of 0.25-0.5% bupivacaine or L-bupivacaine or, 1% lidocaine/prilocaine

Total:	/20

Sciatic nerve block

Sciatic nerve blocks can be used for anaesthesia of the skin of the posterior aspect of the thigh, the leg below the level of the knee (except the medial aspect of the leg which is supplied by the saphenous nerve), and the hip and knee joint.

The gluteal approach to blocking the sciatic nerve is already described above. The posterior subgluteal approach is between the ischial tuberosity medially and GT laterally.

The sciatic nerve divides into peroneal and tibial components approximately 5-7cm above the popliteal crease in the apex of the popliteal fossa, although this can be variable. The nerve can be blocked at this level either through the posterior or lateral approach. In the posterior approach, at the apex of the popliteal fossa, between the semitendinosus muscle medially and biceps femoris muscle laterally, the needle is introduced. The nerve lies lateral to the popliteal artery pulsation. In the lateral approach, the needle is passed between the tendons of vastus lateralis and biceps (intertendinous approach).

Complications of nerve blocks can be due to the local anaesthetic used (allergy, toxicity), or due to the technique used (intravascular injection, intraneural injection, infection, etc.).

Anatomy of the femoral nerve

The femoral nerve is derived from L2, L3 and L4 nerve roots; it descends between the psoas major and iliacus, entering the thigh lateral to the femoral artery under the inguinal ligament. It provides motor supply to quadriceps femoris, pectineus and sartorius muscles. Sensory supply to the anterior aspect of the leg is provided through the intermediate and medial cutaneous nerves of the thigh. The saphenous nerve is the largest branch of the femoral nerve, running along the medial border of the tibia and passing anteriorly to the medial malleolus. It supplies sensation over the medial aspect of the knee, leg, ankle and foot.

Key points

- ◆ The femoral nerve provides sensory supply to the anterior aspect of the thigh and medial aspect of the leg, ankle and foot.
- ◆ The sciatic nerve provides sensory supply to the outer and posterior aspects of the leg and to most of the foot except for the medial aspect.
- ◆ Stimulation of the tibial component of the sciatic nerve produces plantar flexion of the foot; stimulation of the peroneal component produces dorsiflexion or eversion of the foot.

Station 5.6 Communication: dental injury

Information for the candidate

You have anaesthetised a 14-year-old girl for an emergency appendicectomy. Tracheal intubation was difficult; during the process of laryngoscopy the upper left canine tooth was dislodged. In this station you will meet the patient's father.

Examiner's mark sheet

	marks
Introduces him/herself, confirming that he/she is talking to the right person and explains his/her role.	2
Explains what exactly has happened.	2
Explains how the tooth was dislodged (i.e. rapid sequence induction, difficult intubation, need to secure the airway).	2
Explains that the dislodged tooth is carefully preserved.	2
Addresses pain relief for this dental trauma.	1
Reassures and arranges for a dental review.	2
Explains that the tooth can possibly be fixed.	2
Hospital will meet the expenses.	2
'Difficult airway alert' and letter to family doctor.	2
Arranges discussion with a senior (consultant) anaesthetist.	2
Satisfactory conclusion.	1

Total:	/20

Information for the actor

Your daughter underwent an emergency operation (removal of the appendix) today and is now recovering on the postoperative ward. After the operation you discovered that one of her top teeth was missing. The nurse has told you that it happened during the anaesthetic. Naturally, you are angry. You are waiting to talk to a doctor to find out what went wrong.

Key points

- ◆ Be honest.
- ◆ Apologize if there is a genuine mistake, but do not waste time in being too apologetic throughout the session. No matter how sorry you feel, you will only receive the assigned 1 or 2 marks.
- ◆ It is good practice to discuss this risk pre-operatively in susceptible cases and mention about the discussion during counselling.
- ◆ Explain that in a difficult airway and in an emergency, the priority is to secure the airway rather than avoiding dental trauma.
- ◆ Describe the importance of inserting the tube into a windpipe in time to avoid hypoxia.
- ◆ Preserve the dislodged tooth.
- ◆ Inform the consultant and document it in the notes.
- ◆ Give attention to pain relief, secondary to dental injury.
- ◆ Involve the hospital dentist.
- ◆ Send a difficult airway alert to the patient, document it in the anaesthesia record and send a letter to the family physician.
- ◆ Have a sympathetic voice throughout the session, however annoying the actor is.

Station 5.7 Technical skill: chest drain insertion

Information for the candidate

You have anaesthetised a patient for a laparoscopic cholecystectomy. This patient is known to have COAD with mild emphysematous changes in the chest X-ray. Half way through the procedure the patient's saturation decreased to 90%. Increasing inspired oxygen to 100% and hand ventilating failed to increase the saturation. Other vital parameters are: BP: 85/50 mm Hg, heart rate: 110/minute, peak airway pressure: 30 mmHg. On auscultation there is reduced air entry on the right side. You will be asked questions on the further management of this patient.

Examiner's mark sheet**marks**

This patient's saturation is 90% on 100% oxygen and is most likely to have a tension pneumothorax on the right side

What is your immediate management?

2

Needle thoracocentesis.

How would you perform the procedure? Indicate the landmarks (on a manikin or actor)

2

Identify the 2nd intercostal space in the mid-clavicular line and insert a 14G wide-bore cannula (venflon) into the intercostal space, remove the needle, leaving the cannula in place.

How would you locate the 2nd intercostal space?

1

Feel for the sternal angle which corresponds to the 2nd rib and the space below it is the 2nd intercostal space.

On insertion of the cannula there is a sudden escape of air and now the oxygen saturation is 96%

What would you do next?

2

A chest drain should be inserted.

How would you insert the chest drain? Indicate the landmarks

2 x 5*
=10

- ◆ Choose the correct site: 5th intercostal space on the right side, between the mid-axillary and anterior axillary line*.
- ◆ Clean the area with an antiseptic solution and apply a sterile drape.

- ◆ Make a 2-3cm horizontal incision on the upper border of the lower rib*.
- ◆ Use blunt dissection with an artery clamp and finger*.
- ◆ Puncture the pleura using a blunt artery clamp guided by the finger.
- ◆ Insert a finger to sweep the lung away from the pleura.
- ◆ Clamp the proximal end of the chest tube and advance the tube into the pleural cavity.
- ◆ Connect the tube to the underwater seal drainage and release the clamp*.
- ◆ Suture the tube to the chest wall and apply a dressing.
- ◆ Obtain a chest X-ray*.

What are the complications of chest drain insertion?
State three complications

3

- ◆ Visceral injury: laceration of the lung, liver, pericardium and heart.
- ◆ Injury to intercostal vessels and nerves.
- ◆ Haemothorax.
- ◆ Subcutaneous emphysema.
- ◆ Infection.
- ◆ Incorrect tube position, kinking of the tube and tube blockage.

Total:	/20

Tension pneumothorax

The objective of this station is to assess the knowledge and skill that is essential for diagnosing and treating a tension pneumothorax (a critical incident during the intra-operative period). This station can also be simulated on a simulator.

- ◆ Tension pneumothorax is a life-threatening emergency and can result in cardiorespiratory arrest.
- ◆ Prompt diagnosis and immediate treatment is essential.

Management of suspected pneumothorax

- ◆ Turn off the nitrous oxide and administer 100% oxygen.
- ◆ Confirm diagnosis of pneumothorax:
 - auscultate both sides of the chest;
 - percuss the chest for hyper-resonance;
 - feel for tracheal deviation;
 - rule out other causes of high airway pressure.
- ◆ If significant hypotension is present, a tension pneumothorax should be considered.

Treatment of tension pneumothorax

- ◆ Circulatory support with intravenous fluid and vasopressor drugs.
- ◆ Decompress the pneumothorax by inserting a large bore intravenous cannula at the 2nd intercostal space in the mid-clavicular line.
- ◆ Once the intrathoracic pressure is reduced, venous return increases, which increases cardiac output and improves gas exchange.

A chest drain must be inserted following needle thoracocentesis.

Insertion of a chest drain

A chest drain is usually inserted at the 5th intercostal space between the mid-axillary and anterior axillary line. The skin should be incised over the upper border of the lower rib to avoid injury to the neurovascular bundle which runs along the inner aspect of the lower border of the rib. Although a rigid trochar is provided along with the chest drain tube, it should be avoided as it increases the likelihood of injury to the lung. After incising the skin and deep tissues, blunt dissection is achieved using artery forceps. Once the pleura is punctured, a finger tip should be inserted to sweep the lung away from the insertion site. Chest drain tubes of size 20-28 FG (French Gauge) are suitable for most adults. These tubes have side holes to facilitate drainage and a radio-opaque line so that the position can be checked using chest X-ray.

The position of the tip of the tube should be aimed at the apex for draining air and towards the base of the lung for draining fluid. The chest tube should be attached to a drainage system which allows one direction of

flow (from the patient to the drainage system), an underwater seal device. One-way flutter valves may also be used (Heimlich valve), which allow earlier mobilisation and the potential for an earlier discharge of patients with a chest drain.

The chest drain should not be removed until bubbling has ceased and the chest X-ray demonstrates re-inflation of the lung. The chest drain should be removed either while the patient performs a Valsalva manoeuvre or during the expiratory phase.

The underwater seal device should have the following features (Figure 5.7):

- ◆ The tube connecting the chest drain should have minimum resistance.
- ◆ The tube should be approximately 3cm below the surface of the water. If it is more than 5cm it increases the resistance for the air or fluid to escape from the pleural cavity.
- ◆ The bottle should be at least 45cm below the level of the patient's chest. Water may be drawn into the pleural cavity during maximal negative inspiratory effort if it is more close to the patient.

