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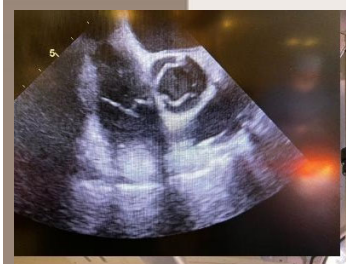
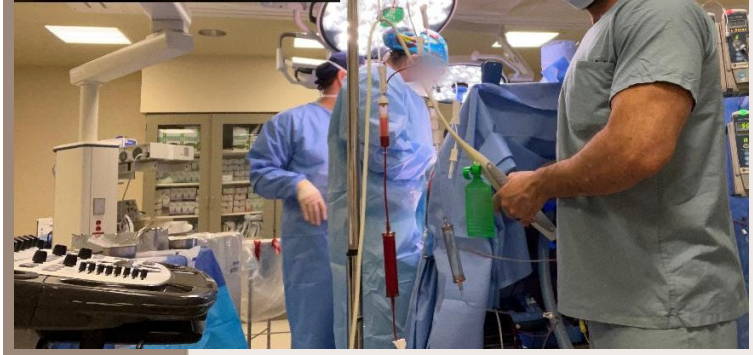
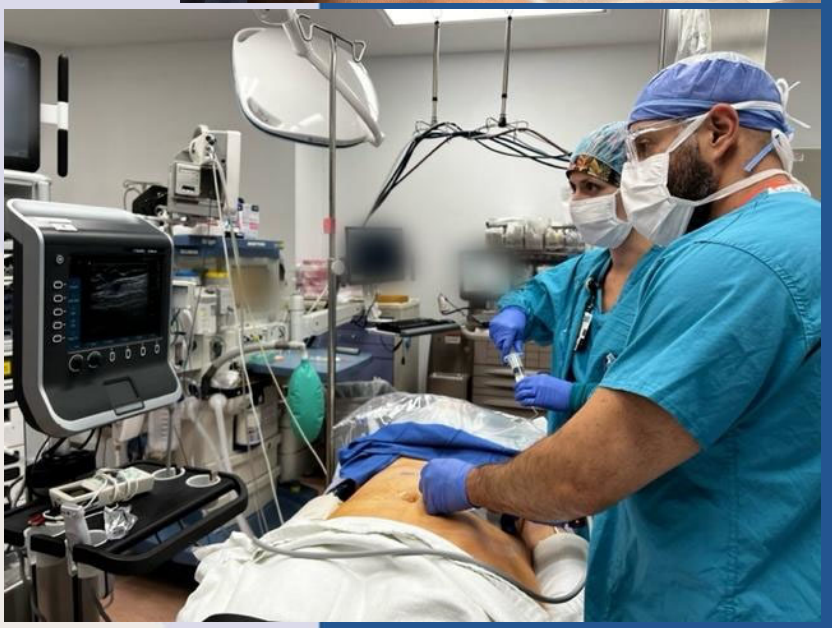
TOPICS IN THIS ISSUE







INTERNATIONAL STUDENT JOURNAL OF NURSE ANESTHESIA
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Front Cover:
On the front cover Alex Duron, BSN, RN, a resident enrolled in the National University Nurse Anesthesiology Program, gains experience with various ultrasound-guided procedures. Pictured clockwise from the top, Mr. Duron performs an adductor canal block, a transversus abdominus plane (TAP) block, and transesophageal echocardiography. Providing instruction and assistance with the TAP block is preceptor Serena Swanson, MSN, CRNA.

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Research Abstract

Spontaneous Subcutaneous Emphysema following Diagnostic Laparoscopy

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Keywords: Subcutaneous emphysema, spontaneous subcutaneous emphysema, crepitus, laparoscopic surgery

Subcutaneous emphysema (SE) is defined as the unintentional accumulation of air or carbon dioxide in the soft tissue under the skin.[1-2] This phenomenon can occur spontaneously, or be a result of trauma, infection, or surgical complications.[1] It commonly occurs in the chest wall and neck, but can also happen in other parts of the body.[2] Typical signs and symptoms of SE includes: crepitus, swelling in the neck and face as well as pain in the chest.[1] This report discusses the case of a patient whose surgical course was complicated by spontaneous SE.

Case Report

An 82-year-old, 178 cm, 60 kg male patient presented to the emergency room with persistent vomiting and moderate abdominal pain. The patient's past medical history was significant for diabetes mellitus, hypertension, chronic obstructive pulmonary disease, gastroparesis, annular pancreas, and duodenal stenosis. The patient's surgical history was significant for hernia repairs, polypectomy (from the bile duct), cholecystectomy, and multiple esophagogastroduodenoscopies with dilations for duodenal strictures. The patient was taken to the operating room (OR) for a diagnostic laparoscopy and a Roux-n-Y hepaticojejunostomy to repair the duodenal strictures and annular pancreas.

Upon entry to the OR, standard non-invasive monitors were initiated. A rapid sequence induction was performed to prevent aspiration during intubation. The trachea was intubated using a macintosh size 3 blade. During direct laryngoscopy, a Cormack-Lehane grade 1 view of the glottic opening was visualized. A 7.5 mm oral endotracheal tube was passed through the vocal cords and secured at 21 cm at the lip. Mechanical ventilation was initiated using pressure-control ventilation with the following settings: peak inspiratory pressure of 18 mm Hg, I:E ratio of 1:3, and PEEP of 5 mm Hg. The observed tidal volume was 500-600 mL, and the respiratory rate was set at 14. General anesthesia was maintained using sevoflurane 2% expired concentration in a mixture of O_2 1 L/min and air 1 L/min. The left radial artery was canulated with a 20-gauge arterial line for precise blood pressure monitoring and frequent lab draws.

The surgery was initiated by the surgeon making three abdominal incisions for trocar placement. The primary and secondary trocars were placed with ease. However, great difficulty was experienced during the placement of the tertiary trocar requiring four attempts by the surgeon through one of the abdominal incisions. After successful placement of all three trocars, a pneumoperitoneum was created using carbon dioxide (CO_2) to insufflate the abdomen. The abdomen was insufflated and maintained at a pressure of 15 mm Hg. Thirty minutes after insufflation, the patient's $EtCO_2$ acutely increased to 64 mm Hg from 36 mm Hg. Different ventilation strategies were implemented including an increase in respiratory rate, tidal volume,

and I:E ratio. The CO_2 absorbent was also changed to help decrease the $EtCO_2$. Despite many interventions, the patient's $EtCO_2$ was sustained in the 60s mm Hg.

Due to the consistently elevated $EtCO_2$ the anesthesia professional performed a thorough assessment of the patient. She felt significant crepitus in the supraclavicular region and noted SE on the patient's chest and right shoulder. The surgeon was notified, and the decision was made to decrease the abdominal insufflation pressure to 12 mm Hg. By the end of the surgery the SE progressed across the patient's chest to his left shoulder, face, and neck. Postoperatively the patient remained intubated, sedated, and transferred to the post anesthesia care unit (PACU) until a room in the intensive care unit (ICU) became available. A chest radiograph, obtained during the patient's time in the PACU, revealed no tracheal deviation, airway obstruction, or any other respiratory sequelae. On postoperative day one, the SE resolved and the patient's endotracheal tube was removed. He was later discharged home on postoperative day two without any further complications.

Discussion

Creating a pneumoperitoneum is an essential part of any laparoscopic surgery.[3] The ideal gas for insufflation is non-toxic, colorless, highly soluble in the blood, easily expelled from the body or excreted by the lungs, non-flammable, and inexpensive.[4] CO_2 is the only gas that satisfies all these characteristics.[4] It's important to understand where the gas travels during laparoscopic surgery.[4] The CO_2 is intended to distend the abdominal cavity to allow for adequate visualization of the abdominal organs. Up to 50% of the complications that ensue with laparoscopic surgery occur while obtaining abdominal access.[5] The remaining percentage occurs during abdominal insufflation.[5] Multiple attempts to gain access to the abdominal cavity can disrupt tissue integrity, increasing the likelihood of CO_2 escaping into the weakened tissue.[4] Other factors that subject the patient to increased risk of developing SE include using 5 or more trocars, surgeries lasting longer than 3.5 hours, age greater than 65 years, intra-abdominal pressures greater than 15 mm Hg, and improper trocar placement.[4]

An improvement of SE is usually seen after desufflation, or releasing the gas from the abdomen.[1] For this reason, there aren't standard interventions in place for the treatment of SE.[1] If the SE doesn't resolve after desufflation, then more invasive therapies need to take place.[1] Some treatments include placing drains, chest tubes, and even compressive massage.[1] In extreme cases, small cuts or "blow holes" can be made into the skin in the infraclavicular region to release the gas.[2] Preventative strategies revolve around the risk factors for SE during laparoscopic procedures.[6] Preventative strategies include: awareness, communication, and monitoring by the anesthesia professional, intra-abdominal pressure less than 15 mm Hg, low insufflation gas flows, less than 5 trocar sites, proper fit of the trocar, having a surgical time less than 3.5 hours, continuous monitoring of $EtCO_2$, and maintaining $EtCO_2$ less than 50 mm Hg.[6]

There are multiple reasons why a patient's $EtCO_2$ could remain elevated during surgery. Differential diagnoses should be ruled out before a diagnosis of SE can be made.[6] Differential diagnoses could include excessive hyperthermia, equipment malfunction, drug toxicity, tourniquet release, ventilatory problems, contrast dye, and malignant hyperthermia.[6] The CO_2 used for insufflation is highly soluble in the blood and it is rapidly absorbed into the circulation

from the peritoneal cavity.[7] This results in the increased $EtCO_2$ seen with laparoscopic surgery.[7] Since absorbed CO_2 can only be excreted through the lungs, there needs to be an increase in minute ventilation by approximately 25% to maintain eucarbia.[1,7] A non-anesthetized patient has the ability to compensate for the increased CO_2, but the anesthetized patient does not.[7] In the anesthetized patient, the only way to prevent hypercarbia is compensatory hyperventilation.[7] It's crucial for the anesthesia professional to make ventilator adjustments on the anesthetized patient to include increasing the respiratory rate and/or tidal volume which will result in an increased minute ventilation.[7]

The patient presented in the case discussion had surgical and non-surgical risk factors that contributed to the development of SE. Risk factors included his age, greater than 65 years old, length of surgery, lasted 11 hours, and trauma during abdominal access, multiple trocar insertion attempts. It appeared that the SE originated from the incision where the surgeon had the most difficulty placing the trocar. The structural integrity of the fascia was weakened, and CO_2 was absorbed into the subcutaneous tissue around the trocar site. Although SE is a rare complication, it has the potential to become a more common occurrence with the increased frequency of laparoscopic procedures.[6] Since most of these complications go undetected, it's imperative the anesthesia professional be aware of the risk factors of SE.[5]

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Anesthesia Management of a Patient with Endemic Goiter in Migori, Kenya

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Keywords: Airway obstruction; airway management; anesthesia; difficult airway; endemic goiter; thyroidectomy; tracheal compression; perioperative management

The term endemic goiter often occurs due to a severe deficiency in dietary iodine. The ensuing diminished synthesis of thyroid hormones leads to a compensatory increase in the production of thyroid-stimulating hormone, causing hyperplasia of thyroid follicular cells, i.e., a goiter.[1] Approximately 28.3% of the African population have goiters present according to the World Health Organization.[2] An endemic goiter presents unique challenges in airway management even in the best circumstances. The case described herein was noteworthy due to the resource-limited setting.

Case Report

A 51-year-old, 73.4 kg female with no known drug allergies and no past medical or surgical history presented to the Brase Clinic in Migori, Kenya. During her initial evaluation, she was diagnosed with a grade 2 endemic goiter, as defined by the World Health Organization goiter classification system.[3] Notably, the patient had compressive symptoms when lying flat, and stated she preferred to sleep with multiple pillows or in a side-lying position. On airway examination, the patient was classified as a Mallampatti class II airway; additionally, an inter-incisor gap and mentum-to-hyoid bone distance of greater than 5-6 cm were noted. Her thyromental distance was approximately 6 cm, she demonstrated a class 1 mandibular protrusion test, and her ability to flex or extend her neck was approximately 50% of a typical patient's range of motion due to her enlarged goiter. Pertinent laboratory results included a basal hemoglobin of 12.1 g/dL and a negative human chorionic gonadotropin (hCG) test. At the completion of the exam, the patient was consented for surgery and general anesthesia.

The patient was given glycopyrrolate 0.2 mg intravenously in the preoperative area by the registered nurse. The patient was then prepared for standard induction in a semi-recumbent position; standard noninvasive monitors for electrocardiography, blood pressure, and pulse oximetry were applied. The patient was preoxygenated with O_2 15 L/min via face mask. Anesthesia was induced using a simultaneous administration of propofol 300 mg, fentanyl 10 mcg, and succinylcholine 200 mg. The trachea was intubated using a Macintosh 4 intubation blade with a standard 6.5 mm endotracheal tube preloaded with a bougie; this size was selected due to limited supplies available. During intubation, the patient was noted to have a grade 2b Cormack-Lehane classification with a slightly left-deviated glottic opening. As part of a combination antiemetic therapy, the patient was given dexamethasone 4mg shortly after induction. Anesthesia was maintained with sevoflurane 2.5% inspired concentration with low-flow O_2 at less than 1 L/min.

