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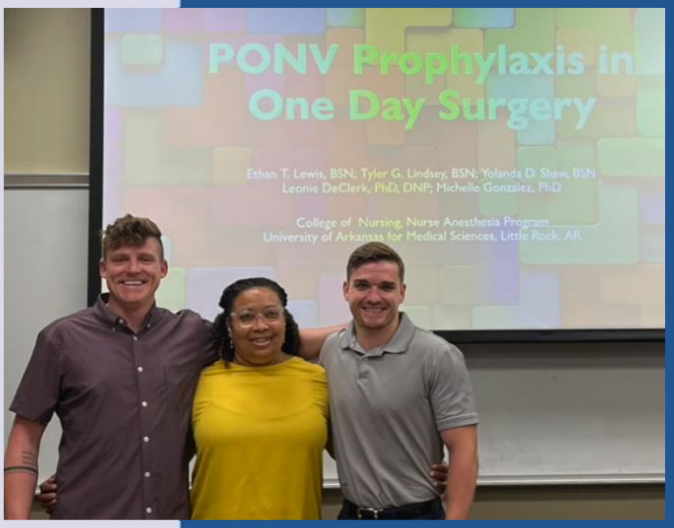
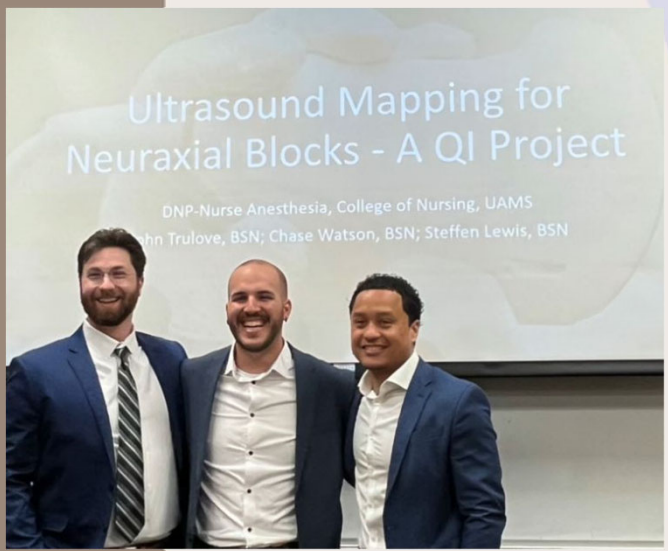
TOPICS IN THIS ISSUE





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Front Cover:

On the front cover residents enrolled in the University of Arkansas for Medical Sciences Nurse Anesthesia Program participate in scholarship and outreach activities. Pictured clockwise from the top and left to right are residents: Ethan Lewis, Yolanda Shaw, and Tyler Lindsey presenting their DNP project on PONV prophylaxis (abstract published in this issue); Steffen Lewis, Darinisha Turner, Emilie Shatto, Ashlyn Spruell, and Tyler Lindsey presenting at Day in the Delta, an outreach program that exposes high school students from rural and underserved communities to careers in healthcare; and Chase Watson, Landon Trulove, and Steffen Lewis, presenting their DNP project on neuraxial ultrasound mapping.

*The **opinions** contained in this journal are those of the authors and do not necessarily represent the opinions of the program or the University.*

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Case Report of a Patient with May-Thurner Syndrome

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Keywords: May-Thurner Syndrome, deep vein thrombosis, iliac vein compression

May-Thurner syndrome (MTS) results from the compression of the left common iliac vein (LCIV) by the right common iliac artery (RCIA) and lower lumbar spine.[1] This anatomical abnormality increases a patient's risk for developing deep vein thrombosis (DVT) in the left lower extremity.[2,3] Chronic LCIV compression leads to cell proliferation causing "spur-like" projections and stenosis within the left iliac vein.[3] May-Thurner syndrome is more commonly diagnosed in young adult females and is also associated with immobility and pregnancy.[3]