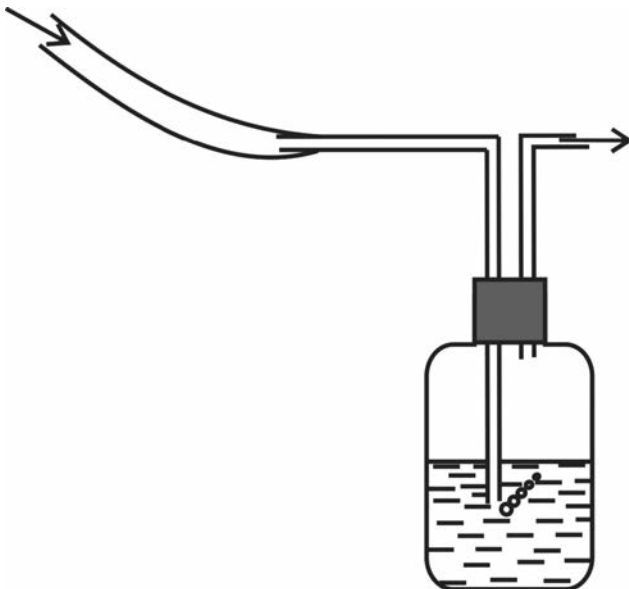


Figure 5.7 Single bottle chest drainage system.

The chest drain bottle should always be kept below the level of the patient. If suction is required a low pressure high volume suction (-10 to -20cmH₂O) should be used. It is used only for a non-resolving pneumothorax.

Key points

- ◆ Tension pneumothorax results in impaired gas exchange and severe hypotension.
- ◆ Treatment includes immediate needle thoracocentesis followed by insertion of a chest drain.
- ◆ A chest X-ray should be performed after insertion of the chest drain.
- ◆ Respiratory swing in the fluid in the chest tube is useful in assessing tube patency.

Station 5.8 Clinical examination: arterial and venous pulses, and pressures

Information for the candidate

In this station you will be asked to perform a clinical examination to check the arterial and venous pulses, and to assess arterial and venous pressures.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself to the patient.	1
Feels radial pulses on both sides.	2
Correctly elicits the rate and rhythm.	2
Looks for a collapsing pulse.	2

Feels for the brachial and carotid pulse, and listens for carotid bruits. 3

Correctly measures the blood pressure (values +/- 10 mmHg of the examiner's reading). 2

Measures or mentions that he/she will measure this on both sides. 2

Uses the correct method of examining the jugular venous pulse. 2

How would you measure the height of the jugular venous pulse? 2

Determine the upper level of the JVP and measure the vertical distance between this point and the sternal angle.

How would you differentiate between the JVP and carotid pulse? 2

The JVP has a definite upper level and becomes more prominent with hepatojugular reflex; the carotid pulse is easily palpable.

Total: /20

Jugular venous pulse

The internal jugular vein is directly connected to the superior vena cava and right heart without any intervening valves.

The jugular venous pulse (JVP) provides information about venous return and right heart function. The patient is examined in a semi-recumbent position at 45° with their head supported on a pillow. The internal jugular vein runs downwards from a point below the ear lobe, above and behind the angle of the mandible, between the two heads of the sternocleidomastoid muscle to join the subclavian vein behind the sternoclavicular joint. The measurement of the JVP is expressed as the vertical distance from the manubriosternal angle to the maximum height of

pulsations in the internal jugular vein. It is normally less than 3cm. This equates to a right atrial pressure of 8cm of water, as in this position, the manubriosternal angle is about 5cm above the centre of the right atrium. The pulsations are better visualised than felt. The complex waveforms (a, c, x, y) and the changes with respiration and compression on the liver differentiates it from the carotid pulse.

Differentiation of the JVP from the carotid pulse

- ◆ The JVP has a definitive upper level (in a normal healthy person it is <4cm).
- ◆ The JVP is multiphasic: it has 2 positive waves, a and v. The carotids have a single beat.
- ◆ The JVP is better seen; the carotids are better felt.
- ◆ The JVP is easily occluded.
- ◆ The JVP varies with the angle of the neck; the carotids remain stable.
- ◆ The JVP varies with respiration; the pressure falls with inspiration.
- ◆ There is a positive hepatojugular reflex with the JVP. On pressing the right subcostal (liver) area there is a transient elevation of the JVP.

Peripheral pulses

The radial pulse is used for assessing the rhythm and heart rate. Both radial pulses should be felt simultaneously to compare the volume and timing. Stenosis of the subclavian artery results in a low volume radial pulse on the affected side. Radiofemoral delay is observed in coarctation of the aorta.

The brachial pulse is used for assessing the character of the pulse. In a hypotensive patient and with peripheral vasoconstriction all peripheral pulses may be feeble. The carotid pulse is the most central pulse and is better for assessing the character.

Key points

- ◆ Use an organised approach to examine the peripheral pulses.
- ◆ A slow rising pulse is seen in severe aortic stenosis.
- ◆ Radiofemoral delay is seen in coarctation of the aorta.
- ◆ A collapsing pulse is seen in aortic regurgitation and a hyperdynamic circulation.
- ◆ Look for the jugular venous pulse in a semi-recumbent position at 45°.

Station 5.9 Measuring equipment: Severinghaus carbon dioxide electrode

Information for the candidate

In this station you will be asked questions on CO_2 measurement, to assess your knowledge of clinical measurement.

Examiner's mark sheet

marks

State how you would measure PaCO_2 from a given blood sample 2

Using a Severinghaus CO_2 electrode.

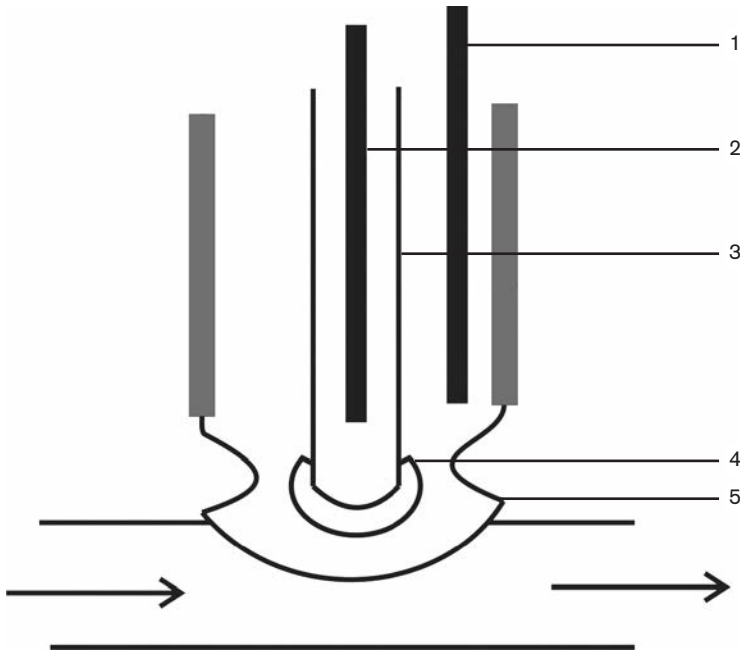


Figure 5.9 Severinghaus electrode.

Name the parts labelled 1, 2 and 3 in Figure 5.9

3

1. Reference electrode.
2. H^+ sensitive glass electrode.
3. H^+ sensitive glass.
4. Bicarbonate-containing nylon mesh.
5. CO_2 permeable membrane.

What is the principle involved measuring PCO_2 using this electrode?

2

CO_2 reacts with water to produce carbonic acid which then dissociates into hydrogen and bicarbonate ions. H^+ ions generated are proportional to the concentration of CO_2 . The potential developed across the H^+ sensitive glass electrode is measured by a voltmeter.

How would you calibrate a CO_2 electrode?

2

It is calibrated by equilibrating the buffer using standard solutions containing known CO_2 concentrations to establish the relationship between pH and CO_2 .

What methods are available for measuring CO_2 in a gas mixture?

4

CO_2 concentration in a gas mixture can be measured using mass spectrometry, Raman spectrometry, an infrared analyser and gas chromatography.

What is the principle of an infrared analyser?

2

Gases containing two or more dissimilar atoms absorb infrared radiation. By measuring the fraction of radiation of a known wavelength absorbed by the gas mixture, the partial pressure of a particular gas can be determined.

At what wavelength does CO₂ absorb infrared light?

1

CO₂ absorbs infrared light at 4.3µm.

What are the sources of error in an infrared analyser?

4

- ◆ There is overlap in the absorption wavelengths of different gases. Presence of other gases, such as nitrous oxide and carbon monoxide, can interfere with the reading.
- ◆ Presence of nitrogen and nitrous oxide in the gas mixture can result in a collision broadening effect which increases the absorption of infrared light.
- ◆ A change in atmospheric pressure can affect the reading.
- ◆ Water moisture can affect the reading.

Total:	/20

Measurement of CO₂ tension

In 1954, Richard Stow described a CO₂ electrode using a rubber membrane permeable to CO₂ to separate a wet pH and reference electrode from a blood sample. Severinghaus modified this electrode stabilising it with a bicarbonate salt solution and a nylon mesh spacer.

The Severinghaus CO₂ electrode consists of two electrodes: a measuring electrode and a reference electrode. The measuring electrode consists of pH (H⁺) sensitive glass in contact with a nylon mesh containing a bicarbonate buffer. A thin Teflon or silicone membrane permeable to CO₂ separates the blood sample from the electrode. CO₂ diffuses from the blood into the buffer and changes the pH. The quantity of hydrogen ion generated and the fall in pH is proportional to the partial pressure of CO₂.

The CO₂ electrode is calibrated by equilibrating the buffer with solutions of two known CO₂ concentrations.

For measurement of CO₂ from a gas mixture, refer to OSCE set 1, station 1.14.

Key points

- ◆ The CO₂ tension in a blood sample is measured using the Severinghaus electrode.
- ◆ The Severinghaus electrode is maintained at a temperature of 37°C.
- ◆ The accuracy depends on the integrity of the semi-permeable membrane.

Station 5.10 Resuscitation: pulseless electrical activity

Information for the candidate

You are on call and have been asked to attend urgently to a surgical ward. A 36-year-old female patient who underwent laparoscopic cholecystectomy an hour ago has collapsed.

Examiner's mark sheet

	<i>marks</i>
Ensures safety of patient and self (safe to approach).	1 ☐
Confirms that the patient is unresponsive to verbal command by gently shaking the shoulders.	2 ☐
Correctly assesses airway and breathing, and confirms that the patient is not breathing, assessing the carotid pulse at the same time.	2 ☐
Calls for help (specifies a surgeon in addition to the crash team).	1 ☐

The crash trolley defibrillator has arrived. What would you do next? 2

Apply pads and assess rhythm.