A right thyroid lobectomy was then performed. As part of a multimodal analgesia plan, the patient was given fentanyl 5 mcg boluses intraoperatively for a total of 25 mcg. Lactated Ringers

500 mL was administered using goal-directed fluid therapy. Thirty minutes prior to completion of the surgery, sevoflurane was turned off and O_2 flow was increased to 15 L/min. Approximately ten minutes later, propofol 50 mg was administered. No significant variations in hemodynamic or respiratory status occurred intraoperatively. To complete the combination prophylactic antiemetic regimen, ondansetron 4mg was given before extubation. The patient's oropharynx was suctioned, an oropharyngeal airway was placed, and the patient was extubated awake in the semirecumbent position. An assessment for recurrent laryngeal nerve injury, tracheomalacia, and hemorrhage was conducted while still in the operating room via direct laryngoscopy and having the patient pronounce the letter "E". To complete the multimodal analgesia plan, the patient also received postoperative paracetamol 1 g and ketorolac 15 mg. The patient was transferred to the recovery unit to be closely monitored for 1-2 hours prior to discharge. No incidents of respiratory complications, pain, nausea, or vomiting were noted during the recovery period, and the patient was discharged home.

Discussion

The most unique aspect of this case, in comparison to similar cases in the literature, was the setting, namely a rural clinic in Migori, Kenya. The resources were very limited, with a notable absence of several standard monitors such as end-tidal gas sampling. Equipment failure and intermittent power loss presented added difficulty to the anesthetic management of this patient, including necessitating manual ventilation with room air until power was restored. Another major limitation was the absence of a formal lab, so only minimal tests could be performed such as hemoglobin level and hCG to determine if the patient was pregnant.

Instinctually one would suspect that patients with a goiter would be considered a difficult intubation; in fact, the incidence is only approximately 13%.[4] Still, the gold standard for airway management for this type of procedure is an awake flexible fiberoptic-assisted endotracheal intubation while the patient is spontaneously breathing. However, a flexible fiberoptic scope and other associated equipment were not available for this case, so direct laryngoscopy was performed. There was a GlideScope (Verathon Inc.) video laryngoscope available if direct visualization had failed. Fortunately, the patient only had minor airway abnormalities so intubation in this case was uneventful and atraumatic. A key aspect of the airway management in this case however was to maintain the head of bed at 30 degrees during intubation to minimize the compression on the airway related to the enlarged goiter.

There were several drug considerations in this case, primarily related to the scarcity and storage of medication. First and foremost were considerations related to the limited availability of medications. No neuromuscular blocking agents were used except during induction. Attempts were made to conserve anesthetic agents and oxygen supply, so low-flow sevoflurane was utilized, and the patient was not placed on a ventilator and instead kept spontaneously breathing during the entire perioperative course. While there has previously been a concern regarding nephrotoxic potential due to the formation of compound A while using low-flow sevoflurane anesthesia, to date there has been no data to substantiate this claim and no such complications were noted in this case.[5] The overall Kenyan population is also very opioid-naïve compared to those in the United States, so decreased fentanyl dosing was administered. Conversely, a higher-than-normal dosing of propofol was required to achieve appropriate loss of consciousness as well

as jaw relaxation and upper airway reflex suppression. This increased dosing may have been related to potency and efficacy of the medications themselves, as many of them were improperly stored or near their expiration.

There are also structural considerations when performing this kind of procedure. The thyroid gland is comprised of a left and right sided lobe, and the recurrent laryngeal nerves runs laterally along the each side of the gland in the transesophageal groove.[6] For this procedure, this structural element was relevant in that a neural integrity monitor endotracheal tube, which provides visual and audio cues to both identify and monitor the function of the recurrent laryngeal nerve (RLN), was not available and thus both the advantages and considerations associated with the use of this device were not pertinent to this case. The surgeon elected to instead use a direct stimulation neural monitoring device during the procedure. Since the intraoperative monitoring of the recurrent laryngeal nerve was suboptimal, careful postoperative monitoring for symptoms indicating post-operative vocal cord palsy, namely hoarseness from unilateral RLN damage or complete airway obstruction from bilateral RLN damage, was a critical consideration.[7] This post-operative assessment was completed by having the patient phonate the letter "E".[7]

Normally for this type of procedure, one of the anesthesia considerations would be calcium replacement in anticipation of potential intraoperative parathyroid gland dissection which could result in hypocalcemia.[8] However, another constraint created by this setting was the limited availability of postoperative care, which was usually a maximum of 2 to 3 hours. For this reason, only a partial thyroidectomy was performed to ensure preservation of parathyroid function and prevent hypocalcemia events, which typically only present 24 to 48 hours postoperatively.

In summation, the entire perioperative course for this patient was uneventful and without complication. The most important aspect of this case was closed-loop communication to ensure the restraints placed by the setting did not impact the outcome of the case, especially when it applied to modifications of workflows or supplies used. In the event of an emergency, everyone in the case already knew what was available and what their roles and expected actions would be. Adaptation into the resource-limited environment is required to maintain safety, even with a relatively simple procedure as was the case here. Anesthesia management in austere environments presents unique, but not insurmountable, challenges.

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Anesthetic Management of a Vallecular Cyst

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Keywords: vallecular cyst, laryngeal cyst, airway obstruction, difficult intubation, airway management

Vallecular cysts are rare supraglottic lesions that can develop in adult and pediatric populations and cause life-threatening airway obstruction.[1] Vallecular cysts make up 10 to 20% of all cysts in the larynx.[1] These cysts develop when mucous glands in the vallecula become obstructed.[1] While most patients present with symptoms of airway obstruction, some may be asymptomatic. These cysts may be incidentally discovered during induction, leading to an unanticipated difficult airway.[1] A thorough preoperative airway assessment and preparedness for difficult airway management is imperative in caring for these patients.

Case Report

A 72-year-old male with an estimated body mass index of 27.98 kg/m² presented for a micro-direct laryngoscopy for the excision of a left vallecular cyst. Past medical history was significant for hypertension, chronic obstructive pulmonary disease, anxiety, gastroesophageal reflux disease, and prostate cancer. Anesthetic history was notable for a difficult intubation 15 years prior, requiring an "intubating laryngeal mask airway (LMA)/fiberoptic;" however, no further anesthesia records were able to be obtained. In the prior 5 months, the patient underwent a colonoscopy under monitored anesthesia care using propofol, tolerating the procedure and anesthetic well. Social history was notable for smoking one pack per day of cigarettes for 50 years. The patient had recently seen his primary care doctor for complaints of worsening shortness of breath with minimal exertion, for which he was referred to a pulmonologist. A chest x-ray demonstrated pulmonary hyperinflation with diaphragm flattening. There were no documented imaging or notes regarding the size or characteristics of the vallecular cyst. Airway examination on the day of surgery was notable for a Mallampati IV, a thyromental distance

greater than 3 finger breadths, limited mouth opening, and restricted neck range of motion. Bilateral breath sounds were clear to auscultation and the patient was noted to have a dry cough.

The operating room was prepared with a flexible fiberoptic scope, an intubating LMA, a tracheostomy kit, supplies for an emergency cricothyrotomy, and a video laryngoscope with size 3 and 4 Macintosh (MAC) blades. Once in the operating room, standard noninvasive monitors were applied, and vital signs were within normal limits. The patient was able to lay flat without difficulty. He was given midazolam 1 mg intravenous (IV) and preoxygenated with O_2 15 L/min via facemask for 5 minutes. Prior to IV induction, the fraction of expired oxygen was 90% and oxygen saturation was 100%. Induction agents consisted of lidocaine 100 mg, fentanyl 100 mcg, and propofol 200 mg IV. After the loss of consciousness, bag-mask ventilation (BMV) was performed, requiring an oropharyngeal airway and 2 providers. Once ventilation was confirmed, succinylcholine 200 mg IV was administered. The trachea was intubated with a MAC 3 video laryngoscope and a 6 mm endotracheal tube with a stylet on the first attempt and mechanical ventilation was initiated. A Cormack-Lehane grade 1 view was present, and a large left vallecular lesion was noted and carefully avoided. General anesthesia was maintained with propofol at 50mcg/kg/min and sevoflurane 1% inspired concentration in O_2 0.3 L/min and air 1.6 L/min on SIMV-VC ventilator setting.

The bed was rotated 90 degrees. Following the return of 4/4 train-of-four count (TOFC), the patient was administered rocuronium 50 mg IV. Additionally, dexamethasone 10 mg and clindamycin 900 mg IV were administered prior to the start of the procedure. The surgeon utilized a laryngoscope to view a large mucous filled left vallecular cyst that was removed with a cup forceps. Hemostasis was achieved with epinephrine pledgets. The propofol infusion and sevoflurane were discontinued at the end of the 45-minute procedure. Oxygen 0.3 L/min and air 1.6 L/min was continued until 10 minutes prior to the end of the case where O_2 was maintained at 15 L/min. At this time, the patient had 0/4 TOFC twitches. The neuromuscular blockade was antagonized with sugammadex 400 mg IV, which produced 4/4 TOFC twitches and sustained tetanus. Ondansetron 4 mg IV was given at the conclusion of the procedure. The trachea was extubated and a non-rebreathing mask with O_2 8 L/min was applied to the patient prior to transport to the post-anesthesia care unit. The patient continued to be stable and was discharged to home later that day.

Discussion

Laryngeal cysts are classified by size, location, and composition.[2] Children are more likely to develop vallecular cysts than adults, with adult cysts occurring most frequently in men in their fifties.[3,4] Ductal cysts are the most common type of cyst and are often found in the vocal cords, epiglottis and vallecula.[2] These cysts are typically 1-5mm and are caused by mucous retention in mucous membranes.[2,3] Imaging is necessary for identification and management, but pathological evaluation is required for definitive diagnosis.[2] Most cysts have benign pathology.[2]

Patients with chronic, slowly developing cysts are less likely to develop symptoms of airway obstruction than those with rapidly growing cysts because their respiratory muscles have been conditioned to overcome the obstruction.[5] Patients with quickly growing cysts may exhibit rapid deterioration due to a lack of respiratory reserve.[5] Incidental findings of cysts can occur in 1 in 1,250 to 1 in 4,200 laryngoscopies for general anesthesia and can cause an unanticipated difficult

airway.[3,4] When vallecular cysts grow quickly, become large enough or develop an infection, they can cause symptoms of airway obstruction such as shortness of breath, hoarseness, dysphagia, stridor, and cough.[3] Large cysts that cause respiratory distress require immediate surgical management and removal.[3]

Airway evaluation and planning are of utmost importance in planned cases. A thorough airway examination and assessment of anesthetic and medical history is necessary. Airway structures can be evaluated with computed tomography scans or magnetic resonance imaging; however, this type of imaging may be time consuming and difficult for patients with large obstructions who cannot lay flat for the scans.[5,6] A nasal endoscopy can quickly and effectively assess the appearance and location of the lesion.[5-7] Preparedness with the appropriate equipment, personnel, optimal positioning (ramped or sniffing position), preoxygenation, and a primary plan with backup plans is necessary.[7]

Different anesthetic approaches can be considered for micro-direct laryngoscopy and tailored on a case-by-case basis. Techniques without tracheal intubation include spontaneous ventilation, intermittent apneic ventilation, and jet ventilation; this case study focuses on management with tracheal intubation.[6] Tracheal intubation offers several advantages, including providing a protected airway as well as continuous monitoring of oxygenation, carbon dioxide, and airway pressures. Additionally, it offers the ability to use neuromuscular blocking agents which allows for a motionless patient and improved surgical exposure.[6]

The American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway offers a framework for approaching an anticipated difficult airway.[7] Awake fiberoptic intubation or general anesthesia with IV or inhalational induction with video laryngoscope are often considered.[5-7] The use of an LMA in a cannot ventilate or intubate situation is typically recommended. However, this may be challenging in patients with laryngeal lesions because the lesion may not allow for a proper seal of the device and could rupture the cyst, compromising the airway.[6] Cricothyrotomy is the definitive treatment if both BMV and intubation fail.[6,7]

Airway patency is dynamic in patients with vallecular cysts. Anesthesia and normal sleep can affect pharyngeal muscle tone and result in obstruction.[5] Awake fiberoptic intubation is often used because it allows the patient to breathe spontaneously and prevents the risk of airway obstruction with sedation or the potential for oversedation. High-flow nasal cannula can be useful for awake fiberoptic intubation in providing oxygenation and positive pressure.[5] However, some patients, particularly children, may not be able to tolerate awake fiberoptic intubation. An additional barrier may be provider inexperience with fiberoptic devices.

A "double airway set-up" is recommended if an awake approach is not possible.[6] In a "double airway set-up," all supplies and personnel required for a cricothyrotomy are available during induction and the cricothyroid membrane will be thoroughly evaluated before sedation is given.[6] Intubation with general anesthesia after either inhalation or IV induction may be considered. Video laryngoscopy is often the preferred method of intubation in the suspected difficult airway.[6,7] An obstruction during an inhalation induction can compromise gas exchange and make exhaling anesthetic gas difficult.[5] Difficult BMV occurs in 40% of patients with airway obstruction, while an impossible BMV occurs in 6% of patients.[6]

An IV induction was chosen for this patient based on his ability to maintain a patent airway when sedated with propofol for a recent colonoscopy. The patient's previous history documented successful intubation with a fiberoptic scope; therefore, the fiberoptic scope and cricothyrotomy supplies were present in the room if BMV and intubation with video laryngoscope were unsuccessful.