Case Report

A 24-year-old female presented to the operating room (OR) for a pelvic abdominal venogram, bilateral iliac vein intra-vascular ultrasound (IVUS), and bilateral common iliac vein stenting. The patient's medical history was significant for MTS, pelvic congestion syndrome, and varicose veins. She weighed 54 kg and measured 162.6 cm with a BMI of 20.25 kg/m^2. Medications included aspirin 81 mg po daily. She endorsed having had a previous mild allergic reaction to iodinated contrast dyes manifesting as hives across her chest. She denied any incidence of shortness of breath or difficulty breathing with the contrast dye reaction. All preoperative laboratory values were within normal limits and urine pregnancy test was negative. Physical assessment included a Mallampati class 2 airway, thyromental distance greater than 3 cm, interincisor distance greater than 2 cm, and full range of motion of the cervical spine. The cardiac and respiratory assessment was within normal limits. Preoperative imaging included a magnetic resonance angiography of the pelvis and abdomen, revealing prominent periuterine veins (left greater than right), and compression of the LCIV by the RCIA. There was no evidence of DVT.

The patient was brought to the operating room suite and self-positioned onto the surgical table. Prior to the induction of anesthesia, all standard noninvasive monitors were applied, followed by the administration of midazolam 3 mg IV. The anesthetic plan was general anesthesia with an endotracheal tube (GETA). Surgical timeout was performed before the start of induction. Anesthesia was induced with fentanyl 50 mcg, lidocaine 50 mg, propofol 130 mg, and rocuronium 50 mg IV. The patient was an easy bag mask ventilation and did not require an oral airway. A 6.5mm endotracheal tube (ETT) was placed via direct laryngoscopy with a grade 1 Cormack-Lehane glottic view. After securement of the ETT, mechanical ventilation was established. Due to the history of hives from and in anticipation of IV contrast dye use, famotidine 20 mg and diphenhydramine 25 mg IV were given. Anesthesia was maintained with propofol infusing at 80-125 mcg/kg/min; volatile agent was avoided to decrease the possibility of postoperative nausea and vomiting (PONV). Two additional fentanyl boluses (50 mcg IV each) were required during stimulating portions of the procedure. Prophylaxis for PONV included a transdermal scopolamine patch and ondansetron 4 mg IV. Heparin 5,000 units IV was administered twice per surgeon request throughout the case, once prior to surgical introduction of

venous stents and again, one hour after the initial dose. Upon conclusion of the procedure, heparin was reversed with protamine 40 mg IV. Ketorolac 30 mg and acetaminophen 1g IV were given for additional analgesia. Neuromuscular blockade was reversed with sugammadex 100 mg IV. The propofol infusion was titrated off and the patient transitioned to spontaneous ventilation. The total volume of IV fluid received was 1,000 mL of lactated Ringers. The estimated blood loss was 50 mL. The ETT was removed once the patient met extubation criteria, and a nasal cannula was applied. No respiratory distress was noted post-extubation. The patient was transferred to the post anesthesia care unit in stable condition, with plans for discharge to home on the same day.

Discussion

In 1957, May and Thurner described the pathophysiology of MTS. Their research concluded that thrombi were eight times more likely to occur on the left compared to the right side of the pelvis. Also described were three "spur" formations that can arise, leading to occlusion of the LCIV.[4] The spurs described by May and Thurner result from chronic compression of the vessel by an overriding RCIA, leading to stenosis or narrowing of the vein.[3,4] If left untreated, chronic compression of the LCIV increases a patient's risk for developing DVT, pulmonary emboli (PE), and death.[5] Risk factors for the development of a thrombus from MTS include female gender, young age, pregnancy, hypercoagulable states, prolonged immobilization, obesity, trauma, and recent surgery.[5,6]

Although most patients with MTS are asymptomatic, many cases are not diagnosed until a DVT develops.[1] Other common presentations include venous claudication relieved with rest progressing to chronic venous insufficiency manifesting as varicose veins.[1] In this case report, the patient's diagnosis of MTS was an incidental finding, demonstrated as chronic diffuse bilateral abdominal pain suggestive of pelvic congestion syndrome. May-Thurner syndrome is implicated in only 2-5% of cases involving lower extremity DVTs. However, pregnant patients diagnosed with MTS have a greater risk of developing thrombotic and potentially embolic complications due to the additional pressure exerted on the common iliac veins from the developing fetus.[5,7]