The ECG monitor shows a heart rate of 65 per minute, sinus rhythm and no carotid pulse. What is this termed? What would you do next? 4

This patient has pulseless electrical activity (PEA); it is a non-shockable rhythm. Continue CPR in 2-minute cycles, secure an IV access, perform tracheal intubation, ventilate with 100% oxygen and give adrenaline 1mg every 3-5 minutes.

Now the blood pressure is 70 mm Hg systolic, the patient is breathing spontaneously

What are the reversible causes for pulseless electrical activity? 4

- ◆ Hypoxia, Hypovolaemia, Hyper and hypokalaemia and Hypothermia (4 Hs).
- ◆ Tension pneumothorax, cardiac Tamponade, Toxic (drug overdose) and Thrombus/pulmonary embolism (4Ts).

What is the most likely cause in this patient? 2

Severe hypovolaemia due to intra-abdominal bleeding.

During resuscitation this patient had 2L of warm Hartmann's solution. She appears very pale and her blood pressure is still low. What would be the next management? 2

Blood transfusion, surgical assessment and possible exploratory laparotomy.

Total:	/20

Pulseless electrical activity

The presence of cardiac electrical activity (normal ECG complexes on the monitor) with the absence of palpable pulses is known as pulseless electrical activity (PEA). These patients have myocardial contractions, but not sufficient enough to produce cardiac output and a pulse.

PEA is often due to reversible causes (4Hs and 4Ts) and can be treated. The most common causes of cardiac arrest with PEA during the early postoperative period are haemorrhage and pulmonary embolism. However, other causes should be kept in mind.

After confirming the rhythm as PEA, CPR should be started at a 30:2 ratio (30 compressions: 2 breaths). If the rate is less than 60/minute, atropine 3mg should be given. If signs of life return during CPR, the rhythm and pulse should be checked. If the pulse is present post-resuscitation care should be provided. This includes immediate resuscitation with intravenous fluids, followed by blood transfusion if required.

If the rhythm changes to VF, it should be treated with defibrillation. If the rhythm persists to PEA, CPR should be continued and adrenaline 1mg should be given every 3-5 minutes.

In the event of a massive haemorrhage, the management strategies should include:

- ◆ Maintenance of circulation with resuscitation fluids.
- ◆ Improving oxygen-carrying capacity with blood transfusion.
- ◆ Surgical control of bleeding.

Key points

- ◆ PEA is often caused by reversible conditions and can be treated.
- ◆ Survival is unlikely unless the reversible cause is found and treated.
- ◆ If massive haemorrhage is suspected, obtaining surgical control of bleeding is essential.

Station 5.11 Anatomy: arterial system of the hand

Information for the candidate

In this station you will be asked questions on applied anatomy of the hand.

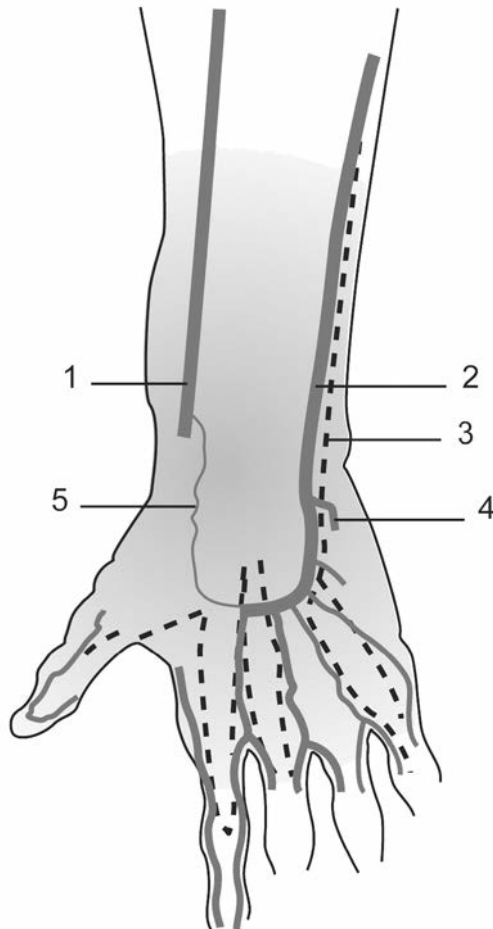


Figure 5.11 Arterial system of the hand.

Examiner's mark sheet**marks****Name the parts labelled 1-5 in Figure 5.11**5

1. Radial artery.
2. Ulnar artery.
3. Ulnar nerve.
4. Deep palmar branch of the ulnar artery.
5. Superficial palmar branch of the radial artery.

Which arteries can you cannulate in the forearm?1

Radial, ulnar and brachial.

What precaution would you take before cannulating the radial artery?1

Ensure that there is adequate ulnar collateral circulation in the hand.

What test would you do?1

Allen's test.

What are the relations of the radial artery at the wrist?2

It lies lateral to flexor carpi radialis and anterior to the pronator quadratus muscle and radius.

Describe the collateral circulation in the hand3

The superficial and deep palmar arches provide collateral circulation in the hand. The ulnar artery continues as the superficial palmar arch and anastomoses with the superficial branch of the radial artery. The deep palmar arch of the radial

artery anastomoses with a smaller deep branch of the ulnar artery.

How would you perform Allen's test? (Demonstrate on the actor) 4

- ◆ Elevate the hand and make a fist for 20 seconds.
- ◆ Then occlude both the ulnar and radial arteries.
- ◆ Open the fist and note that the hand is blanched white.
- ◆ Release the ulnar compression and note the flushing occurring within 5-10 seconds.

What are the complications of radial artery cannulation? 2

Infection, haematoma, thrombosis, distal ischaemia, embolisation, neurologic injury and pseudo-aneurysm.

Which nerve is more likely to be damaged? 1

The median nerve in the carpal tunnel is most likely to be compressed by a haematoma.

Total:	/20

Arterial system of the hand

The ulnar artery enters the palm along the medial side of the wrist. It continues as the superficial palmar arch. The superficial palmar arch anastomoses with the superficial branch of the radial artery. The superficial palmar arch is covered by skin, the palmaris brevis muscle and the palmar aponeurosis.

The radial artery enters the hand along the lateral side of the wrist after crossing the anatomical snuffbox. It anastomoses with the deep branch of the ulnar artery to form the deep palmar arch.

Key points

- ◆ The radial artery is most commonly used for arterial cannulation. It is easily accessible and has a good collateral blood flow through the superficial palmar branch of the ulnar artery.
- ◆ Prior to cannulation the adequacy of the collateral circulation should be assessed using Allen's test (although the reliability of the test is questioned).
- ◆ The brachial artery is easily palpated medial to the biceps tendon. As it is the sole source of blood flow to the lower part of the forearm, thrombosis of the brachial artery can be catastrophic.
- ◆ Dorsalis pedis, posterior tibial and femoral arteries in the lower limb can be used for arterial cannulation.

Station 5.12 History taking: septoplasty

Information for the candidate

A 54-year-old male patient is scheduled to have a septoplasty. You will be asked to take a relevant history from the patient.

Examiner's mark sheet

	<i>marks</i>
Introduces him/herself and confirms the nature of the proposed surgery.	2
Reason for proposed surgery (nasal obstruction).	1
Enquires as to whether the patient has been investigated for sleep apnoea.	2
Elicits symptoms related to obstructive sleep apnoea.	2

Asks about cardiovascular symptoms (shortness of breath and angina). 2

Asks about history of asthma and elicits severity (asks about recent hospital admission with asthma). 2

Exercise tolerance. 2

Medications

- ◆ Inhalers (becotide and salbutamol). 2
- ◆ Specifically asks about steroid tablets. 2
- ◆ H/O smoking. 1
- ◆ Drug allergies. 2

Total:	/20

Information for the actor

You are 54 years old and you have been admitted to hospital to have an operation on your nose (to straighten the bent nasal septum). You are having trouble with breathing as you find it hard to breathe through the nose. You also have mild asthma that is well controlled on inhalers (blue salbutamol and brown becotide). Your asthma has been well controlled; you have never needed any steroid tablets to control asthma and you have never been into hospital with an asthma attack. Your partner complains that you snore a lot at night. An ENT specialist told you that you would need to undergo an operation to straighten the bent nasal septum which is the cause of your breathing difficulty. In the last few months you have had a headache and find it a bit hard to concentrate on your work during the day. You have no allergies.

Obstructive sleep apnoea

- ◆ Obstructive sleep apnoea/hypopnoea syndrome (OSAHS) is defined as the coexistence of excessive daytime sleepiness with irregular breathing at night.

- ◆ It is characterised by repetitive partial or complete upper airway obstruction during sleep.
- ◆ It is common in males with a prevalence of about 1-2% in the population.
- ◆ The consequences of OSAHS include daytime sleepiness, poor concentration, mood and personality disorder.
- ◆ The classical history is the partner complaining about snoring.
- ◆ Increasing age, male gender, obesity, sedative drugs, smoking and alcohol consumption are predisposing factors.
- ◆ There is an independent association between OSAHS and hypertension.
- ◆ OSAHS may decompensate with cor pulmonale. The combination of COAD and OSAHS is potentially dangerous.
- ◆ There is a possibility of a difficult airway and difficult intubation.
- ◆ There is a possibility of hypothyroidism, acromegaly and Marfan's syndrome as underlying causes for OSAHS, which should always be considered. A thyroid function test is often indicated.
- ◆ Polysomnography is the objective way to quantify the severity of OSAHS, but limited sleep studies to assess respiratory events are an adequate first-line method of diagnostic assessment for OSAHS.
- ◆ Conservative management measures include weight loss, cessation of smoking and alcohol consumption, and changing sleeping position.
- ◆ Non-surgical interventions include continuous positive airway pressure (CPAP), bi-level positive airway pressure (BiPAP) and intra-oral devices.
- ◆ Surgical intervention commonly performed is uvulopalatopharyngoplasty. Other surgeries performed in these patients include mandibular advancement, nasal surgeries and weight reduction (bariatric) surgery.