Airway management of patients with vallecular cysts is complex. Careful airway evaluation and understanding of the difficult airway algorithm is necessary when caring for patients with vallecular cysts and other laryngeal lesions. Preparation for and risks and benefits must be weighed with each anesthetic technique based on specific patient characteristics.

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Anesthetic Management of a Patient with Klippel-Trenaunay Syndrome

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Keywords: Klippel-Trenaunay Syndrome, port wine stain, vascular malformation, varicose veins, cutaneous hemangioma

Klippel-Trenaunay Syndrome (KTS) is a rare congenital disorder characterized by cutaneous hemangiomas, venous varicosities, and bone and soft tissue hypertrophy.[1] Diagnosis is typically made in early life and based on this triad of symptoms.[1] Because soft tissue hypertrophy is common, it is necessary to anticipate airway difficulty.[2] Regional anesthesia may pose risks of

bleeding and hematoma because of vascular malformations in the surrounding structures. Chronic coagulopathy is common and can be difficult to manage in the perioperative period.[2] Anesthetic management of patients with KTS is challenging; therefore, anesthesia practitioners should be aware of this syndrome and its implications.

Case Report

A 74-year-old male presented to the operating room (OR) for transurethral resection of a bladder tumor. The patient was 180 cm tall and weighed 135.6 kg with a body mass index of 39.75 kg/m^2. The patient had an extensive medical history of KTS, hypertension, coronary artery disease, congestive heart failure, chronic atrial fibrillation, high-grade atrioventricular block requiring a pacemaker, osteoarthritis, obstructive sleep apnea (OSA), asthma with recurrent bronchospasm, and malignant neoplasm of the urinary bladder. His current medication list included albuterol, amlodipine, carvedilol, clopidogrel, dabigatran, finasteride, furosemide, isosorbide mononitrate, lisinopril, medical marijuana, rosuvastatin, and tadalafil. The patient's clopidogrel and dabigatran were stopped 120 hours before surgery. All preoperative lab values were within normal limits. Additional coagulation studies were not completed. A recent echocardiogram showed a left ventricular ejection fraction of 49% 8 months prior to surgery. The echocardiogram also demonstrated severe dilation in the left atrium, mild mitral and pulmonic regurgitation, moderate concentric left ventricle hypertrophy, and hypokinesis of the apical septum, apical inferior wall, and basal to mid anterolateral wall of the left ventricle. An airway exam revealed a Mallampati score of II, normal dentition, thyromental distance, and full neck range of motion. The patient's physical exam was notable for a large cutaneous hemangioma extending to the patient's right anterior and posterior thorax and down the entire edematous right upper extremity.

A 20-gauge intravenous (IV) catheter was inserted in the left antecubital fossa in the preoperative area. Upon entry to the OR, noninvasive monitors were applied to the patient and a lactated Ringer's infusion was initiated. The patient was preoxygenated with O_2 15 L/min via face mask for 4 minutes. General anesthesia was induced with fentanyl 100 mcg, lidocaine 100 mg, and propofol 200 mg IV. A size 4 i-Gel (Intersurgical) supraglottic airway was placed but was exchanged for a size 5 i-Gel due to the presence of a large air leak. The patient received cefazolin 3 g and ondansetron 4 mg IV after induction.

Inhalation anesthesia was maintained with inspired sevoflurane 2% in O_2 0.37 L/min and air 0.63 L/min. Throughout the procedure, the patient ventilated spontaneously, maintaining adequate tidal volume, respiratory rate, and end-tidal CO_2. The patient was positioned in the lithotomy position with bilateral arms secured on padded arm boards. Bilateral sequential compression devices were placed on the lower extremities for mechanical emboli prophylaxis. The patient's intraoperative course was uneventful. At the conclusion of the procedure, the sevoflurane and air were discontinued and O_2 was increased to 15 L/min. The laryngeal mask airway (LMA) was removed, oropharynx suctioned, and the patient was transported to the post anesthesia care unit with a O_2 10 L/min via facemask awake and in stable condition. The patient was discharged home on the same day.

Discussion

Klippel-Trenaunay Syndrome is a rare disorder marked by cutaneous hemangiomas, venous varicosities, and bone and soft tissue hypertrophy.[1] Lymphedema and hypertrophy are most common in a unilateral lower extremity, but it can also affect bilateral and upper extremities.[1,3] In this case, the patient had hypertrophy and cutaneous hemangioma extending to the anterior and posterior sides of his thorax and the entire edematous right upper extremity. Other manifestations of KTS include oligodactyly, thrombophlebitis, pulmonary embolism, bone fractures, seizures, and coagulopathy.[1,4]

Due to its low prevalence, KTS is challenging to diagnose, and its incidence is difficult to calculate. However, it is more common in males, and there is no racial predisposition.[4] Researchers have demonstrated that KTS is likely caused by a mutation of the phosphatidylinositol-4,5-bisphosphate 3-kinase catalytic subunit alpha (PIK3CA) gene,[3] which regulates ribosomal protein synthesis and is responsible for embryonic cellular growth and angiogenesis.[5] Mutations resulting in abnormal stimulation can lead to limb overgrowth and vascular malformations.[5]

There is no well-defined anesthetic management plan for KTS. Anesthesia practitioners should consider all potential symptoms and complications when caring for patients with KTS. Bone and soft tissue hypertrophy typically present in an extremity with increased girth and potentially, limb length differences. However, KTS can present with craniofacial abnormalities including jaw enlargement, deviated or obstructed nasal septum, and facial asymmetry.[1] These abnormalities coupled with soft tissue hypertrophy of the oropharynx and hypopharynx may complicate airway management. Varices and vascular malformations in the trachea have been described as the cause of difficult intubation and massive airway hemorrhage.[6] Anesthesia practitioners may perform an awake fiberoptic airway exam prior to airway manipulation and flexible fiberoptic intubation to prevent massive bleeding.[6]

The patient in this case presented as a Mallampati II, with normal interincisor and thyromental distances. Soft tissue hypertrophy related to KTS could not be excluded as a cause of OSA in this limited airway exam; obesity and increased neck circumference were the most likely cause for this. The patient had an extensive surgical history with multiple anesthesia records available. Historically, the patient had been intubated with ease and had multiple prior procedures with an LMA. Given this information, the anesthesia practitioners had confidence that the use of a supraglottic airway device was appropriate for this patient.

Cutaneous hemangiomas are hyperpigmented vascular malformations with thin capillary walls seen in 98% of KTS cases.[1] These areas are at high risk for skin related complications such as breakdown, especially when cutaneous hemangiomas are in the trunk, perineal, or foot area.[7] Positioning and padding are of special concern to prevent skin complications. Large cutaneous hemangiomas of the upper extremity may preclude the insertion of IV and arterial catheters. In this patient, IV access was limited to the left upper extremity because of the large cutaneous hemangioma covering the right upper extremity.

Neuraxial anesthesia has been described in patients with KTS. However, vascular malformations near the spinal cord may create challenges and complications. Magnetic resonance imaging (MRI) and ultrasound imaging of the spine are recommended prior to the administration of neuraxial anesthesia.[8] Neuraxial anesthesia was considered for this procedure. However, previous MRI noted venous congestion in the anterior spinal canal from L2 to L5. This imaging also found venous engorgement in the epidural space at the L3-L4 interspace. Neurovascular malformation of the spinal cord and surrounding structures and the risk for disseminated intravascular coagulopathy (DIC) can be considered contraindications for neuraxial anesthesia.[2,6]

A small percentage of patients with KTS have intracerebral aneurysms.[2] Blood pressure should remain near baseline values during the perioperative period to avoid rupture. In this case, the patient remained hemodynamically stable throughout, with blood pressures near his baseline. Hemangiomas and varicosities can be found on visceral organs including the spleen, liver, colon, and bladder and are often responsible for rectal and internal bleeding.[1,8] The patient's blood was typed and screened preoperatively. Additional coagulation studies were not collected due to availability of recent studies with normal values. Large cutaneous hemangiomas can create a consumptive coagulopathy such as DIC by sequestering platelets.[1] This increases the risk for bleeding and embolism. Vascular malformations, varicosities, and coagulopathy can lead to large volume blood loss, even in small surgeries.[1]

Varicosities and coagulopathy predispose patients with KTS to pulmonary embolisms and deep vein thrombosis in the perioperative period.[2] Reports lack consensus; however, mechanical and pharmaceutical prophylaxis should be considered on an individual basis. It is unknown if the patient in this case had a history of coagulopathy. Due to his chronic atrial fibrillation, this patient was anticoagulated with clopidogrel and dabigatran. These medications were stopped within an appropriate time frame prior to surgery and mechanical prophylaxis was provided throughout the perioperative period.

Anesthetic management for patients with KTS can be challenging. Because of its low prevalence, information is still lacking about this rare disease. There are several important anesthesia implications to consider, including positioning, coagulopathies, risks for pulmonary embolism and deep vein thrombosis, and the potential for difficult ventilation and intubation. Care of these patients will require preoperative planning. Careful, individualized anesthetic management should be provided to each patient with KTS as they may present with a wide array of issues.

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Avoidance of Sugammadex after Sexual Assault

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Keywords: sugammadex, emergency contraception, sexual assault, Plan B, hormonal contraception

Survivors of sexual assault may receive levonorgestrel, also known as Plan B, as a first-line oral emergency contraceptive pill.[1] Sugammadex, a neuromuscular blockade antagonist commonly used in anesthesia, binds to hormonal contraceptives and decreases serum progesterone concentrations.[2] Levonorgestrel acts as a synthetic progesterone, inhibiting ovulation, with peak effectiveness when given during the pre-ovulation stage.[1] Anesthesia professionals must identify at-risk patients and potential drug interactions that can alter emergency contraception efficacy.

Case Study

A 17-year-old, 172 cm, 76 kg female presented to the emergency department with left jaw pain. Radiologic and physical examinations confirmed a non-displaced left mandibular fracture. The patient reported she was at a party the previous night where she consumed alcohol, resulting in loss of consciousness. The patient voiced concern about a potential sexual assault. The patient received prophylactic treatment for gonorrhea, chlamydia, human immunodeficiency virus, and emergency contraception, Plan B Levonorgestrel 1.5 mg, was administered. An oral and maxillofacial surgeon (OMFS) evaluated and scheduled the patient for an emergent open reduction and internal fixation of the left mandible with tooth extraction and intermaxillary fixation.

A pre-operative evaluation for anesthesia was initiated in the emergency department with the patient's mother and Sexual Assault Nurse Examiner (SANE) at the bedside. The patient reported a past medical history of gastroesophageal reflux disease (GERD), well controlled with pantoprazole, and depression, managed with fluoxetine. The patient-reported a hormonal contraceptive implant was removed three days prior to the emergency room encounter. She denied any past obstetrical history, and a urine pregnancy test was negative on the day of surgery. The patient was nil per os for more than 24 hours. Physical examination revealed a class II Mallampati airway, normal neck range of motion, > 4 cm thyromental distance, and limited mouth opening due to pain.

After obtaining informed consent from the minor's guardian, oxymetazoline 2 sprays was administered to each nare in preparation for nasal intubation. Additionally, intravenous (IV) midazolam 2 mg was given. The patient was positioned supine upon operating room entry and connected to standard noninvasive monitors. After adequate pre-oxygenation, general anesthesia was induced with fentanyl 100 mcg IV, lidocaine 80 mg IV, propofol 200 mg IV, and rocuronium 50 mg IV. Direct laryngoscopy revealed a grade I Cormack-Lehane view, and the patient's airway was secured with a size 7.0 mm nasal right angle endotracheal tube to the right nostril. Dexamethasone 8 mg IV and ondansetron 4mg IV were given for postoperative nausea and vomiting prophylaxis. Acetaminophen 1gm IV and ketorolac 15 mg IV were administered for pain control. General anesthesia was maintained with end-tidal concentration of sevoflurane 2.2% for the duration of the case.

In preparation for anesthetic emergence, the patient's degree of neuromuscular blockade was assessed utilizing a train-of-four (TOF) nerve stimulator. The TOF denoted four twitches appearing equal in amplitude and size, with no notable fade. The patient was administered 0.6 mg IV glycopyrrolate and 3 mg neostigmine for neuromuscular blockade antagonism. After approximately 15 minutes, the patient was spontaneously breathing. Sevoflurane was discontinued, oxygen flows were increased to 10 L/min. Oral suctioning had been completed by the OMFS prior to inter maxillary fixation. After an additional 5 minutes, the endotracheal tube was removed, and O_2 8 L/min was administered via facemask before being transferred to the post anesthesia care unit. The patient's vital signs and airway remained stable.

Discussion

The nurse anesthesia resident discussed special considerations for anesthetic emergence following intermaxillary fixation with the CRNA instructor to create an optimal post-operative plan, recognizing possible complications. Considerations included the patient's pre-operative airway assessment, ease of intubation at induction, strategies to facilitate emergent reintubation after intermaxillary fixation, risk of postoperative nausea and vomiting, and accessibility to wire cutters. Alternatives to sugammadex for pharmacological reversal of neuromuscular blockade were deemed necessary to prevent a drug-drug interaction that would decrease the efficacy of emergency contraception, levonorgestrel administered preoperatively.