The implication of MTS in the development of lower extremity DVTs may be underappreciated.[3] Because the majority of cases are asymptomatic, DVTs may not develop until patients experience high risk conditions such as injury, prolonged immobilization, and pregnancy.[3] Therefore, the diagnosis of MTS may be unexplored since DVTs are often only discovered in the presence of higher risk conditions. Historically, the gold standard tool for diagnosis of MTS includes the use of contrast venography with transvenous pressure measurements. Hallmark signs include collateral vessel formation and a > 2 mmHg pressure gradient across the compressed area.[3] However, other noninvasive techniques can be utilized for the diagnosis of MTS, including multi-detector computed tomography (MDCT) and magnetic resonance (MR) venography. These procedures supplement diagnosis and rule out other possible pathologies.[1] Venography is still utilized for patients undergoing endovascular procedures or for cases where a diagnosis cannot be made with MDCT and MR.[1]

Treatment modalities for MTS consist of medical or surgical management. In patients without a history of DVTs or asymptomatic to mild symptoms, medical management may be preferred with the use of compression stockings and anticoagulation therapy.[5] Prior to the patient's procedure for the above mentioned case report, prophylactic anticoagulation consisted of aspirin 81 mg daily, which was discontinued 4 days before the procedure. Anticoagulation therapy will also depend on whether patients have had a previous DVT or PE.[7] Recommendations for treatment of parturients with a diagnosis of MTS include either a therapeutic, intermediate, or prophylactic dosing of enoxaparin.[7] Mei and associates reviewed 30 cases of women with MTS, 24 of whom were anticoagulated with enoxaparin. Thirteen underwent cesarean delivery; all were able to receive neuraxial anesthesia.[7]

For patients with more advanced symptoms such as pain and DVTs, surgical treatment includes endovascular intervention with or without thrombolysis or open vascular surgery.[6] Endovascular surgery has a higher success and lower complication rate when compared to open procedures; however, potential complications include acute or chronic stent thrombosis requiring further endovascular treatments.[1,2] Additionally, the utilization of IVUS enables the surgeon to better assess compression and focus in on the cause/location of the obstruction for patients already undergoing an endovascular approach to treatment.[1]

Depending on the patient's comorbidities and invasiveness of the endovascular procedures, interventions can be performed with local anesthesia and sedation or general anesthesia.[2] The procedure described above required GETA due to surgeon preference and the potential for additional endovascular interventions to be performed. If stenting of the LCIV for treatment of MTS is the sole procedure, local anesthesia and sedation is sufficient assuming that the patient can cooperate and remain immobile. Communication with the surgical team is critical in establishing hemodynamic monitoring goals, anticoagulation status, and any potential complications unveiled during the procedure.

In this case, IVUS identification and stenting of the common iliac veins bilaterally was performed with no surgical or anesthetic complications. Despite the administration of IV contrast, no allergic reaction was noted throughout or following the procedure. In summary, anticoagulation and endovascular interventions can reduce the risk of developing life-threatening thrombi and ameliorate untoward symptoms in the patient with MTS, improving quality of life. It is important for the anesthesia provider to have a knowledge of MTS to deliver safe and comprehensive care to these patients.

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Mentor: Marianne S. Cosgrove, PhD, DNAP, CRNA, APRN, FAANA

Craniotomy for Tumor Debulking in a Patient with Neurofibromatosis Type 1

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Keywords: neurofibromatosis, astrocytoma, optic pathway glioma, craniotomy, anesthesia management

Neurofibromatosis type 1 (NF1) is a condition resultant from a genetic mutation of the NF1 tumor suppressor gene.[1] NF1 is associated with multisystem tumors, of which 15-20% are optic pathway gliomas.[2] Many neurofibromas are low-grade; however, they may still present with aggressive features, requiring prompt treatment.[2] The patient in this case study has a low-grade thalamic astrocytoma with rapid progression of symptomatology, proving her to be a candidate for prompt surgical tumor debulking via temporal craniotomy. This case report will detail the anesthetic management of a patient with NF1 who required craniotomy for debulking of thalamic astrocytoma.