Key points

- ◆ It is vital to gather information on the presenting complaint of the patient.
- ◆ Nasal obstruction is one of the predisposing factors for obstructive sleep apnoea.
- ◆ Obstructive sleep apnoea contributes to an increased peri-operative morbidity.

(For more information please refer to OSCE set 1, station 1.12).

Station 5.13 Simulation: bronchospasm

Information for the candidate

A 30-year-old female patient who is a known asthmatic is on the operating table for an emergency appendicectomy. General anaesthesia was induced using a rapid sequence induction technique with thiopentone 250mg and suxamethonium 75mg. The laryngoscopic view was grade 1 and the trachea was easily intubated. Subsequently, atracurium 40mg and morphine 5mg were administered and the surgery has just begun.

On entering the station:

- ◆ Parameters on the monitor: SaO₂: 90%, HR: 78 per minute, BP: 130/80 mmHg.
- ◆ Airway pressure is high, end-tidal isoflurane: 0.9 in 40% oxygen and nitrous oxide.

Examiner's mark sheet

	marks
Recognises increased airway pressure.	1
Checks saturation, heart rate and blood pressure.	2
Increases oxygen concentration.	2
Hand ventilates and confirms the reduced compliance of the bag.	2
Auscultates chest and identifies wheezing.	2
Checks the endotracheal tube position/suctions the endotracheal tube.	2
Increases the depth of anaesthesia.	1

Administers a bronchodilator (nebulised salbutamol through a catheter mount). 2

Asks for IV salbutamol or IV aminophylline. 2

Informs the surgeon and asks for help. 2

What is the dose of aminophylline? 1

5mg/Kg and maintenance is 0.5-0.9mg/Kg/hr.

What would you do if despite all the above measures the patient is still wheezy and the saturation is 92%? 1

Administer adrenaline (epinephrine) 10µg IV bolus, increasing up to 100µg in total.

Total:	/20

Information for the examiner

- ◆ Run the bronchospasm scenario on the SimMan as the bell rings.
- ◆ Parameters on the monitor: SaO₂: 90%, HR: 78 per minute, BP: 130/80 mmHg.
- ◆ Airway pressure high, end-tidal isoflurane: 0.9 in 40% oxygen and nitrous oxide.
- ◆ Chest: bilateral wheezes and reduced compliance.

Intra-operative bronchospasm

This patient is a known asthmatic who has an increased risk of bronchospasm during the peri-operative period. As a result of bronchospasm, increased airway pressure is noted on the monitor (high pressure alarm on the ventilator is activated). You should immediately check the other vital parameters of the patient and then systematically investigate the cause of high airway pressure. Switching the ventilation to

manual mode and hand ventilation helps to confirm the reduced compliance and rules out ventilator malfunction as a cause of high airway pressure. Visual inspection of the breathing system, including the breathing filter and catheter mount, should be carried out to exclude kinking and obstruction. Inspection and auscultation of the chest will aid you in diagnosing an intrathoracic cause of high airway pressure.

In severe bronchospasm, reduced air entry may lead to difficulty in differentiating from a tension pneumothorax. Tracheal deviation and a resonant note on percussion should aid in the diagnosis of a tension pneumothorax.

Management of bronchospasm

- ◆ Administer 100% oxygen.
- ◆ Stop respiratory irritant agents (e.g. desflurane) and increase the depth of anaesthesia using isoflurane or sevoflurane while maintaining haemodynamic stability.
- ◆ Exclude a breathing system or airway obstruction.
- ◆ Bronchodilators: a salbutamol inhaler, if immediately available, can be used in one of the following ways:
 - disconnect the breathing system at the endotracheal end and discharge 2-4 puffs of salbutamol directly into the endotracheal tube, reconnect the system and ventilate. Most of the drug is likely to be deposited in the tracheal tube and can be inefficient;
 - place the inhaler canister into the barrel of a 50ml leuc lock syringe and replace the plunger. Attach the syringe to manometer tubing (infusion tubing) which is placed down the endotracheal tube and discharge 2-4 puffs by pressing the syringe plunger;
 - using an appropriate T-piece adapter and external source of oxygen, 5mg of salbutamol can be nebulised into the breathing system between the breathing filter and endotracheal tube;
 - intravenous salbutamol 250µg slow bolus followed by 5-10µg /minute infusion.
- ◆ Intravenous hydrocortisone 100mg.
- ◆ In extreme cases where there is no response to all the above measures, intravenous adrenaline may be used.

Key points

- ◆ Recognise the changes in vital parameters.
- ◆ Administer 100% oxygen.
- ◆ Increase the depth of anaesthesia if permitted by cardiovascular parameters.
- ◆ Administer inhaled (nebulised) or intravenous bronchodilators.

Station 5.14 Monitoring equipment: invasive blood pressure monitoring

Information for the candidate

In this station you will be expected to demonstrate your skills of setting up an invasive arterial blood pressure monitoring system.

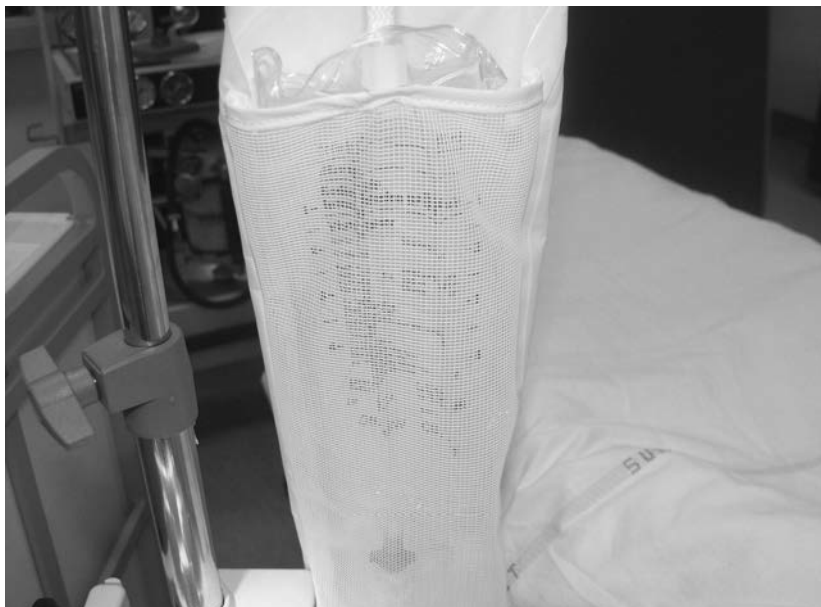


Figure 5.14a Intra-arterial blood pressure monitoring.



Figure 5.14b Intra-arterial blood pressure monitoring.



Figure 5.14c Intra-arterial blood pressure monitoring.

Examiner's mark sheet**marks**

Check this arterial pressure monitoring system (in Figures 5.14a, 5.14b and 5.14c) and outline any faults

Infusion bag is not pressurised.

1

Transducer system is loosely attached.

1

Wrong catheter tubing (catheter tubing is not stiff).

1

Number of three-way stopcocks is more than required.

1

Arterial cannula (22G IV cannula) is too narrow for an adult patient.

1

What information can be obtained from an arterial waveform?

5

Heart rate, systolic and diastolic pressure, myocardial contractility, systemic vascular resistance and volume status (preload).

Describe how you would perform zero calibration of the transducer

2

The transducer is opened to the atmosphere by opening the three-way stopcock between the patient and transducer, and then selecting zero on the monitor.

How would you calibrate for a higher pressure?

2

The transducer is connected to an aneroid manometer using sterile tubing and the manometer pressure is raised to 100 and 200 mmHg. The monitor display should read the same pressure as the transducer.

Which of these is a normal arterial waveform? What is the problem with the other two?

3

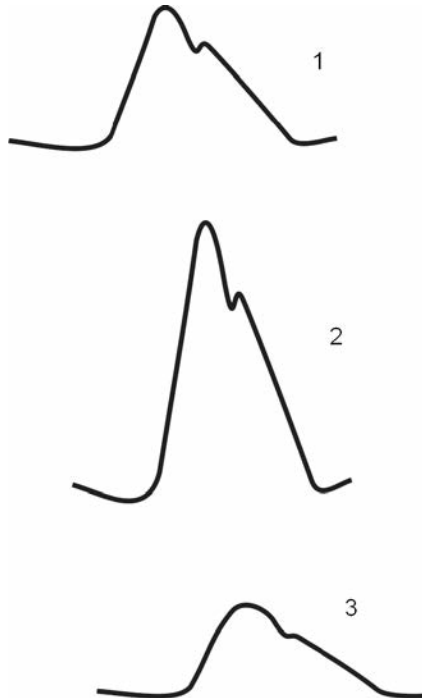


Figure 5.14d Arterial pressure waveforms.

(1) is normal, (2) is underdamped and (3) is an overdamped trace.

What will happen to the reading in a trace which is overdamped?

3

An overdamped trace under-reads systolic BP and over-reads diastolic BP; however, the mean blood pressure reading is not affected.

Total:	/20

Invasive blood pressure monitoring

The arterial pressure monitoring system includes an arterial cannula, catheter tubing connecting the cannula to the transducer, a transducer, a pressurised flush system, a monitor to display the reading and waveform, and a cable connecting the transducer to the monitor. The purpose of the fluid-filled tubing system is to provide a means of transmitting the pressure generated in the artery to the transducer. Normal saline is used as the flushing fluid. The viscosity of the fluid used influences the natural frequency of the measurement system. Fluids with a viscosity higher than normal saline lead to overdamping. The flushing system is pressurised to 300 mmHg and provides a continuous slow flow of fluid (3-4ml/hr), preferably heparinised, to minimise the risk of clot formation in the catheter.

In order for the blood pressure waveform to be an accurate representation of the pressure within the artery, the column of fluid must convey the correct information to the strain gauge diaphragm. The arterial cannula should be wide and stiff. Increased compliance tends to reduce the natural frequency. The number of three-way taps should be kept to a minimum. Usually, one three-way stopcock is inserted between the arterial cannula and catheter tubing and another between the catheter tubing and transducer. Stopcocks have a narrower lumen than the catheter, therefore, they can reduce the natural frequency. The tubing system connecting the catheter to the transducer should be as short and as stiff-walled as possible, and free from bubbles and stopcocks.