Females of reproductive age undergoing surgery not only face routine risks and obstacles but are also confronted with the management of their contraception in the pre and post-operative

periods.[2] Sugammadex, brand name Bridion (Merck), is a selective relaxant binding agent that directly encapsulates, binds, and inactivates steroidal neuromuscular blocking drugs rocuronium and vecuronium.[2] The FDA label for sugammadex contains a drug-drug interaction warning between this medication and hormonal contraception, instructing women to use a backup contraceptive method or abstinence for seven days after exposure to sugammadex.[2,3]

By potentially binding estrogens and progestins contained within hormonal contraception, sugammadex can lead to increased clearance of steroid hormones by attaching and lowering plasma progesterone concentrations and overall increasing the risk of contraceptive failure.[1,2] Progesterone levels can be decreased up to 34% in females after administering 4 mg per kilogram of sugammadex.[3] The adverse drug linkage between hormonal contraception and sugammadex exposure may be ignored by anesthesia professionals, particularly after emergency contraception.[2,3] The threat of unintended pregnancy due to contraceptive failure necessitates an alternative to sugammadex for neuromuscular blockade antagonism in at-risk patients who recently received emergency contraception.

Before sugammadex availability, medication options to reverse the effects of neuromuscular blocking agents included anticholinesterases combined with anticholinergic medications.[4] When compared to these other agents, sugammadex reverses neuromuscular blocking agents, particularly rocuronium and vecuronium, with significantly quicker recovery times and reduced incidence of residual neuromuscular blockade in the postoperative period, and no incidences of emergent reintubation.[4] In clinical scenarios involving trauma or head injury, complex airway management, or as in this case, intermaxillary fixation, sugammadex presents as the superior drug choice for neuromuscular blockade antagonism. However, it should be recognized that the decrease in the serum concentration of progestins due to sugammadex plays a critical role in anesthetic management for victims of sexual assault.[1]

Outside the operating room, the use of rocuronium for rapid sequence intubation in the emergency department is rising as it avoids the potential side effects caused by using succinylcholine, such as hyperkalemia, malignant hyperthermia, and increased intracranial pressure.[4] Head injury is one of the most common medical emergencies in victims immediately following sexual assault.[5] The role of sugammadex for the antagonism of the neuromuscular blockade after rapid sequence intubation has potential use to aid in vital neurologic examination following administration of rocuronium.[4] However, by identifying at-risk patients and respecting the pharmacokinetic impact sugammadex has on emergency contraceptive efficacy, there is potential to avoid the risk of unintended pregnancy in assault survivors requiring rapid sequence intubation and airway management.

The American College of Obstetricians and Gynecologists reports that approximately 32,000 pregnancies result from rape yearly.[5,6] With relatively low use of contraception and higher baseline fertility, pregnancy rates are remarkably higher among adolescent sexual assault survivors.[6] Statistically, when rape results in pregnancy, women are more likely to choose pregnancy termination than a continuation.[6] The significant variability in health facilities worldwide regarding policies and practices to provide emergency contraception is a public health problem.[6] The care delivered to a victim of sexual assault directly after the incident may affect the patient's recovery, both in physical and emotional terms. Pregnancy prevention offers

comfort that potential physical damage may be avoided.[5] Regardless of the ever-changing availability of emergency contraception, it is the duty and medicolegal responsibility of the anesthesia professional to assess the consequences of a drug-drug interaction that lower hormonal contraception efficacy and may result in unintended pregnancy in reproductive-aged women.

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Anesthetic Implications for Awake Craniotomy

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Keywords: awake craniotomy, awake brain surgery, alert brain surgery

General anesthesia procedures are often performed on sedated and immobile patients, while awake craniotomies are performed on alert and communicative patients. Indications for an awake craniotomy include operating in complex brain areas where preoperative imaging is not reliable.[1] These brain areas include communicative pathways in the cortex for speech or motor function.[1] The awake craniotomy approach enables neurosurgeons to monitor neurological function with continuous patient feedback while simultaneously performing tumor resection.[1] Despite being awake, anesthetic services are still required throughout the procedure as explained in this case study.

Case Report

A 76-year-old, 66 kg, 160 cm female presented for an awake craniotomy in the setting of an 18 mm x 15 mm right frontal lobe lesion. This high-grade glioma was located in the precentral gyrus, just lateral to the omega region of the central sulcus with associated vasogenic edema. The motor strip cortex is located within the precentral gyrus, and it involves face and hand area. Two years ago she began to have tingling of her left arm, face, and lips. The patient was otherwise healthy, with no significant medical, surgical, or social history. Her only home medication was oral lacosamide. Preoperative vital signs were: blood pressure (BP) 140/72 mm Hg, heart rate (HR) 79/min, temperature 36.9 °C, respiratory rate (RR) 18/min, and oxygen saturation (SpO_2) 99% on room air. A 20-gauge IV was placed in the right hand in the preoperative holding area.

Upon arrival to the operating room (OR), standard noninvasive monitors were applied. O_2 4 L/min was administered via nasal cannula, and the patient was placed in a sitting position on the OR table. Midazolam 2 mg, remifentanil 0.03 mcg/kg/min, dexmedetomidine 0.7 mcg/kg/min, and 0.9% normal saline (NS) solution 200 mL/hr were initiated via intravenous infusion. An arterial line was placed in the right radial artery. Bilateral scalp blocks were administered via a regional technique using 0.5% ropivacaine. The O_2 delivery method was exchanged to 100% O_2 6 L/min via fire safe facemask. A bolus of intravenous propofol 130 mg in divided doses was administered for Mayfield skull pins placement, urinary catheter insertion and positioning. A brief period of apnea following propofol administration was treated with O_2 15 L/min via mask ventilation. Hypotension and bradycardia throughout this period were treated with intravenous glycopyrrolate 0.2 mg, phenylephrine 10-40 mcg/min infusion, and ephedrine 5 mg. The patient was positioned in a semi-fowlers position with her right arm tucked and her left arm was draped in a sterile fashion to maintain visualization of the patient's left upper extremity and face. An additional 16-gauge IV was placed in the left hand. Vancomycin 1000 mg, ceftriaxone 2 G, dexamethasone 10 mg, ondansetron 4 mg, and levetiracetam 500 mg were administered intravenously.

Upon surgical exposure of the lesion, intravenous phenylephrine was titrated to 10-20 mcg/min, remifentanil was adjusted to 0.02 mcg/kg/min, and dexmedetomidine was turned off. The patient was awake, alert, comfortable, and responding appropriately to commands for the neurosurgical team to proceed with the surgical resection. Intraoperative findings revealed a high-grade glioblastoma tumor near the cortical hand region. Its resection caused paralysis of the patient's left thumb, while left-hand function remained intact. Once the surgical resection was completed, awake patient cooperation was no longer required. Dexmedetomidine 0.4 mcg/kg/min intravenous infusion was resumed. Acetaminophen 1000 mg and hydromorphone 0.3 mg were given intravenously with surgical closure. Upon cessation of the surgical procedure, all intravenous infusions were discontinued.

The total procedure time from anesthesia start to patient transfer of care in the postanesthesia care unit was 3 hours and 51 minutes. Intraoperatively the patient received a total of 900 mL of intravenous 0.9% NS. The estimated blood loss was 30 mL. The patient was breathing spontaneously throughout the procedure, aside from one brief period of apnea. The patient remained stable and cooperative intraoperatively and postoperatively. Upon arrival at the post-anesthesia care unit, the patient reported no pain and remained alert and oriented.

Discussion

An awake craniotomy is a rare surgical procedure performed with experienced neurosurgical and anesthetic practitioners.[1] The indication for an awake craniotomy, in contrast to a general anesthesia craniotomy, depends on the location of the insulting lesion in the brain.[1-5] The awake craniotomy method enables continuous monitoring of neurological function pertaining to speech, motor, or both, while aggressively resecting tumors within the associated regions of the cortex.[1-5] Awake craniotomies are associated with improved patient outcomes compared to general anesthesia craniotomies.[1] Patient benefits of awake craniotomies include substantial gross tumor resection, decreased pain, decreased neurological deficits, increased survival rates, decreased levels of postoperative monitoring and care, shorter hospital stays, decreased cost, and reduced postoperative nausea and vomiting.[1,3]

Anesthesia for an awake craniotomy can be provided in one of three ways.[2] The three methods of anesthesia are asleep-awake-asleep (SAS) technique, awake-awake-awake (AAA) technique, and monitored anesthesia care (MAC).[2] General anesthesia is considered a safety backup in all the aforementioned scenarios.[2] SAS method includes general anesthesia before and after brain mapping, and tumor resection.[2] AAA technique includes the sole use of regional anesthesia and no sedatives.[2] MAC technique involves light sedation for patient comfort, while maintaining spontaneous ventilation.[2] All three methods of anesthesia are safe and effective. However, MAC technique may be associated with a decreased rate of conversion to general anesthesia as compared to SAS technique.[2] A MAC anesthetic was used for the patient discussed in this case study.

The preoperative assessment is vital to establish patient rapport and a foundation of expectations prior to an awake craniotomy.[3] During the preoperative assessment, patient anxiety and cooperation must be thoroughly assessed.[3] An absolute contraindication to an awake craniotomy is patient refusal.[1,3] Extensively detailing the procedure, as it pertains to anesthetic considerations and interventions, should be conducted. The patient should be informed about the likelihood of hearing conversation and surgical equipment, feeling vibration with skull opening, and smelling surgical solutions or cautery. Finally, it is imperative the patient's baseline neurological function be exhaustively assessed to determine changes that may occur during the surgery. It is common to have the patient engage in a series of motor function tests on the affected side or state the alphabet to establish baseline motor and speech function. The anesthetist should consider the affected side and avoid placing any devices that may interfere with intraoperative assessment on that side.[3] In addition, an awake craniotomy has an increased surgical fire risk because the procedure is above the xyphoid, uses cautery, and oxygen is often administered. Povidone-iodine solution instead of 70% alcohol-based chlorhexidine should be used to prep the regional and surgical sites to mitigate the risk of intraoperative fire.[7] Additionally, the anesthetist should avoid the use of supplemental oxygen if it's not required.

Intraoperative management of a patient undergoing a craniotomy under MAC anesthesia includes continuous verbal communication between the provider and patient that is established in the preoperative setting, intravenous sedation, and scalp block placement. A scalp block is a regional anesthetic procedure utilized to provide analgesia for scalp and skull procedures.[4,6] It is performed as a field block or with an ultrasound-guided technique. Six nerves per scalp side can

be anesthetized with this technique.[6] The six nerves are the supraorbital, supratrochlear, auriculotemporal, zygomaticotemporal, greater occipital and lesser occipital nerves.[6]

Typical drugs used during a MAC anesthetic for an awake craniotomy are propofol, dexmedetomidine, and remifentanil. The goal of drug selection is to maintain spontaneous ventilation, provide quick onset/offset of action, and minimize neurological interference.[1,3] When the tumor resection portion of the surgery is approached, all intravenous sedatives are stopped, except for remifentanil. This will depend on the patient's clinical presentation. The goal is to achieve an awake and alert patient response to facilitate neurological function testing.[1,3] Continuous verbal communication, comfort care including moistening mucous membranes, and administering antiemetics typically occur during this phase.[3] As the resection of the tumor is completed, intravenous sedation can be resumed. However, depending on the duration of the surgical procedure, patients can be fatigued and require minimal to no sedation after tumor resection.[3,4]

Given the improved patient benefits such as maximized tumor resection, decreased pain, shorter hospital stays, and increased survival rates associated with awake craniotomy procedures, the practice of awake craniotomies are expected to become more popular. Anesthetists should become comfortable providing safe anesthetic care to this patient population. Optimizing preoperative assessment and establishing patient rapport are fundamental for successful awake craniotomy.

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A Patient with Multifocal Venous Malformations of the Upper Extremity

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Keywords: Direct stick embolization, venous malformation, vascular surgery

Venous malformations are defects that occur during fetal development.[1] The lesions may be misdiagnosed without proper imaging studies. Significant blood volume and slow flow to the vessels can cause significant clotting disorders such as disseminated intravascular coagulation (DIC).[2] Treatment includes a multistage embolization procedure to shrink the volume and flow to the vessels.[3] While the procedures are generally outpatient, they carry significant risk such as thromboembolism, hemorrhage, drug toxicity, death, and DIC.[4]

Case Report

The patient was a 65-year-old female with a past medical history of headaches and venous malformations. She weighed 79 kg and was 170 cm tall with a body mass index of 27.1 kg/m^2. The patient reported intolerance of epinephrine as her only drug allergy. Her past surgical history included several procedures to the left upper extremity to treat vascular lesions which were unsuccessful. The patient reported the lesions had first appeared in her teenage years; however, she had not thought much about them until later in life. Six months prior to surgery, the patient noticed one of the growths became significantly larger over a period of days. She was initially consulted by a general surgeon who believed it could be a ganglion cyst, and recommended excision. However, the patient declined the procedure and was seen by a vascular surgeon.

Magnetic resonance imaging (MRI) and duplex ultrasound were obtained of the left forearm. Images revealed multifocal lobulated venous malformations throughout the dorsal medial aspect of the left hand and forearm. Older imaging studies (brain MRI, chest computed tomography (CT)) were unremarkable. An abdominal CT revealed a suspected small hemangioma on the dome of the liver. Baseline laboratory samples were drawn; values were within normal parameters except for elevations in D-dimer (1.66 mg/L), alpha-2-antiplasmin (127%) and Von Willebrand Factor Antigen (192%). These values prompted a hematology consultation prior to the day of surgery. Hematology advised that the patient should receive rivaroxaban 20 mg daily for two weeks following therapy.

A direct stick embolization procedure was planned. General anesthesia with neuromuscular blockade was requested by the attending surgeon. The patient was premedicated with intravenous (IV) midazolam 2 mg prior to the operating room. A smooth IV induction was performed with propofol 200 mg, fentanyl 100 mcg, dexamethasone 4 mg and rocuronium 50 mg. Hydrocortisone 80 mg IV was given in addition per surgeon request.

The patient was mask ventilated and endotracheal intubation was performed with a 7.0 mm endotracheal tube (ETT). Mechanical ventilation was initiated. General anesthesia was maintained via sevoflurane 1% expired concentration and a propofol infusion at 125 mcg/kg/min. After induction, an 18-gauge peripheral IV was placed in the hand of the operative

side at the request of the surgeon. A tourniquet was applied to the operative arm and inflated to 80 mm Hg, slightly above the diastolic blood pressure, to limit extravasation of the sclerosing agent into the circulation. It was requested that the non-invasive blood pressure cuff be cycled every minute for the duration of the procedure. Additionally, an IV infusion of heparinized saline was initiated into the operative hand by the surgeon.

The venous malformations were accessed via micropuncture technique under ultrasound guidance. Fluoroscopy with contrast was used to obtain sizing of the malformation. A sclerosing emulsion was created via the Tessari method using sodium tetradecyl sulfate (180 mg/6 mL), 2 parts air, and ethiodized oil (480 mg/1 mL). The Tessari method involves attaching two syringes to a single stopcock and rapidly agitating the solutions back and forth between syringes to facilitate mixing of a sclerosing foam. The emulsion was injected into the malformations as well as some venous inflow/outflow tracts. The patient's heart rate and blood pressure increased significantly immediately upon injection. Fentanyl 50 mcg IV was administered resulting in return of hemodynamics to the prior level.

Hemostatic matrix was applied to the access sites by the surgeon. Acetaminophen 1000 mg and ketorolac 30 mg IV were administered at the end of the case. Neuromuscular blockade was antagonized with sugammadex 200 mg IV prior to emergence. The ETT was removed, and the patient was transported to the post-anesthesia recovery unit on O_2 2 L/min via nasal cannula. During the case, 700 mL of lactated Ringers solution was administered and estimated blood loss was less than 10 mL. The patient was discharged home later that day.

Discussion

Vascular malformations are congenital abnormalities that can be venous, arterial, or a fusion between an artery directly to a vein.[5] Venous malformations (VMs) are the most common, representing about 80% of all vascular malformations, and may be the result of syndromes or independent. The primary form of treatment for VMs can be several treatments of direct-stick embolization.[1] Various chemical agents can be used by the interventionalist, some of which carry significant risks over others.[2] The exact agent and mixture selection is often based on provider preference. Many of the agents are being used off-label for embolization.[1]

Patients often seek treatment for venous malformations due to aesthetic as well as functional concerns. Prior to embolization techniques, venous malformations were removed surgically, leading to increased intraoperative bleeding and poor results.[3] While often safer, embolization of large venous malformations can cause significant sequelae that should be considered by both the surgeon and the anesthesia staff. Significant complications include disfigurement, thromboembolism, disability, consumptive coagulopathies such as local intravascular coagulopathy (LIC) or DIC.[1] Disseminated intravascular coagulation is a condition characterized by activation of the clotting cascade to a degree where factors are consumed and exhausted. The elimination of clotting factors leads to profound hemorrhage or thrombosis resulting in end organ failure.

Large vascular malformations can be the ideal environment for microemboli to develop and embolize or begin to exhibit increased fibrinolysis.[1] Local intravascular coagulopathy can

progress to systemic DIC, drastically increasing morbidity and mortality.[1] Methods have been developed to stratify risks and often rely on laboratory values leading up to the procedure. Two values which are critically important are the D-Dimer and fibrinogen levels. D-Dimer analyzes byproducts of fibrinolysis and can be evidence for increased clotting and subsequent breakdown of the clot. The value should not exceed 500 mg/mL.[5] Fibrinogen levels should be greater than 150 mg/dL or 200-350 mg/mL.[5] Fibrinogen values lower than expected may indicate consumption of the fibrin or clot formation. If the D-dimer is high and/or the fibrinogen levels are low, it is highly recommended that hematology evaluate the patient for proper anticoagulation prior to embolization of the venous malformations.

Venous malformations should be treated prior to the development of LIC/DIC indicators; however, optimal treatment following their initiation remains uncertain.[6] Traditional treatment includes low-molecular weight heparin but oral anticoagulants such as rivaroxaban (Factor Xa blocker) and dabigatran (reversible thrombin inhibitor) seem to be effective.[6] Anticoagulation in the setting of large venous malformation is hemostatic, due to the prevention of consumptive coagulopathy and progression to DIC.[6]

In the past, ethanol was a common sclerosing agent; however, it carried a significantly higher risk of toxicity and death.[1] Similarly, cyanoacrylate ("skin glue") and bleomycin are used intravascularly during direct-stick embolization as a less-toxic alternative to ethanol. Sodium tetradecyl sulfate (STS) was the chemical sclerosing agent used for this procedure. This agent aids in the elimination of the malformation via thrombosis of the blood within the structure, as well as necrosis of the endothelial cells composing the venous malformation.[2] The sclerosing agent can be used in the liquid form; however, the risk of side effects is higher, as the liquid can extravasate into the systemic circulation. When combined with the ethiodized oil, the viscosity of the STS increases, allowing the agent to remain within the venous malformation for a longer period.[2] The oil also provides excellent contrast on fluoroscopy so the surgeon can appropriately direct therapy.[7]

Notably, patients who present with patent foramen ovale may comprise up to 35% of the general population.[5] This patient population is at risk for paradoxical embolism during direct-stick embolization if a clot were to cross through the foramen ovale leading to an arterial thrombus.[8] This complication may lead to acute myocardial infarction, pulmonary embolus, and cerebrovascular accident.

Due to the high amount of variability in these sclerosing procedures, it is critically important to discuss the procedural plan with the surgical team. Open communication can reduce the likelihood of complications and systemic spread of emboli or chemical sclerosing agents. Take note of preprocedural lab values such as D-Dimer and fibrinogen levels and ensure that hematology has been consulted in the setting of LIC. Additionally, many of these procedures are performed in stages, so patients will likely be returning for future treatments before intended results are achieved.

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Bivalirudin in Transcatheter Aortic Valve Replacement

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Keywords: Transcatheter aortic valve replacement, TAVR, anticoagulation, bivalirudin, AS

Aortic stenosis (AS) is the most prevalent heart valve disease, and the incidence is predicted to increase.[1,2] Transcatheter aortic valve replacement (TAVR) is a treatment strategy for high-risk patients with symptomatic AS.[2] Anticoagulation is key to the procedure's success in decreasing the risk for thromboembolic cerebrovascular events and valve thrombosis.[3] There is no clear evidence of a superior procedure anticoagulant, though heparin is frequently utilized.[4] Alternatively, bivalirudin is a nonreversible, short-acting, direct thrombin inhibitor utilized in patients with heparin-induced thrombocytopenia or heparin allergy.[4] This case report aims to discuss bivalirudin in a patient undergoing a TAVR procedure.

Case Report

A 68-year-old, 95.2 kg, 177.8 cm (BMI 31.42 kg/m²) male presented for a TAVR with #29-mm Sapien Edwards Lifesciences valve utilizing the right common femoral arterial approach to treat severe symptomatic AS. The aortic valve mean gradient was 36 mm Hg, and the peak gradient was 60 mm Hg. The valve area was 0.8 cm². His past medical history was significant for ischemic cardiomyopathy, coronary artery disease, congestive heart failure, ejection fraction 20-25%, essential hypertension, myocardial infarction, ventricular tachycardia, ventricular fibrillation arrest, pacemaker, valvular disorders, anemia, chronic kidney disease, type 2 diabetes mellitus, and deep venous thrombosis. The patient's allergies included heparin and heparin analogs. His home medication regimen was comprised of aspirin, apixaban, carvedilol, torsemide, rosuvastatin, metformin, allopurinol, magnesium, and tamsulosin. The patient reported no prior complications with anesthesia. Notable laboratory values included hemoglobin 8 g/dL, hematocrit 28.2%, platelets 167 uL, and creatinine 1.4 mg/dL. Coagulation studies included PT 17.7 seconds, INR 1.5, and PTT 38.6 seconds. A right radial arterial line and a left arm 16 gauge and right hand 18 gauge intravenous (IV) catheters were placed. The anesthesia plan for moderate sedation was discussed.

Once in the hybrid operating room, standard noninvasive monitors were applied, and invasive monitoring devices were connected and recorded. Oxygen at 8 L/min was administered via a face mask. A baseline activating clotting time (ACT) was measured at 134 seconds. Induction medications included a propofol bolus of 20 mg followed by an infusion at 30 mcg/kg/min, was titrated to the patient's response via the right hand 18 gauge peripheral IV. Epinephrine, phenylephrine, and norepinephrine were titrated based on the patient's hemodynamics. The patient was prepped and draped in the usual sterile fashion, and the surgical procedure was initiated. Anticoagulation was achieved with bivalirudin. The patient received an IV bivalirudin bolus of 0.75 mg/kg, a total bolus of 73.95 mg, and an infusion rate of 1.75 mg/kg/hr. The infusion rate was based on an estimated glomerular filtration rate greater than or equal to 60 mL/min.[2,4] The ACT measured at 370 seconds. The valve was deployed utilizing rapid ventricular pacing. Upon discontinuation of rapid ventricular pacing, the patient developed asystole and required brief cardiopulmonary resuscitation. The propofol infusion was discontinued, and a bolus of epinephrine 1mg and calcium chloride 1g was administered. The trachea was intubated, and mechanical ventilation was initiated without additional medications. The return of spontaneous circulation was achieved within approximately 2 minutes. Norepinephrine and epinephrine infusions were titrated based on the patient's hemodynamics. Sevoflurane was initiated for sedation. The attending interventional cardiologist and the cardiothoracic surgeon performed 2D echocardiography, and the valve was functioning appropriately. The patient's hemodynamics were stabilized, and the bivalirudin infusion was discontinued. The patient received a total cumulative dose of 188 mg. Hemostasis of the right femoral artery access site was achieved with an angio-seal device. Sevoflurane was discontinued and a propofol drip was initiated for sedation. The patient was transferred to the intensive care unit for further recovery.

In recovery, immediate postoperative coagulation studies included PT 21.9 seconds, INR 1.9, and PTT 74.3 seconds. The hemoglobin was 8.2 g/dL, hematocrit 27.6%, and platelets 141 uL. Additional repeated coagulation studies at postoperative hour 6 included PT 19.5 seconds, INR

1.7, and PTT 54.3 seconds. The patient was titrated off intravenous epinephrine and norepinephrine on postoperative day 0. The propofol infusion was discontinued, and the patient was extubated to O_2 6 L/min via nasal cannula on postoperative day 1. The post-procedure echocardiogram revealed the TAVR valve in the appropriate aortic position. The mean gradient was 8 mmHg, and the peak gradient was 15 mm Hg. The patient recovered with adequate final angiographic and hemodynamic results. He was discharged from the hospital 6 days post-procedure on aspirin and apixaban.

Discussion

The transfemoral approach for TAVR involves using large arterial sheaths, raising concern for major bleeding and vascular complications. Anticoagulation used to mitigate thrombotic risk must be balanced against complications. Bivalirudin is indicated for intravenous anticoagulation in patients with acute myocardial infarction, unstable angina, percutaneous coronary intervention, and thrombosis in patients with a history of heparin allergy or heparin induced thrombocytopenia.[5] The recommended dose is an intravenous bolus of 0.75 mg/kg and an infusion rate of 1.75 mg/kg/hr for the procedure's duration, with an additional bolus of 0.3 mg/kg if needed to achieve a therapeutic ACT.[5]

Anesthesia practitioners plan the anesthetic management based on the patient's preoperative assessment. In this narrative, the patient had a documented heparin allergy with reported severe hypotension and low platelets. The surgical and anesthesia teams opted to use bivalirudin for anticoagulation, which permitted the patient to undergo the procedure.