An up-slope of the arterial waveform indicates myocardial contractility and a down-slope of the arterial waveform indicates systemic vascular resistance. Increased swing of the waveform during the respiratory cycle indicates a reduced preload.

Zero calibration eliminates the effect of atmospheric pressure on the measured pressure. To eliminate the gradient drift, calibration at a higher pressure is necessary. For accuracy, the transducer system must be 'zeroed' to a reference point, usually the level of the left ventricle, taken to be the mid-axillary line on the left side. Overdamping is usually produced by air bubbles, clots, catheter kinking, stopcocks, and narrow, compliant long tubing.

Key points

- ◆ For accurate measurement of arterial blood pressure, a measurement system with optimal damping is essential.
- ◆ A wide, short cannula with stiff tubing reduces the effect on damping.
- ◆ The number of stopcocks should be kept to a minimum as possible.
- ◆ Zero calibration eliminates the effect of atmospheric pressure on the measured pressure.
- ◆ An underdamped trace over-reads the systolic blood pressure and under-reads the diastolic blood pressure.

Station 5.15 Clinical safety: patient positioning

Information for the candidate

In this station your knowledge on the importance of positioning under anaesthesia and injuries pertaining to an improper position will be assessed.



Figure 5.15a.

Examiner's mark sheet**marks**

What is the position shown in Figure 5.15a?

1

Knee elbow position.

For what surgical procedures is this position used?

2

This position is used for posterior spinal decompression and laminectomy.

What are the problems associated with this position?

1 x 7
= 7

- ◆ Airway: endotracheal tube dislodgement, disconnection and kinking.
- ◆ Anatomical: nerve injury.
- ◆ Pressure effect on eyes and corneal abrasion.
- ◆ Soft tissue injury of the face (abrasion of nose, lips and cheeks).
- ◆ Skin ischaemia and subsequent ulcers over pressure points and bony prominences.
- ◆ Physiological: compression of femoral vessels resulting in an impaired venous return.
- ◆ Poor circulation and venous stasis in the lower limbs predisposing to deep vein thrombosis (DVT).

Which nerves can be injured and what is the mechanism?

2 x 5

=10

Table 5.15a Nerve injury.

Nerve involved	Mechanism of injury
Brachial plexus	Stretch due to excessive neck extension or shoulder rotation
Ulnar nerve	Direct pressure on the nerve
Peroneal nerve	Pressure over the head of the fibula
Lateral cutaneous nerve of the thigh	Pressure over the iliac crest by supporting poles
Supra-orbital nerve	Pressure from the head rest

Total: /20

Problems associated with patient positioning

Prone position

The prone position is used for surgery on the spine and spinal cord at the lumbar and thoracic regions. The trachea should be intubated with an armoured tracheal tube and should be firmly secured. The abdomen should be free to move so that ventilation is not impaired during the prone position. Care should be taken to prevent neurovascular injury. The neck and cervical spine should be kept in a neutral position during prone positioning. Excessive extension or flexion should be avoided. The forehead and face is supported using a soft jelly pad ring to minimise pressure effects.

In the simple prone position, the chest and pelvis should be supported with rolls or a Montreal mattress and care should be taken to allow enough room for diaphragmatic excursion and to prevent an increase in intra-abdominal pressure. Oedema of peri-orbital tissues is occasionally seen following the prone position.

Lateral position

The lateral position is used for total hip replacement and thoracotomy. The ulnar nerve, brachial plexus and the common peroneal nerve on the dependent side are vulnerable to injury.

Lithotomy position

The lithotomy position is used for urological and gynaecological procedures. Extreme flexion of the hips can compress the femoral nerve and vessels, and can stretch the sciatic nerve. The common peroneal nerve can be trapped between the head of the fibula and supporting stirrups. Pressure over the medial epicondyle of the tibia can result in saphenous nerve injury.

Lower limb compartment syndrome is a recognised complication of the lithotomy position, which results from a reduced perfusion of the lower limbs due to a prolonged lithotomy position.

Sitting position

The sitting position is used for posterior fossa surgery and shoulder surgery. The specific problems of this position include venous air embolism and postural hypotension. Excessive flexion of the neck can cause obstruction of carotid and vertebral arteries, leading to spinal cord ischaemia and stroke. Excessive extension or rotation of the neck and downward pull on the arms can result in brachial plexus injury. Knees should be flexed to avoid stretching of the sciatic nerve. Reduced venous return from the lower limbs can predispose to DVT.

Sensory deficit resulting from peripheral nerve injury (Figures 5.15b and 5.15c)

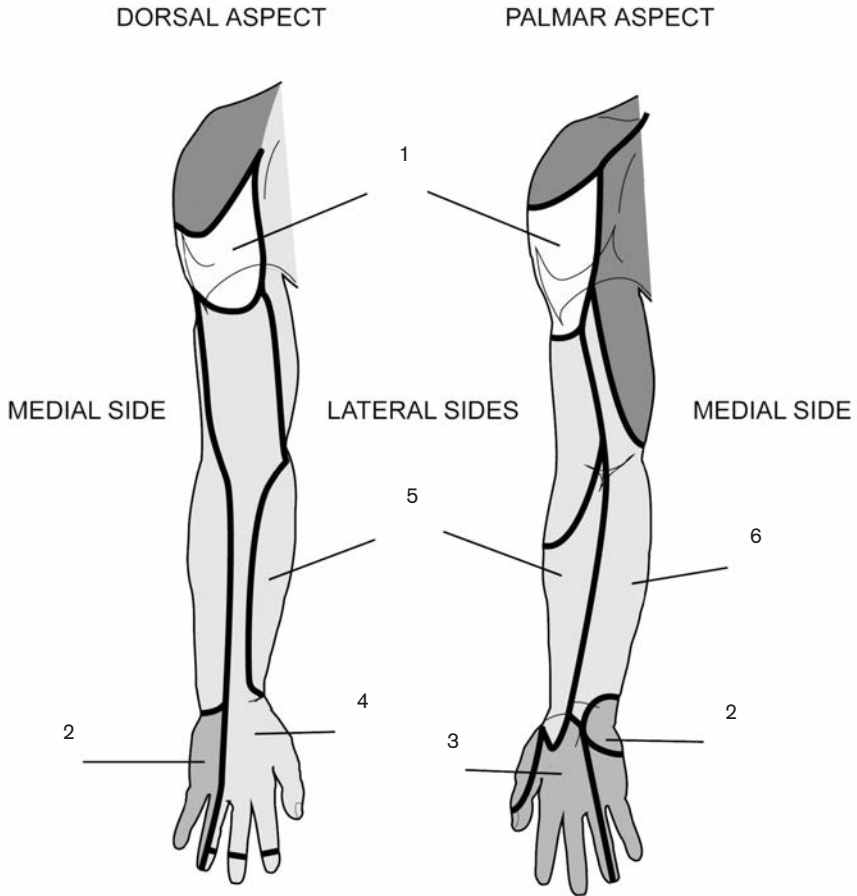


Figure 5.15b.

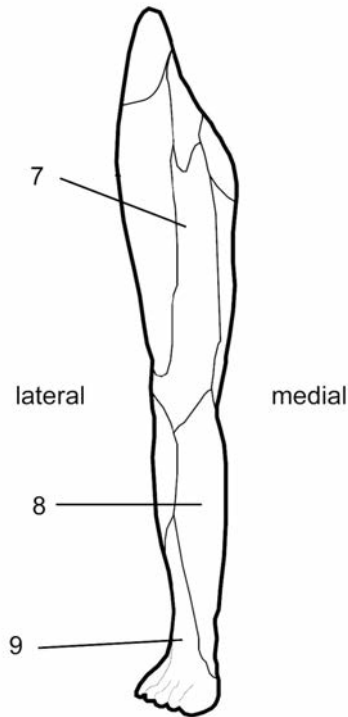


Figure 5.15c.

Table 5.15b Nerve injury (numbers correspond to Figures 5.15b and c).

Nerve	Anatomical area of sensory deficit
1. Axillary	Over the lateral aspect of the shoulder
2. Ulnar	Little finger, medial half of the ring finger and medial third of the hand
3. Median	Palmar surface of the hand, lateral part of the ring finger, middle and index finger and thumb
4. Radial	Lateral aspect of the dorsum of the forearm and hand, thumb, index and middle fingers and lateral half of the ring finger on the dorsal aspect
5. Musculocutaneous	Radial aspect of the forearm
6. Medial cutaneous nerve of the forearm	Medial aspect of the forearm
7. Femoral	Anterior surface of the thigh up to the knee
8. Saphenous	Medial aspect of the knee, leg and foot
9. Common peroneal	Lateral aspect of the leg and dorsal surface of the foot

Peripheral nerve injuries of lower limb

(For peripheral nerve injuries of the upper limb, refer to OSCE set 4, station 4.15).

The sciatic nerve can be damaged by pressure against the hard surface of a table in a lateral position, a pneumatic tourniquet around the thigh with a pressure of more than 350 mm Hg and stretching of the nerve in a lithotomy position. Damage to the sciatic nerve at the level of the thigh will result in an inability to flex the knee joint. At the level of the knee joint, the sciatic nerve divides into two main terminal branches: the tibial nerve and common peroneal nerve. The common peroneal nerve is more vulnerable to damage as it passes around the head of the fibula. Damage results in foot drop and a loss of sensation over the lateral aspect of the leg and dorsum of the foot.

The femoral nerve is subject to damage at the level of the inguinal ligament and may be kinked in extreme flexion of the hip during a lithotomy position. Damage to the nerve at this level results in sensory loss over the anterior aspect of the thigh and an inability to extend the knee joint due to paralysis of the hamstring muscles.

The lateral cutaneous nerve of the thigh provides sensory supply over the lateral part of the lower gluteal region and anterolateral aspect of the thigh. Supporting frames used while the patient is in the prone position may damage the nerves. The saphenous nerve may be compressed against the medial tibial condyle if the legs are placed in a vertical stirrup support.

Key points

- ◆ A prone position is used for spinal decompression and for posterior cranial fossa surgery.
- ◆ Compression of the femoral vessels in a prone position may result in reduced venous return.
- ◆ Soft tissue injury of the face and pressure on the eyes should be avoided.

Station 5.16 Radiology: cervical spine X-ray

Information for the candidate

This is a cervical spine X-ray of a 69-year-old male patient who is scheduled for an emergency laparotomy. Two years ago he had fallen down from a ladder and sustained a neck injury. Six months ago he underwent an operative procedure on the cervical spine. A cervical spine X-ray, which was taken during pre-operative assessment, is presented. Inspect the cervical spine X-ray and answer the questions.



Figure 5.16 Cervical spine X-ray.

Examiner's mark sheet

Please tick the correct answer - true or false.

marks

1. There is malalignment of the vertebral bodies.	True	False	2	☐
2. There is calcification of the anterior vertebral ligament.	True	False	2	☐
3. All 7 cervical vertebrae are visualised in this X-ray.	True	False	2	☐
4. The space between the anterior arch of the atlas and odontoid process is increased.	True	False	2	☐
5. The 3rd, 4th and 5th cervical vertebrae are fused using a plate and screws.	True	False	2	☐
6. Rapid sequence intravenous induction can be performed safely.	True	False	2	☐
7. Awake tracheal intubation is indicated in this patient.	True	False	2	☐
8. The space between the anterior arch of the atlas and odontoid process of less than 3mm suggests atlanto-axial subluxation.	True	False	2	☐
9. The gap between A and B is known as the atlanto-occipital gap.	True	False	2	☐
10. An increased atlanto-occipital gap suggests a difficult intubation.	True	False	2	☐

Total:	/20

Answers

1. True. There is malalignment at the level of the 2nd and 3rd vertebrae, as indicated by the line passing through the anterior vertebral bodies.
2. False.
3. False. The first three cervical vertebrae are clearly visible; the 4th, 5th and 6th vertebrae are fused using a plate and screws.

4. False. The space between the anterior arch of the atlas and the odontoid process is less than 3mm.
5. False. It is the 4th, 5th and 6th vertebrae which are fixed with a plate and screws.
6. False. This patient has a potentially difficult intubation.
7. True. This would be the safest plan for tracheal intubation in this patient.
8. False. A space between the anterior arch of the atlas and the odontoid process of more than 3mm suggests atlanto-axial subluxation, which may result in backward displacement of the odontoid process and compression of the spinal cord.
9. True. A is the occiput and B is the posterior process of the atlas. A reduced atlanto-occipital gap limits the extension of the head and results in a poor laryngoscopic view.
10. False.

Interpretation of the cervical spine X-ray

As with the chest X-ray, a systematic approach is used for reading the cervical spine X-ray. In a patient with a suspected cervical spine injury three views are necessary to exclude cervical spine injury:

- ◆ Lateral view.
- ◆ Anteroposterior view.
- ◆ Open mouth odontoid view.

A lateral cervical spine X-ray should include all 7 vertebrae and the upper half of the first thoracic vertebra. An open mouth odontoid view involving the odontoid process and lateral mass of the atlas (C1) is useful in diagnosing fracture or lateral displacement of the odontoid process.

A systematic approach includes the following:

A: Alignment of the cervical spine is assessed using 4 lordotic curves:

- ◆ A line passing through the anterior vertebral bodies.
- ◆ A line passing through the anterior aspect of the spinal canal.
- ◆ A line passing through the posterior aspect of the spinal canal.
- ◆ A line passing through the tips of the spinous processes.

B: Bony components of the cervical spine are assessed by observing the contour, height of the vertebral body, pedicle, laminae, and the transverse and spinous processes.

C: The cartilaginous area includes the intervertebral discs and the posterolateral facet joints. Vertebral malalignment of more than 3mm suggests vertebral dislocation. A reduction in anterior height of the vertebral body of more than 3mm suggests a compression fracture.

Soft tissue contour: in suspected cases of cervical spine injury prominence of the pre-vertebral soft tissue shadow in front of the line passing through the anterior vertebral bodies indicates haemorrhage. Soft tissue thickness anterior to C2 should be less than 6mm and anterior to C4-C7 should be less than 20-22mm.

Key points

- ◆ A lateral cervical spine X-ray should include all 7 vertebrae and the upper half of the first thoracic vertebra.
- ◆ Lucency through the tip of the odontoid process suggests fracture.
- ◆ A normal space between the anterior arch of the atlas and the odontoid process is less than 3mm.
- ◆ Vertebral malalignment of more than 3mm suggests vertebral dislocation.

Station 5.17 History taking: abdominal hysterectomy

Information for the candidate

In this station you will be asked to take a history from a 48-year-old female patient scheduled to have an abdominal hysterectomy.

Examiner's mark sheet

	marks
Introduces him/herself to the patient, confirming that he/she is talking to the right person and explains his/her role.	2
H/O previous anaesthetic: PONV following dental extraction.	2
Current presentation: per-vaginal bleeding.	1
Palpitations and shortness of breath on climbing a flight of stairs.	2
H/O anaemia.	2
H/O migraine.	1
H/O DVT, pulmonary embolism 6 months ago.	2
Drug history: warfarin.	1
Specifically asks for dose and logbook (yellow) for INR.	2
Other regular drugs	
Ibuprofen for migraine.	1
Iron tablets for anaemia.	1
H/O allergy: none known.	1
H/O smoking: 20 cigarettes a day.	1

H/O alcohol intake: none.

1

Total:	/20

Information for the actor

You are a 48-year-old female scheduled to have a hysterectomy (removal of the womb). You have suffered from vaginal bleeding for the past year secondary to some new growths (fibroids) in the uterus. Consequent to the blood loss, you are quite anaemic (reduced red cells in blood). Nowadays, you get tired, have shortness of breath and palpitations even after climbing up a flight of stairs. Your GP has started you on iron tablets.

Six months ago you developed severe pain and swelling in your left calf and subsequently suffered tightness of the chest. You were diagnosed with deep vein thrombosis (clot in the leg) and pulmonary embolism (clot in the lung). Since then you were started on a medicine, warfarin, which prevents clot formation, but can cause bleeding. You have a little yellow book to follow-up with your doctor in which the details of the medicine dosage and clotting are entered on a regular basis.

Some years ago you underwent teeth extraction under general anaesthesia and were admitted to hospital after the procedure for severe nausea and vomiting. You suffer from migraine for which you take ibuprofen. You have no known allergies to medicine or food. You smoke about 20 cigarettes a day, but do not consume alcoholic beverages.

Anticoagulation with warfarin

Patients can be given warfarin either for venous or for arterial thrombo-embolic diseases. Venous thrombo-embolism conditions include deep vein thrombosis (DVT), pulmonary embolism (PE), and deficiencies of antithrombin III, protein C and protein S. Arterial thrombo-embolism conditions include atrial fibrillation, acute myocardial infarction, mural cardiac thrombus, and problems associated with prosthetic heart valves.

The effect of warfarin is monitored by measuring the INR. In treatment of DVT, PE, atrial fibrillation, patients with tissue heart valves, and valvular heart

disease, a therapeutic range of INR of 2.0-3.0 is recommended. In the presence of mechanical prosthetic valves or recurrent systemic emboli, the recommended range is 2.5-3.5.

In the peri-operative period, the decision to continue or withhold warfarin is determined by balancing the risks of recurring thrombo-embolism and surgical bleeding. In general, warfarin is stopped 3-5 days prior to surgery. If the risk of thrombo-embolism is high, in the absence of a warfarin effect, patients should receive 'heparin bridging' with unfractionated or low-molecular-weight heparin until warfarinisation is re-established. Seeking a haematologist's advice will be valuable.

Key points

- ◆ Use a structured approach.
- ◆ Explore the reason for the proposed surgery.
- ◆ If patients volunteer a history of conditions, such as anaemia, explore more about its systemic effects.
- ◆ Do not forget to elicit a history of exercise tolerance.
- ◆ Ask details about the drugs and the reason for taking the drugs.

(For more information please refer to OSCE set 1, station 1.12).

Station 5.18 Communication: abdominal aortic aneurysm repair

Information for the candidate

A 70-year-old man underwent emergency repair of a ruptured abdominal aortic aneurysm. Intra-operative blood loss was 3.5L; 8 units of blood were transfused during the surgery. An arterial blood gas shows severe metabolic acidosis. He is ventilated in the intensive care unit. He requires an adrenaline infusion at a rate of 3-4mg per hour.

In this station you will meet the patient's son.

Examiner's mark sheet

	marks
Introduces him/herself to the patient's relative.	1
Ensures that the relative is able to understand the role of the abdominal aorta (as a major blood vessel) and the consequences of a leaking or ruptured aneurysm.	1
Elicits relative's understanding and details already known to the relative.	2
Explains the nature of the surgery and the reason for doing the surgery.	2
Explains the nature and seriousness of the problem in simple terms.	1
Explains about intra-operative blood loss and blood transfusion.	2
Explains the reason for ventilating.	2
Reassures that he is sedated and pain is controlled.	2
Gives details about the current general condition.	2
Gives details on possible complications that can be anticipated in the next 24-48 hours.	2
Ensures that the relative understands the seriousness of the problem and associated mortality.	2
Gives an opportunity for further questions and clarification.	1

Total: /20

Information for the actor

Your father (70 years old) is admitted to the hospital and you have been told that he is seriously ill. You visited him a week ago and he seemed fine. You know that he has mild diabetes and high blood pressure. He has neither been admitted to hospital in the past, nor had any operations. You have no idea what this emergency operation was for.

Your concerns are: How is he? Can you see him? When will he be able to go home? Did he receive the right treatment? Can you speak to the senior surgeon who operated on him? The doctor may mention that he is on a breathing machine which will make you worried that his condition may be serious.