Bivalirudin is the synthetic form of hirudin.[5] It is a direct thrombin inhibitor that recognizes thrombin's fibrinogen-binding site and inhibits the active site of thrombin.[5] Bivalirudin demonstrates a prompt onset and predictable dose-dependent anticoagulation with a plasma half-life of 25 minutes, the shortest half-life of all parenteral direct thrombin inhibitors.[4] Coagulation tests normalize within approximately 1 hour upon discontinuation of the drug. [5]

Bivalirudin does not bind to platelet factor 4 and therefore does not share cross-reactivity with antibodies in patients with a history of adverse reactions to heparin.[5] When compared to heparin, bivalirudin offers more advantages. It is less dependent on renal function, has a lower incidence of anaphylaxis, and exhibits less variability in levels of anticoagulation.[6] It offers a more predictable pharmacologic response. The main disadvantages of bivalirudin are it is more expensive and has no antidote, unlike heparin.[5] Potential adverse effects include hypotension, backache, nausea, hemorrhage, and thrombosis.[5] Contraindications include active major bleeding or hypersensitivity.[5]

In a meta-analysis of 12 randomized controlled trials, 44,088 patients demonstrated that bivalirudin appeared to be non-superior compared to heparin in reducing all-cause mortality, myocardial infarction, revascularization, and stroke.[6] In a BRAVO-3 trial, authors concluded in patients with peripheral artery disease undergoing TAVR, there was no increased risk of major adverse events; however, higher rates of minor vascular complications were noted.[2] In a randomized trial of procedural pharmacotherapy in 802 patients undergoing TAVR with bivalirudin versus unfractionated heparin, bivalirudin did not significantly reduce rates of major

bleeding at 48 hours or net adverse cardiovascular events at 30 days. [4]Analysis of secondary outcomes did not demonstrate any crucial differences, indicating that bivalirudin may be an alternative to heparin during TAVR without any superiority claim.[4] Though bivalirudin was not superior, the noninferiority hypothesis was met.[4]

In this case, the patient's pre, intra, and post-procedural laboratory findings were discussed in the case report. Serial arterial blood gases were trended for hemoglobin and lactate levels with little to no variation to report. After discontinuation of bivalirudin, the surgical team opted not to measure a post-procedural ACT. Instead, the team achieved hemostasis as described, and labs, including standard coagulation and complete blood count, were sent to the central laboratory. No signs of bleeding were noted at the incision site. The post-procedural laboratory findings were similar to the baseline findings, with no downtrend in the hemoglobin. Bleeding after TAVR indicates an adverse prognosis, and nearly 80% of all bleeding events occur within the first 30 days of the procedure.[7] In this case, there was no evidence of bleeding or thrombotic complications throughout the patient's hospitalization.

Case highlights include the importance of a thorough preoperative assessment communicated among anesthesia and surgical teams to create a safe and comprehensive plan. Pharmacological considerations in this patient included an alternative anticoagulant in a patient with a heparin allergy undergoing a procedure requiring anticoagulation. Although the patient suffered from an intraoperative event requiring brief cardiopulmonary resuscitation, it was likely related to the patient's heart function during the valve deployment and not the anticoagulation. The anesthetic considerations and anticoagulation therapy had a positive outcome for this patient. In summary, direct thrombin inhibition with bivalirudin can be the alternative anticoagulant. Given the lower cost and more widespread use, heparin should remain the standard of care, and bivalirudin can be the alternative anticoagulant option in patients unable to receive heparin undergoing TAVR.[4]

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#

A Patient with an Unsuspected Pheochromocytoma

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Keywords: Pheochromocytoma, anesthesia management, catecholamine, hemodynamic instability, alpha adrenergic receptor antagonist

Originating from adrenal and extra-adrenal chromaffin cells, pheochromocytomas are neuroendocrine tumors which release norepinephrine, epinephrine, and occasionally dopamine.[1,2] Classic symptoms include hypertension, headaches, palpitations, and hyperhidrosis.[1] The overproduction and secretion of catecholamines is the principal catalyst for increased cardiovascular risk during surgery.[1] To curtail intraoperative hemodynamic instability, pretreatment with an alpha-adrenergic antagonist medication is recommended to block the catecholamine-induced vasoconstriction via the alpha receptor. Specifically, doxazosin and phenoxybenzamine are customarily prescribed.[2] Vigilant perioperative blood pressure management is crucial to avoid a hypertensive crisis preluding to life-threatening complications such as myocardial infarction, stroke, or pulmonary edema.[3]

Case Report

A 79-year-old male with a history of well-controlled hypertension, hyperlipidemia, bladder cancer, neuropathy, and arthritis presented to the operating room for a robot-assisted transabdominal lumbar dorsal laparoscopic left adrenalectomy. An incidental left adrenal nodule was discovered two months previously; the patient was asymptomatic resulting in his preoperative plasma metanephrine and normetaphrine levels mildly elevated at 1.1 pg/mL and 1.0 pg/mL. The patient's preoperative blood pressure (BP) was 120/78 mm Hg, and heart rate (HR) was 61/min. Doxazosin was prescribed and taken for two weeks prior to surgery. Additionally, the patient was taking amlodipine and losartan/hydrochlorothiazide but had foregone those medications on the day of surgery. Standard noninvasive monitors for general anesthesia were applied and oxygen was administered via circuit mask at 10 L/min. Following a standard induction sequence, direct laryngoscopy was performed unsuccessfully using a Macintosh 3 blade followed by successful endotracheal intubation with a Macintosh 4 blade. Mechanical ventilation was initiated with sevoflurane 3% inspired concentration in a mixture of oxygen 1 L/min and air 1 L/min.

Significant post-intubation hypotension was treated with intravenous phenylephrine 200 mcg, glycopyrrolate 0.4 mg, ephredrine 30 mg, and vasopressin 1 unit over the course of six minutes. An intravenous (IV) phenylephrine infusion was started at 0.6 mcg/kg/min, and hemodynamic stability was achieved via the return of the patient's baseline BP. After arterial line and additional peripheral intravenous catheter placement, the patient was positioned in the right lateral position. Fifty mcg of IV fentanyl was given to treat post-incisional hypertension, and the phenylephrine infusion was paused. Upon instrumental manipulation of the adrenal nodule, the patient's BP increased within a matter of seconds to a systolic BP (SBP) of 240 mm Hg. The surgeon was requested to discontinue manipulation of the nodule, and phentolamine 5 mg IV was administered followed by esmolol 30 mg. In addition to a nitroglycerin bolus of 40 mcg, an IV infusion of nitroglycerin was initiated at 3 mcg/kg/min and titrated to 2 mcg/kg/min. Once the procedure resumed, the patient's BP remained labile until the tumor was extracted. Due to the fluctuations in the patient's hemodynamics, the following medications were administered in total: IV phenylephrine 1,103 mcg, ephedrine 40 mg, vasopressin 3 units, glycopyrrolate 0.8 mg, phentolamine 5 mg, esmolol 30 mg, nitroglycerin 4,959 mcg, albumin 1000 mL, and crystalloid 2,500 mL. The estimated blood loss was 100 mL. Hemodynamic stability was maintained after emergence and extubation. The patient was taken to the Post Anesthesia Care Unit with a BP of 135/60 mm Hg. In the patient's post-anesthesia evaluation, the BP was recorded as 100/58 mm Hg. He was admitted for inpatient observation as planned and discharged the following day with a blood pressure recorded as 110/62 mm Hg. The pathology report confirmed the intraoperative diagnosis of a pheochromocytoma.

Discussion

Diagnosis of a pheochromocytoma entails measuring catecholamine metabolites such as normetanephrine and metanephrine in addition to subjective symptoms as mentioned previously.[1] Increased catecholamine levels and a tumor size greater than 5 cm are indicative of a higher risk of intraoperative hemodynamic instability.[4] The patient presented in this case report was asymptomatic with mildly elevated preoperative normetanephrine and metanephrine plasma levels; the left adrenal nodule was sized at 1.9 cm.

Preoperative usage of alpha-adrenergic blockers has become standard in clinical practice for suspected and diagnosed pheochromocytomas.[5] Alpha-adrenergic blockade may be achieved via a non-selective alpha 1 and alpha 2 receptor antagonist, phenoxybenzamine, or a selective alpha 1 receptor antagonist, doxazosin.[2] Blood pressure and HR customarily normalize within 7-14 days of treatment. This patient was prescribed doxazosin for 14 days preceding surgical intervention. In the preoperative area, the patient's BP was 120/78, and his heart rate was 61/min. Calcium channel blockers can be used as an adjunct for BP control; most commonly: amlodipine, nicardipine, nifedipine, and diltiazem.[6] Prior to the inadvertent adrenal nodule discovery, amlodipine was prescribed for essential hypertension. Another intervention aimed to optimize perioperative hemodynamics for these patients is increased fluid intake and a high sodium diet. The goal is to preserve blood volume and decrease the risk of perioperative hypotension.[5] Because a pheochromocytoma was not suspected preoperatively, this patient was not advised of this treatment option.

Intraoperative management of patients with pheochromocytoma includes establishing large-bore IV access and an arterial line.[7] Diligent BP control is imperative; thus, an arterial line for hemodynamic monitoring is obligatory.[6] A 20 gauge IV was placed in the preoperative holding area; a 16 gauge IV was obtained post induction as well as a 20 gauge right radial arterial line. Traditionally, any physical stimulation causing a sympathetic nervous system response such as direct laryngoscopy, intubation, initiation of pneumoperitoneum, or manipulation of the tumor results in hypertension.[4] Interestingly, despite requiring two direct laryngoscopy attempts to permit endotracheal intubation, sustained hypotension ensued necessitating IV administration of vasopressors and volume resuscitation. Moreover, the creation of the pneumoperitoneum did not generate hypertension but rather mild hypotension, which was treated with IV isotonic crystalloid administration. Manipulation of the tumor did produce remarkable hypertension.

A hypertensive crisis is defined as a systolic BP greater than 180 mm Hg or a diastolic blood pressure greater than 120 mm Hg.[5] Treatment of a hypertensive crisis in the presence of a pheochromocytoma includes IV administration of phentolamine 2.5-5 mg (nonselective alpha-adrenergic antagonist; can be given every 3-5 minutes), urapidil (selective alpha 1 adrenergic antagonist), esmolol (selective beta 1 adrenergic antagonist), sodium nitroprusside, nitroglycerin, or magnesium sulfate.[5,6] Beta-adrenergic antagonists should never be given prior to alpha-adrenergic blockade, as beta 1 blockade of the cardiac sympathetic drive preceding efficient arteriolar dilation can cause acute cardiac failure and pulmonary edema.[5,6] Phentolamine 5 mg IV was administered to the patient upon recognition of the pheochromocytoma, followed by esmolol and nitroglycerin.

Hemodynamic instability continued intraoperatively, requiring rotation of antihypertensives and vasopressor administration until tumor resection; hypotension occurred after the tumor was removed. This hypotension is due to the collaborative effects of preoperative and intraoperative pharmacological interventions, the rapid decline of plasma catecholamine levels, and surgical blood loss.[3] Post-tumor removal hypotension can be treated with isotonic crystalloids, phenylephrine, and ephedrine.[7] In addition to the previously stated medications, 1 liter of colloid IV was administered to the patient.

Early postoperative management includes vigilant BP, HR, and glucose monitoring. Postoperative fluid loading and vasopressor infusion are common interventions.[6,7] Rebound hyperinsulinemia can occur postoperatively due to the previously increased catecholamine levels suppressing alpha and beta cells in the pancreas.[6,7] This patient's BP remained stable and did not require postoperative vasopressor support. The patient received IV maintenance fluids totaling an additional 1 liter of crystalloid. The patient's postoperative glucose checks were within normal limits, requiring no additional interventions.

This case did not present as a typical pheochromocytoma. Objective signs such as marginal elevated plasma catecholamine metabolites, profound hypotension post-intubation, and hypotension immediately after insufflation suggested the left adrenal nodule was negative for characteristics of a pheochromocytoma. Regardless of the lack of typical signs and symptoms, precautionary preoperative and perioperative interventions were prepared such as alpha 1 adrenergic antagonism, invasive hemodynamic monitoring, large bore IV access, and specific pharmacological medications (phentolamine, nitroglycerin, esmolol, etc.). While intraoperative

hemodynamic instability did occur, there was little to no change in the anesthetic management. Exceptional anesthesia care necessitates thorough preparation for all potential possibilities, and this case was no exception. Phentolamine and nitroglycerin were retrieved from the pharmacy despite the low suspicion of a pheochromocytoma. Having these medications readily available saved valuable time in administering them immediately upon intraoperative diagnosis, averting a sustained hypertensive crisis. Every patient is unique, and each case must be tailored to the patient's idiosyncratic characteristics.

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Nurse Anesthetist Opinions about a Preoperative Asthmatic Assessment Tool

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Keywords: preoperative asthma assessment tool, asthma and anesthesia, bronchospasm, and anesthesia

Introduction

The asthmatic population has an increased risk of perioperative complications making the management of these patients more challenging for anesthesia providers.[1] The prevalence of this chronic pulmonary disease affects more than 300 million people worldwide and is growing each year.[1] With such a high prevalence, anesthesia providers commonly provide care to these

patients. Effective preoperative evaluation of the asthmatic patient via a standardized or stepwise approach may help to minimize the occurrence of perioperative bronchoconstriction.[1] In a recent case study report from France, 7% of anesthesia-related deaths were attributed to intraoperative bronchospasm.[2] A second case study reports 9% of asthmatic patients suffer from bronchospasm after induction of general anesthesia.[3] A national survey of pediatric anesthesiologists resulted in the need for routine preoperative assessment and treatment of asthmatic patients.[4] This project's goal is to gauge the nurse anesthesia profession on the usefulness of a preoperative assessment tool for asthmatic patients. “Open Airway”, a sample assessment tool for asthmatic patients created by the researcher, was utilized for this study.

Methods

The participants, current practicing nurse anesthetists and student nurse anesthetists, received a link via email that directly granted access to examine the “Open Airway” patient assessment questionnaire: (1) Have you experienced a new onset of cough during the night? (2) Do you get short of breath with mild to moderate exercise? (3) Are there any triggers in your home or work environment that causes a cough or chest tightness? (4) Have you used an inhaler more than once in the last 7 days? (5) Does the patient have audible wheezing?