Communication skill: providing information to the patient's relative

Convey the facts to the relative who may not have any background knowledge about the patient's illness. The pathology and illness should be explained in simple language. Issues such as major surgery, pre-operative comorbidity, postoperative complications and mortality should be outlined to the relative or next of kin.

Have a list of simple layman words for complex medical terminology. An example for the abdominal aorta would be: a major blood pipe inside the tummy; for the ventilator: a breathing machine; and for the endotracheal tube: a breathing tube to the windpipe.

A ruptured aortic aneurysm has a high mortality rate (nearly 50%). Intra-operative blood loss, problems related to blood transfusion, hypotension, reduced organ perfusion, aortic cross-clamping - all contribute to increased peri-operative morbidity. The majority of patients require intra-operative inotropic support. Renal failure, myocardial infarction, continued bleeding and retroperitoneal bleeding, pulmonary embolism, and graft infection are the major complications during the postoperative period.

Key points

- ◆ Convey the facts sensitively.
- ◆ Establish the understanding and knowledge of the relative about the patient.
- ◆ A ruptured aortic aneurysm has a high mortality rate.

Station 5.19 Anatomy: spine and vertebrae

Information for the candidate

In this station you will be asked questions on anatomy and the technical skill required for performing epidural anaesthesia.

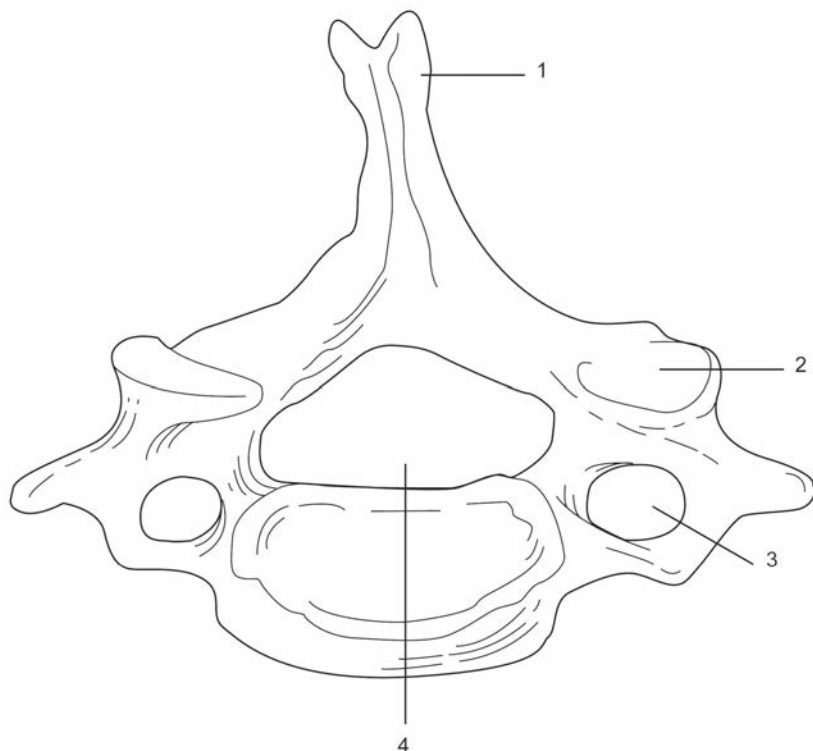


Figure 5.19a.

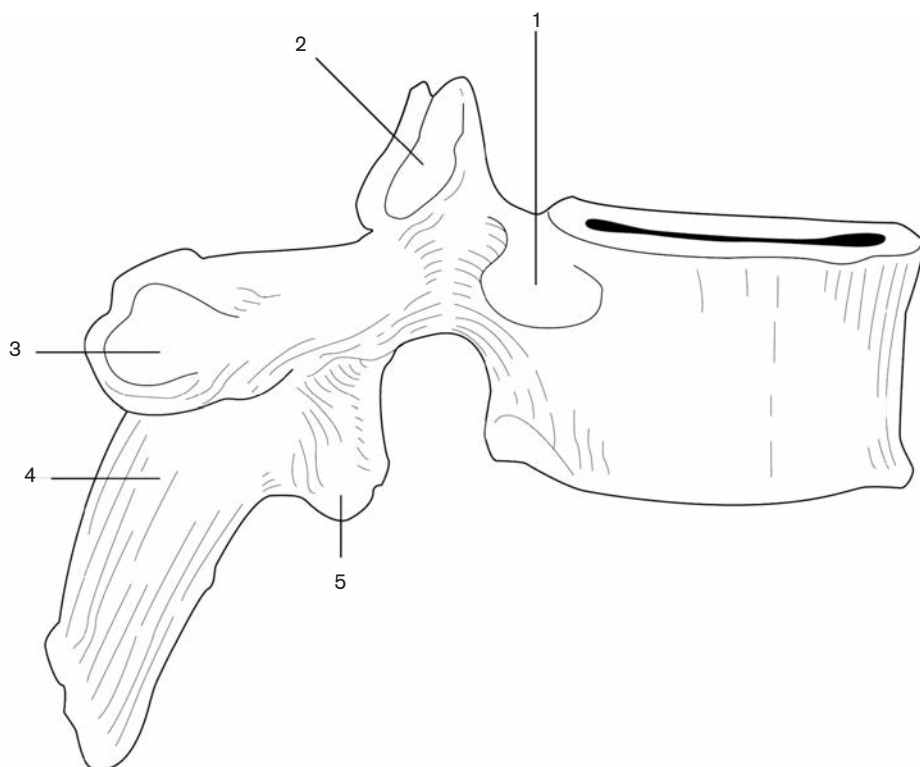


Figure 5.19b.

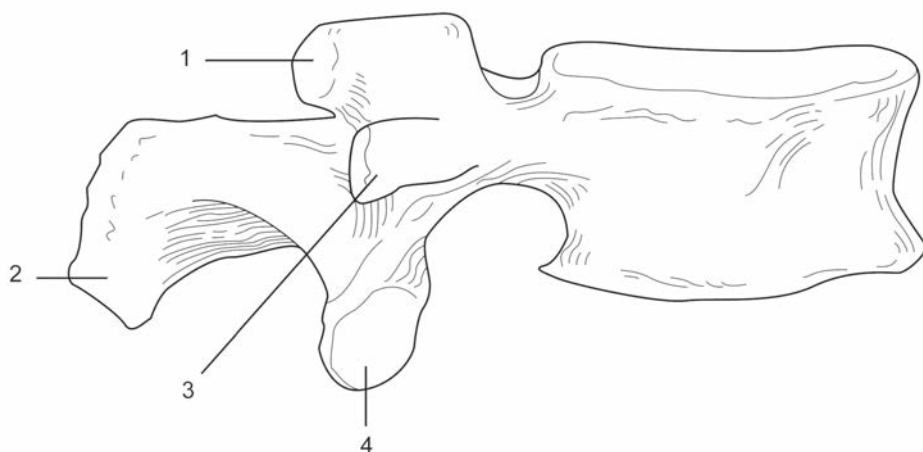


Figure 5.19c.

Examiner's mark sheet**marks****Name the vertebrae in Figures 5.19a, 5.19b and 5.19c****3**

- ◆ Figure 5.19a: typical cervical vertebra.
- ◆ Figure 5.19b: typical thoracic vertebra.
- ◆ Figure 5.19c: typical lumbar vertebra.

Figure 5.19a

1. Spinous process.
2. Superior articular facet.
3. Foramen transversarium.
4. Vertebral foramen.

Figure 5.19b

1. Facet for rib attachment.
2. Superior articular facet.
3. Transverse process.
4. Spinous process.
5. Inferior articular process.

Figure 5.19c

1. Superior articular process.
2. Spinous process.
3. Transverse process.
4. Inferior articular process.

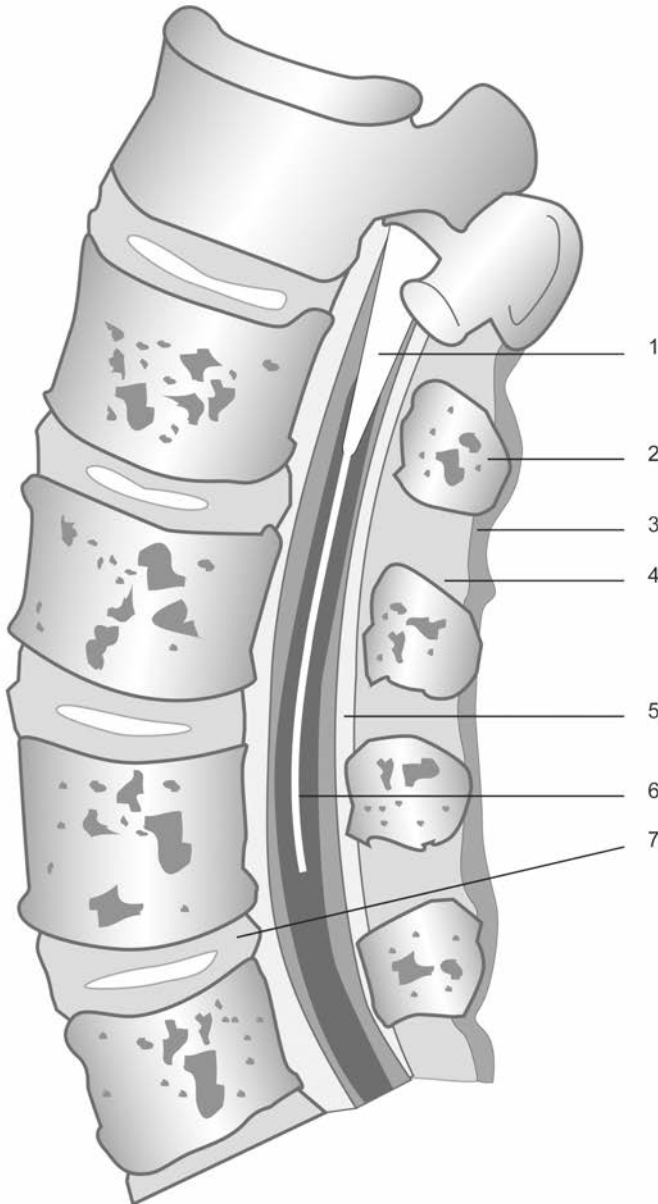


Figure 5.19d Sagittal view of the lumbar spine.