Participants used a 5-point Likert response scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree) to express their opinions about the Open Airway assessment tool: (1) The suggested interventions will help reduce occurrences of postoperative pulmonary complications; (2) The suggested interventions are consistent with good clinical practice; (3) The assessment tool will be a great addition to the routine preoperative assessment; (4) The assessment tool will help uncover risks that would otherwise go unnoticed; (5) The interventions in the assessment tool will uncover information on asthmatic patients.

Results

There were 18 participants consisting of current practicing certified registered nurse anesthetists (16) and student registered nurse anesthetists (2). Their mean response over the five statements was 4.0 (95% CI, 3.5, 4.4) signifying the group, on average, “agreed” with each statement on the Likert Scale. Three represents the neutral response (neither agree nor disagree) and the 95% confidence excluded this value, indicating that participants perceived Open Airway as a viable assessment tool for asthmatics. However, this conclusion should be replicated with a larger sample size.

Discussion

Asthmatic patients suffer from overactive airways when triggered by an external source. Several stages during anesthesia care serve as triggers for these patients leading to narrowing of the airways making it difficult for gas exchange and breathing. Previous studies have shown significant patient advantages to the use of routine step by step approaches to care for specific patient populations and emergency scenarios. Based on the results of this data collection survey, the “Open Airway” tool or one similar may be useful in clinical practice to help optimize the asthmatic patient with the intentions of decreasing postoperative respiratory complications.

References

1. Applegate R. The perioperative management of asthma. *Journal of Allergy & Therapy*. 2013;01(S11). doi:10.4172/2155-6121.s11-007
2. Kim BS, Choi JC. Bronchospasm during anesthesia induction in a patient with undiagnosed asthma. *Asian Journal of Pharmacy, Nursing and Medical Sciences*.2020;8(6). doi:10.24203/ajpnms.v8i6.6417
3. Gkiouliava A, Zarzava E, Trikoupi A, Stergiouda Z, Koraki E. [PDF] A case of persistent bronchospasm after anesthesia induction | Semantic Scholar. https://www.semanticscholar.org/paper/A-case-of-persistent-bronchospasm-after-anesthesia/ddad6d35e958fa2d908f12fe96c18c399efa6a73. Published January 1, 2017. Accessed May 2, 2021. .
4. Domany KA, Soferman R, Gut G, Sivan Y. A national survey of preoperative treatment of asthmatic children by Israeli Pediatric pulmonologists. *Paediatric Respiratory Reviews*. 2013;14. doi:10.1016/s1526-0542(13)70057-5

Mentor: Eugene Komaroff, PhD

Editorial

I hope you have enjoyed reading the variety of articles in this issue. From consideration of the use of sugammadex in sexual assault victims to the management of unsuspected pheochromocytoma to endemic goiter during mission trips, nurse anesthesiology residents are providing safe, thoughtful, high-quality care to patients across the globe. The front cover also demonstrates the wide range of skills and knowledge residents gain as they prepare to enter the field of nurse anesthesiology. I would like to take this opportunity to thank all CRNAs who are educating the next generation of nurse anesthesiologists, particularly in the clinical environment. It can be challenging and time-consuming, but also enjoyable and rewarding. Thank you for supporting and sustaining this great profession.

Sincerely,

Vicki Callan, PhD, CRNA, CHSE, FAANA
Editor

INTERNATIONAL STUDENT JOURNAL OF NURSE ANESTHESIA
GUIDE FOR AUTHORS

MISSION STATEMENT

The International Student Journal of Nurse Anesthesia (ISJNA) is produced exclusively for publishing the work of nurse anesthesia students. It is intended to be basic and introductory in its content. Its goal is to introduce the student to the world of writing for publication; to improve the practice of nurse anesthesia and the safety of the patients entrusted to our care.

ITEM PREPARATION & SUBMISSION

Case reports, research abstracts, evidence-based practice (EBP) analysis reports, evidence-based practice project abstracts, and letters to the editor may be submitted. These items must be authored by a student under the guidance of an anesthesia practitioner mentor (CRNA or physician). Case reports must be single-authored, while EBP analysis reports and abstracts may have multiple authors. Submissions may list only one mentor. **Mentors should take an active role** in reviewing the item to ensure appropriate content, writing style, and format prior to submission. The mentor must submit the item for the student and serve as the contact person during the review process. Items submitted to this journal should not be under consideration with another journal. Authors and mentors should critically evaluate the topic and quality of the writing – multiple reviews of the item by the mentor, faculty, and peers (fellow graduate students) prior to submission is recommended. If the topic and written presentation are beyond the introductory publication level we strongly suggest that the article be submitted to a more prestigious publication such as the *AANA Journal.*

The journal is committed to publishing the work of nurse anesthesia students. The review process is always initiated with the following rare exceptions. We are conservative in accepting reports where the patient has expired, realizing that you can do everything right and still have a negative outcome. Submissions that report a case demonstrating failure to meet the standard of care (by any practitioner involved in the case) will not be accepted. Unfortunately, while the experiences in these cases can offer valuable insight, these submissions will not be accepted for review due to potential legal risks to the author, journal, and anyone else involved in evaluating the report.
It is the intent of this journal to publish items while the author is still a student. In order to consistently meet this goal, all submissions must be received by the editor at least **3 months prior** (4-6 months recommended) to the author's date of graduation. Manuscripts must be submitted by the mentor of the student author via e-mail to **INTSJNA@aol.com** as an attachment. The subject line of the e-mail should use the following format: ISJNA Submission_submission type_author last name_mentor last name. The item should be saved in the following format – two-three word descriptor of the article_author's last name_school abbreviation_mentor's last name_date (e.g. PedsPain_Smyth_GU_Pearson_5.19.09)

REVIEW PROCESS

Items submitted for publication are initially reviewed by the chief editor. If the chief editor does not acknowledge receipt of the item within two weeks, please inquire to ensure receipt. Upon receipt, the chief editor will review the submission for compliance with the Guide to Authors. If proper format has not been followed, the item will be returned to the mentor for correction. This is very important as all reviewers serve on a volunteer basis. Their time should be spent ensuring appropriate content, not making format corrections. It is the mentor and author's responsibility to ensure formatting guidelines have been followed prior to submission.

All accepted submissions undergo a formal process of blind review by at least two reviewers. After review, items may be accepted without revision, accepted with revision, or rejected with comments. Once the item has been accepted for review the chief editor will assign a submission number and send a blinded copy to an editor, who will then coordinate a blinded review by two reviewers who are not affiliated with the originating program. Submissions are reviewed using the Track Changes function of Word. The editor will return the item to the chief editor, who will return it to the mentor for appropriate action. **The mentor should guide the author through the revision process. The revised copy must be returned clean (no comments or Track Changes) with the original submission number in the filename and subject line of the email.** Every effort is made to complete the process in an efficient, timely matter. Again, the goal is for all articles submitted by students to be published while the author is still a student. If an item is not ready for publication within 6 months after the student author has graduated it will no longer be eligible for publication. Mentors will be listed as contributing editors for the issue in which the item is published.

PHOTOS

Photos of students for the front cover of the Journal are welcome. Please contact the chief editor at intsjna@aol.com to submit photos for consideration. Only digital photos of high quality will be accepted. If the photo is accepted, consent forms must be completed and returned by all identifiable individuals in the photo, and the individual who took the photo.

ACADEMIC INTEGRITY

Issues of academic integrity are the responsibility of the author and mentor. Accurate and appropriate acknowledgement of sources is expected. The two most common breaches of academic integrity that have been identified in submissions to this journal are (AMA 11th ed., 5.4.2):

1. Direct plagiarism: verbatim lifting of passages without enclosing the borrowed material in quotation marks and crediting the original author.
2. Paraphrase: restating a phrase or passage, providing the same meaning but in a different form without attribution to the original author.

Please note that changing one or two words in a reference source passage (e.g. 'of' for 'in', or 'classified' for 'categorized') and then citing it as a paraphrase or summary is also not appropriate, and still falls within the definition of direct plagiarism. If plagiarism in any form is identified, review of the item will be suspended and it will be returned to the mentor. Repeated instances of plagiarism will result in rejection of the item.
Plagiarism detection software (Scribbr, TurnItIn, PlagScan, SafeAssign, etc . . .) can be used to analyze the document prior to submission to ensure proper citation and referencing, but is not required.
"Plagiarism is the presentation of someone else's ideas, writings, or statements as one's own. Plagiarism is a serious breach of academic integrity, and anyone who is found to have committed plagiarism will be subject to disciplinary action.

Paraphrase is the act of putting someone else's ideas into one's own words. The use of paraphrase can be an acceptable practice under some circumstances if it is used sparingly and if the original text is properly acknowledged. Unacknowledged paraphrase, like plagiarism, is a serious breach of academic integrity. Any improper use of sources may constitute plagiarism. Every quotation from another source, whether written, spoken, or electronic, must be bound by quotation marks and be properly cited. Mere citation alone is not sufficient when a scholar has used another person's words. Similarly, every paraphrase or summary (a more concise restatement of another's ideas) must be properly cited."
https://sites.google.com/a/georgetown.edu/gsas-graduate-bulletin/vi-academic-integrity-policies-procedures

GENERAL GUIDELINES

Items for publication **must adhere to the *American Medical Association Manual of Style*** (AMA 11th ed., the same guide utilized by the *AANA Journal* and such prominent textbooks as *Nurse Anesthesia* by Nagelhout and Elisha). Section numbers from the online version are provided for easy reference in the AMA Manual of Style throughout this document. The review process will not be initiated on items submitted with incorrect formatting and will be returned to the mentor for revision.

Reference: Christiansen S, Iverson C, Flanagin A, et al. *AMA Manual of Style: A Guide for Authors and Editors*. 11th ed. Oxford University Press; 2020.

Please note the following:

1. Use complete sentences.
2. Acronyms/Initialisms (2.1.5, 10.6, 13.9) - spell out with first use, do not capitalize the words from which the acronym/initialism is derived unless it is a proper noun or official name. If you are using the phrase only once, do not list the acronym/initialism at all. Avoid beginning sentences with acronym/initialisms.
3. Abbreviations (13.0)
4. Use *Index Medicus* journal title abbreviations (3.11.2, http://www.ncbi.nlm.nih.gov/nlmcatalog/journals)
5. Always provide units of measure (17.0). In most cases The International System of Units (SI) is used. Abbreviations for units of measure do not need to be spelled out with first use. Report height in cm, weight in kg, temperature in °C, pressure in mm Hg or cm H_2O. Report heart and respiratory rate as X/min (e.g. the patient's heart rate increased to 145/min). The manual includes a complete list of SI units (17.1 – 17.5).

6. In general, first use of pulmonary/respiratory abbreviations should be expanded, with the following exceptions: O_2, CO_2, PCO_2, $PaCO_2$, PO_2, PaO_2, $EtCO_2$, N_2O. Please use SpO_2 for oxygen saturation as measured by pulse oximetry.
7. Use the nonproprietary (generic) name of drugs (2.1.3, 10.3.5) - avoid proprietary (brand) names. Type generic names in lowercase. When discussing dosages state the name of the drug, *then* the dosage (midazolam 2 mg).
8. Use of descriptive terms for equipment and devices is preferred. If the use of a proprietary name is necessary (for clarity, or if more than one type is being discussed), give the name followed by the manufacturer in parenthesis (e.g. a GlideScope (Verathon Inc.) was used) (14.5.1). Please note, TM and ® symbols are not used per the AMA manual.
9. Infusion rates and gas flow rates:
    a. Use mcg/kg/min or mg/kg/min for infusion rates. In some cases it may be appropriate to report dose or quantity/hr (i.e. insulin, hyperalimentation). If a mixture of drugs is being infused give the concentration of each drug and report the infusion rate in mL/min.
    b. Report gas flow of O_2, N_2O and Air in L/min (not %) and volatile agents in % as inspired or expired concentration (e.g. General anesthesia was maintained with sevoflurane 3% inspired concentration in a mixture of O_2 1 L/min and air 1 L/min.)
10. Only Microsoft Word file formats will be accepted with the following criteria:
    a. Font - 12 point, Times New Roman
    b. Single-spacing (except where indicated), paragraphs separated with a double space (do not indent)
    c. One-inch margins
    d. End the sentence with the period before placing the superscript number for the reference.
    e. Do not use columns, bolds (except where indicated), or unconventional lettering styles or fonts.
    f. Do not use endnote/footnote formats.
11. If referencing software is used (Endnote, Zotero, etc.), any embedded <u>formatting must be removed</u> prior to submission.
12. Remove all hyperlinks within the text.
13. Avoid jargon and slang terms. Use professional, scholarly, scientific language.
    a. *'The patient was reversed'* - Did you physically turn the patient around and point him in the opposite direction? "Neuromuscular blockade was antagonized."
    b. *The patient was put on oxygen.* "Oxygen 2 L/min was administered via face mask."
    c. *The <u>patient</u> was intubated and put on a ventilator*. "The trachea was intubated and mechanical ventilation was initiated.
    d. *An IV drip was started.* "An intravenous infusion was initiated."
    e. Avoid the term "MAC" when referring to a sedation technique - the term sedation (light, moderate, heavy, unconscious) may be used. Since all anesthesia administration is monitored, pharmacologic, rather than reimbursement, terminology should be used.
14. Direct quotes are discouraged for reports of this length – please express in your own words.
15. Use the words "anesthesia professionals" or "anesthesia practitioners" when discussing all persons who administer anesthesia (avoid the reimbursement term "anesthesia providers").
16. Do not include ASA Physical Status unless it is germane to the report.
17. Do not use the phrase "ASA standard monitors were applied". Instead, "standard noninvasive monitors" is acceptable – additional monitoring can be detailed as needed.
18. References
    a. The **<u>AMA Manual of Style must be adhered to</u>** for reference formatting.
    b. All sources should be published within the past 8 years. Seminal works essential to the topic being presented will be considered.
    c. Primary sources are preferred.
    d. **A maximum of one textbook (must be most recent edition available) may be used as reference for case report submissions only**.
    e. All items cited must be from peer-reviewed sources – use of sources found on the internet must be carefully considered in this regard. URLs must be current and take the reader directly to the referenced source.