Name the structures labelled 1 to 6 in Figure 5.19d

6

1. Spinal cord.
2. Spinous process.
3. Supraspinous ligament.
4. Interspinous ligament.
5. Ligamentum flavum.
6. Filum terminale.
7. Intervertebral disc.

What are the differences between thoracic and lumbar vertebrae?

2

Thoracic vertebrae have the following features (refer to Figure 5.19b):

- ◆ Upper and lower hemi-facets (on the body) for the attachment of rib heads.
- ◆ The transverse processes are larger than lumbar vertebrae.
- ◆ The transverse process has a facet which articulates with the tubercle of the rib.
- ◆ Spinous processes are long and angulate downwards; lumbar spinous processes are horizontal and are perpendicular to the body of the vertebra.

You are asked to perform an epidural block at the L1-L2 interspace. Can you describe the procedure?

6

- ◆ Preparation: ensures that the patient has been consented and all drugs and equipment are available and checked.
- ◆ Mentions aseptic precautions.
- ◆ Selects appropriate position.
- ◆ Correctly locates L1-2 interspace (on an actor).
- ◆ Describes:
 - preparation of back with antiseptic solution;
 - local anaesthetic injection to skin and deeper tissues;
 - appropriate technique to identify the epidural space.

How much of the catheter would you insert into the space? 1

About 4-5cm of catheter should be left in the space.

Would you use a test dose? What is the purpose of a test dose? 2

A test dose of 10mg of bupivacaine is used to identify the subarachnoid placement of the catheter.

Total: /20

Epidural anaesthesia

The epidural space is a potential space that lies between the dura and periosteum lining the inner aspect of the vertebral canal. On the posterior aspect the ligamentum flavum completes the boundary between the laminae. It extends from the foramen magnum to the sacral hiatus. It contains fat, areolar tissue and a vertebral venous plexus.

The line joining the top of the iliac crests usually corresponds to the level of the L4 vertebra. The space just above the line is usually the L3-L4 interspace. The epidural space can be identified by either using a loss of resistance technique or negative pressure technique.

With the loss of resistance method, a syringe filled either with saline or air is used to locate the epidural space. The disadvantages of air include the potential for injection of air into the vascular space and subarachnoid space (pneumocephalus), and the greater incidence of the catheter puncturing the epidural veins. Saline tends to push the dura away from the needle tip as it enters the epidural space.

Negative pressure techniques, such as a visual indication of pressure change, sucking in of a hanging drop or sucking in of fluid from a drip attached to the epidural needle, have been used.

The use of a test dose is still a controversial practice. A test dose cannot reliably identify the intravascular placement of a catheter. But 10mg of bupivacaine injected into the subarachnoid space will produce some motor block.

Key points

- ◆ Epidural technique involves preparation of the patient (assessment, consent), preparation of theatre (trained assistant, drugs, equipment), preparation of the site (positioning, aseptic precautions) and then performance of the block.
- ◆ The intercrystal line corresponds to the L4 vertebra.
- ◆ More than 5cm of the catheter in the epidural space can exit through the intervertebral foramen causing a unilateral block; less than 4cm poses a risk of accidental dislodgement. The optimal recommended length in the epidural space is 4-5cm.

Station 5.20 Technical skill: supraclavicular brachial plexus block

Information for the candidate

In this station you will be asked questions to assess your knowledge and skills related to supraclavicular brachial plexus block.

Examiner's mark sheet

marks

Describe the relations of the brachial plexus in the neck

4

The brachial plexus is formed by the union of the anterior primary rami of the lower 4 cervical nerves and the anterior

primary rami of the first thoracic nerve (C5-T1). The roots emerge from the intervertebral foramina. The roots of the 5th and 6th cervical nerves unite to form the upper trunk. The root of the 7th cervical nerve continues as the middle trunk. The 8th cervical nerve and 1st thoracic nerve roots unite to form the lower trunk.

In the neck the roots and trunks lie in the posterior triangle, covered by skin, platysma and deep fascia. Superficially the plexus is crossed by the external jugular vein and the supraclavicular nerves. The trunks emerge from the space between the scalenus anterior and scalenus medius muscles. This space becomes wider in the anteroposterior plane as the muscles approach their insertion on the first rib. The plexus leaves the neck by crossing the clavicle near its midpoint.

What are the indications for supraclavicular brachial plexus block?

2

A supraclavicular brachial plexus block can be used as a sole anaesthetic technique or as a supplement to general anaesthesia for surgeries in the shoulder, arm and forearm.

Describe the technique of performing the supraclavicular block

2

- ◆ Preparation: ensure that the patient has been consented and that all drugs, equipment and monitors are available and checked; use aseptic precautions.
- ◆ Position: head slightly turned to the opposite side.

Indicate the landmarks and point of needle entry (on the actor)

4

The midpoint of the clavicle is located midway between the acromial end and sternal end of the clavicle. The point of needle entry is 1cm above the midclavicular point, lateral to the insertion of the clavicular head of sternocleidomastoid and lateral to the subclavian artery pulsation.

The skin is infiltrated with 1ml of 1% lidocaine. An insulated nerve stimulator needle is inserted perpendicular to the skin. Using a nerve stimulator, contractions of the forearm muscles can be observed. Once muscle contractions are elicited at a current of less than 0.5mA, 30-40ml of local anaesthetic can be injected following careful negative aspiration.

What part of the brachial plexus would you stimulate with this approach?

2

The trunk of the brachial plexus is stimulated at this level. The plexus is quite close at this region. A dense block is often possible in this approach.

What are the contra-indications for this block?

4

General contra-indications for the nerve block include patient refusal, allergy to local anaesthetics, bleeding disorders and infection at the site.

Specific relative contra-indications for supraclavicular block are a short, stiff neck, large goitre, previous radiotherapy to the neck, previous radical neck surgery and recurrent laryngeal nerve palsy, and a pneumothorax in the opposite side.

What movements are elicited when you stimulate i) the lateral cord and ii) the posterior cord?

2

- ◆ Stimulation of the lateral cord causes the contraction of biceps with elbow flexion (musculocutaneous nerve).
- ◆ Stimulation of the posterior cord causes contraction of triceps and elbow extension (radial nerve).

Total:	/20

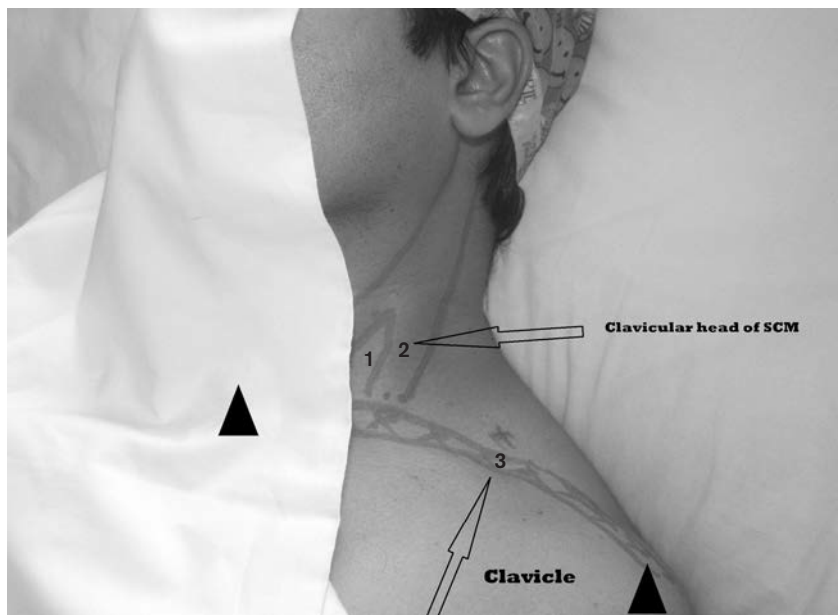


Figure 5.20 Landmarks for supraclavicular brachial plexus block.

1. Sternal head of sternocleidomastoid; 2. Clavicular head of sternocleidomastoid; 3. Midpoint of the clavicle.

Use of a nerve stimulator to locate the nerves

Use of the nerve stimulator increases the success of peripheral nerve blocks. It provides objective evidence that the needle tip is close to the nerve. Using a short square wave impulse of 0.1 msec duration, only the motor fibres can be stimulated without stimulating the C-fibres. Hence, it does not cause pain.

Insulating the needles except for the tip reduces dispersion of current; hence, insulated needles require less current. The cathode (negative electrode) causes depolarisation of the nerve, therefore requiring less current to stimulate the nerve. The anode causes an area of hyperpolarisation around the needle and requires a higher current to stimulate the nerve. A stimulating frequency of 2Hz is usually chosen. A high frequency causes painful muscle twitches. If the frequency of stimulation

is too slow, the nerve may be impaled. If a muscle twitch is generated at very low current of less than 0.2mA, there is a possibility that the needle may penetrate the nerve.

Once the appropriate twitch is generated, maintaining the immobility of the needle, 1ml of local anaesthetic is injected. This causes mechanical displacement of the nerve away from the needle tip and results in the immediate disappearance of the twitches.

Key points

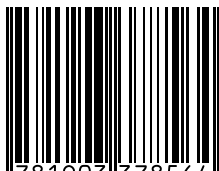
- ◆ Stimulation of the radial nerve (C7, C8) elicits extension of the elbow, wrist and finger.
- ◆ Stimulation of the ulnar nerve (C8, T1) elicits wrist flexion and medial deviation.
- ◆ Stimulation of the median nerve (C5-8) elicits wrist flexion, finger flexion and thumb opposition.

The Objective Structured Clinical Examination (OSCE) is a highly reliable and valid tool for the evaluation of trainees in anaesthesia. It enables examiners and trainers to assess a number of competencies in an organised way. Performance in the OSCE is considered to be a fair reflection of the level of knowledge and skill attained during anaesthesia training. Apart from having a wide and deep knowledge on the subject, trainees are expected to have the capacity to demonstrate their competency in a short period of time allotted for each station.

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