<u>Heading</u> – for all submission types (Case Report, Abstract, EBPA Report) use the following format.

1. **Title** is bolded, centered, 70 characters (including spaces) or less
2. Author name (academic credentials only) and NAP are centered, normal font
3. *Graduation date and email address* are centered, italicized, and will be removed prior to publication)
4. **Keywords** is left-justified, bolded – list keywords that can be used to identify the report in an internet search

Title

Author Name
Name of Nurse Anesthesia Program
Anticipated date of graduation
E-mail address

Keywords: keyword one, keyword two, etc.

Case Reports - The student author must have had a significant role in the conduct of the case. The total word count should be between 1200 – 1400 words (references not counted). Case reports with greater than 1400 words will be returned to the mentor for revision prior to initiation of the review process. The following template demonstrates the required format for case report submission.

Heading (see above)

A brief introductory paragraph of less than 100 words to focus the reader's attention and interest them to continue reading. This may include historical background, demographics or epidemiology (with appropriate references) of the problem about to be discussed. It is written in the *present tense*. Although it is introductory, the heading word '***Introduction'*** is not used. Be certain to cite references in this section, especially statistics and demographics pertaining to your topic.

Case Report (400-600 words)

This portion discusses the case performed and is written in the *past tense*. Do not justify actions or behaviors in this section; simply report the events as they unfolded. Present the case in an orderly sequence. Some aspects need considerable elaboration and others only a cursory mention. Under most circumstances if findings/actions are normal or not contributory to the case then they should not be described. Events significant to the focus of the report should be discussed in greater detail. The purpose of the case report is to set the stage (and 'hook' the reader) for the heart of your paper which is the discussion and teaching/learning derived from the case.

- Give dosage and schedule only if that information is pertinent to the consequences of the case.
- **Significant** laboratory values, x-rays or other diagnostic testing pertinent to the case. Give the units of measure after the values (eg. Mmol/L or mg/dL).
- Physical examination/pre-anesthesia evaluation - **significant** findings only.
- Anesthetic management (patient preparation, induction, maintenance, emergence, post-operative recovery).

Discussion (600-800 words)

Describe the ***anesthesia*** implications of the focus of the case report citing current literature. Describe the rationale for your actions and risk/benefits of any options you may have had. This section is not merely a pathophysiology review that can be found in textbooks. *Relate the anesthesia literature with the conduct of your case noting how and why your case was the same or different from what is known in the literature.* Photographs are discouraged unless they are essential to the article. Photos with identifiable persons must have a signed consent by the person photographed forwarded to the editor via first class mail. Diagrams must have permission from original author. This is the most important part of the article. In terms of space and word count this should be longer than the case presentation. End the discussion with a summary lesson you learned from the case, perhaps what you would do differently if you had it to do over again.

References

A minimum of 5 references is recommended, with a maximum of 8 allowed. One textbook may be used as a reference – it must be the most recent edition. All references should be no older than 8 years, except for seminal works essential to the topic. This is also an exercise in searching for and evaluating current literature.

Mentor: mentor name, credentials

E-mail address: *(*will be removed prior to publication)

EBP Analysis Reports - Evidence-based practice analysis reports are limited to 3000 words. Please do not include an abstract. The report should provide a critical evaluation of a practice pattern in the form of a clinical question about a specific intervention, population, and outcome. The manuscript should:

1. Articulate the practice issue and generate a concise question for evidence-based analysis. A focused foreground question following either the PICO or SPICE format should be used.
2. Describe the methods of inquiry used in compiling the data.
3. Critically analyze the quality of research reviewed and applicability to different practice settings.
4. Draw logical conclusions regarding appropriate translation of research into practice.

The same general format guidelines apply with the exception of the section headings as below. Textbooks and non-peer reviewed internet sources may not be used, and sources of reference should be less than 8 years old unless they are seminal works specifically related to your topic of inquiry. A maximum of 16 references is allowed.

Heading

Introduction (bold)
Briefly introduce the reader to the practice issue or controversy, describe the scope or significance or problem, and identify the purpose of your analysis. Describe the theoretical, conceptual, or scientific framework that supports your inquiry.
Methods (bold)
Include the format used for formulating the specific question you seek to answer, search terms and methods used, and levels of evidence.
Literature Analysis (bold)
Analyze and critique the literature relevant to your question, determining scientific credibility and limitations of studies reviewed. Your synthesis table is included in this section. Please follow AMA formatting guidelines for your table (4.1.2, 10.2.3). Your review and discussion of the literature should logically lead to support a practice recommendation. Subheadings may be used if desired.
Conclusions (bold)
Summarize the salient points that support the practice recommendation and make research-supported recommendations that should improve the practice issue, while also acknowledging any limitations or weaknesses
[space]
References (bold, 16 maximum)
Mentor: (bold, followed by mentor name and credentials in normal text)
E-mail address: (normal text, will be removed prior to publication)

Evidence Based Practice Project Abstracts - Evidence-based practice project abstracts are limited to 600 words. References do not impact the word count - a maximum of 5 are allowed. Note that the abstract is different from a project proposal. The following format should be used:

Heading

Introduction (bold)
A brief introductory paragraph including purpose (what change is intended) and rationale (why change is needed/evidence to support the change) here.
Design and Methods (bold)
Include population, intervention, and measures
Outcome (bold)
Present results from statistical analysis – do not justify or discuss here.
Conclusion (bold)
Discuss results (implications). Optionally include limitations, suggestions for future projects/research.
References (bold, 5 maximum)
Mentor: (bold, followed by mentor name and credentials in normal text)
E-mail address: (normal text, will be removed prior to publication)

Research Abstracts - Research abstracts are limited to 600 words. References do not impact the word count - a maximum of 5 are allowed. Note that the abstract is different from a research proposal. The following format should be used:

Heading

Introduction (bold)
A brief introductory paragraph including purpose and hypotheses.
Methods (bold)
Include sample and research design
Results (bold)
Present results from statistical analysis – do not justify or discuss here.
Discussion (bold)
Discuss results (implications, limitations, suggestions for future research)
References (bold, 5 maximum)
Mentor: (bold, followed by mentor name and credentials in normal text)
E-mail address: (normal text, will be removed prior to publication)

Letters to the Editor - Students may write letters to the editor topics of interest to other students. Topics may include comments on previously published articles in this journal. Personally offensive, degrading or insulting letters will not be accepted. Suggested alternative approaches to anesthesia management and constructive criticisms are welcome. The length of the letters should not exceed 100 words and must identify the student author and anesthesia program.

AMA MANUAL OF STYLE

The following is brief introduction to the *AMA Manual of Style* reference format along with some links to basic, helpful guides on the internet. The website for the text is http://www.amamanualofstyle.com/oso/public/index.html. It is likely your institution's library has a copy on reserve. Journal names should be in italics and abbreviated according to the listing in the PubMed Journals Database. PubMed can also be used to perform a search: http://www.ncbi.nlm.nih.gov/pubmed. The International Student Journal of Nurse Anesthesia (ISJNA) is not listed in the PubMed Database. For the purpose of citing the ISJNA *in this Journal* use "**Int Student J Nurse Anesth**" as the abbreviation.

Journals (3.11) - A comma is placed after the first initials until the last author, which has a period. If there are six or less authors **cite all six**. If there are more than six authors **cite only the first three** followed by "et al." Only the first word of the title of the article is capitalized. The first letters of the major words of the journal title are capitalized. There is no space between the year, volume number, issue number, and page numbers. If there is no volume or issue number, use the month. If there is an issue number but no volume number use only the issue number (in parentheses). Page numbers are inclusive - **do not omit digits** (note - some online journals do not use page numbers). Some journals may be available both as hard copies and online. When referencing a journal that has been accessed online, the DOI (digital object identifier) or PMID (PubMed identification number, 3.15.2) should be included (see examples below).

Journal, 6 or fewer authors:

Han B, Liu Y, Zhang X, Wang J. Three-dimensional printing as an aid to airway evaluation after tracheotomy in a patient with laryngeal carcinoma. *BMC Anesthesiol*. 2016;16(6). doi:10.1186/s12871-015-0170-1

Journal, more than 6 authors:

Chen C, Nguyen MD, Bar-Meir E, et al. Effects of vasopressor administration on the outcomes of microsurgical breast reconstruction. *Ann Plast Surg*. 2010;65(1):28-31. PMID: 20548236

Elayi CS, Biasse L, Bai R, et al. Administration of isoproterenol and adenosine to guide supplemental ablation after pulmonary vein antrum isolation. *J Cardiovasc Electrophysiol*. 2013;24(11):1199-1206. doi: 10.1111/jce.12252

Electronic references (3.15) - Only established, peer-reviewed sources may be referenced. Please do not reference brochures, fact sheets, or informational websites where a peer-review process cannot be confirmed. The accessed date may be the only date available. The URL must be functional and take the reader directly to the source of the information cited.

Author (or if no author, the name of the organization responsible for the site). Title. *Name of Website*. Year;vol(issue no.):inclusive pages. Published [date]. Updated [date]. Accessed [date]. URL (with no period following).

Examples:

Kamangar N, McDonnell MS. Pulmonary embolism. *eMedicine*. Updated August 25, 2009. Accessed September 9, 2009. http://www.emedicine.com/med/topic1958.htm

Howlader N, Noone AM, Krapcho M, Garshell J, Miller D, et al. SEER Cancer statistics review, 1975-2012. National Cancer Institute. Published April 2015. Updated November 18, 2015. Accessed February 29, 2016. http://seer.cancer.gov/csr/1975_2012

Textbooks (3.12) - There are two types of books – 1) those that are fully authored by one or more individuals, and 2) those that are edited by one or more individuals, with chapters authored by different individuals. Edited textbooks give primary credit to the chapter authors, who are listed first, and the inclusive page numbers of the entire chapter are provided at the end. Textbooks that are authored do not have different chapter authors and the chapter titles are

not listed, but the inclusive page numbers where the information was found are provided, unless the entire book is cited.

Authored text:
Shubert D, Leyba J, Niemann S. *Chemistry and Physics for Nurse Anesthesia*. 3rd ed. Springer; 2017:405-430.

Chapter from an edited text (3.12.4)**:**
Pellegrini JE. Regional anesthesia. In Nagelhout JJ, Elisha S, eds. *Nurse Anesthesia*. 6th ed. Elsevier; 2017:1015-1041.

SUBMISSION CHECK LIST

Adheres to AMA Manual of Style and all other format instructions
___ Total word count not exceeded (1400 for case report, 600 for abstracts, 3000 for EBPA report)
___ The item is one continuous Word document without artificially created page breaks
___ All matters that are not common knowledge to the author are referenced appropriately
___ Generic names for drugs and products are used throughout and spelled correctly in lower-case
___ Units are designated for all dosages, physical findings, and laboratory results
___ Endnotes, footnotes not used
___ Jargon/slang is absent

Heading
___ Concise title less than 70 characters long (including spaces)
___ Author name, credentials, nurse anesthesia program, graduation date and email are included
___ Three to five **Keywords** are provided

Case Report
___ Introduction is less than 100 words.
___ Case Report section states only those facts vital to the account (no opinions or rationale)
___ Case report section is 400-600 words and not longer than the discussion
___ Discussion section is 600-800 words
___ Discussion of the case management is based on a review of current literature
___ Discussion concludes with lessons learned and how the case might be better managed in the future

Abstracts
___ The 600 word count maximum is not exceeded
___ Appropriate format used depending on type of abstract (research vs. EBP project)

EBPA Report
___ The 3000 word count maximum is not exceeded
___ A critical evaluation of a practice pattern in the form of a precise clinical question about a specific intervention, population, and outcome is presented
___ A focused foreground question following either the PICO or SPICE format is used
___ Includes Introduction, Methodology, Literature Analysis (with synthesis table), and Conclusion sections

References
___ Adheres to AMA Style format
___ Reference numbers are sequenced beginning with 1 and superscripted
___ References are from anesthesia and other current (within past 8 years) primary source literature
___ Journal titles are abbreviated as they appear in the PubMed Journals Database
___ Number of references adheres to specific item guidelines (1 textbook allowed for case reports only)
___ Internet sources are currently accessible, reputable, and peer reviewed

Transmission
___ The article is sent as a Word document attachment to **INTSJNA@AOL.COM**
___ The file name is correctly formatted (e.g. PedsPain_Smyth_GU_Pearson_5.19.09)
___ Item is submitted by the mentor
___ Subject heading format - ISJNA Submission_submission type_author last name_mentor last name