Case Report

A 9-year-old female (40 kg, 136 cm, BMI 20 kg/m^2) presented for a right temporal craniotomy for debulking of a thalamic astrocytoma. Her past medical history was significant for NF1, optic nerve glioma with associated blindness, hydrocephalus, hyperprolactinemia, adrenal dysfunction, and developmental delays. In recent months she had experienced increased severity of blindness, left upper and lower extremity weakness, and dysphagia. Magnetic resonance imaging revealed a significantly increased size of a right thalamic tumor.

Preoperative sedation included an oral solution of midazolam 20 mg. In the magnetic resonance operative room (MROR), the patient was transferred to the operative table and standard non-invasive magnetic resonance (MR) compatible monitors applied. Inhalation induction was

commenced with O_2 3 L/min and N_2O 7 L/min via standard anesthesia mask. Sevoflurane was then incrementally increased to 8% inspired concentration, with O_2 10 L/min and discontinuation of N_2O. The patient continued to breathe spontaneously with mask management and sevoflurane titrated to appropriate anesthetic depth at 3% expired concentration. Anesthesia practitioners obtained peripheral intravenous access of the right cephalic vein. Fentanyl 100 mcg and Propofol 40 mg was administered. Direct laryngoscopy was performed, and the patient's trachea was intubated with a 5.5 mm cuffed endotracheal tube.

Mechanical ventilation was initiated with pressure control settings, an inspiratory pressure to achieve tidal volumes of 6-7 mL/kg ideal body weight, respiratory rate titrated to maintain end tidal carbon dioxide ($EtCO_2$) between 34 to 36 mm Hg, and PEEP of 3 mm Hg. General anesthesia was maintained with sevoflurane 2% expired concentration in a mixture of O_2 0.3 L/min and air 0.7 L/min. The MROR table was turned 180 degrees and additional intravenous access was obtained via the left proximal cephalic vein. An arterial line for hemodynamic monitoring was obtained via the left radial artery with ultrasound guidance. A propofol infusion was initiated at 50 mcg/kg/min and a remifentanil infusion was initiated at 0.2 mcg/kg/min. Sevoflurane was decreased to achieve 1% expired concentration. Tranexamic acid was administered via initial bolus of 30 mg/kg over 15 minutes and subsequently infused at 10 mg/kg/hr. Remifentanil 40 mcg was administered prior to placement of Mayfield pins. Levetiracetam 400 mg, hydrocortisone 60 mg, dexamethasone 8 mg, and cefazolin 1000 mg were administered prior to surgical incision. Neuromuscular blockade was achieved with rocuronium 20 mg as needed according to peripheral nerve monitoring of the posterior tibial nerve. During surgical hemostasis, Morphine 2 mg was administered, the propofol infusion was discontinued, and remifentanil infusion was decreased to 1.5 mcg/kg/min. During surgical closure, ondansetron 4 mg and acetaminophen 500 mg was administered. The patient's hemodynamics were stable throughout the procedure. The total volume of crystalloid administered was 1000 mL. The estimated blood loss was 50 mL and total urine output was 310 mL. Length of surgery was 10 hours.

During surgical closure of skin, sevoflurane was discontinued. Once the Mayfield pins were removed, train of four assessment exhibited 3/4 twitches and neuromuscular blockade was antagonized with sugammadex 2 mg/kg. Remifentanil infusion was discontinued. The MROR table was turned 180 degrees, the oropharynx was suctioned, and the endotracheal tube was removed once the patient's respiratory pattern was regular and achieved spontaneous volumes greater than 6 ml/kg of ideal body weight. Neurologic examination was carried out by the surgeon. Morphine 2 mg was administered as the patient was tearful, restless, hypertensive, and tachycardic. The patient continued to be restless and hypertensive, at which point dexmedetomidine 10 mcg and, subsequently, labetalol 5 mg was administered. Upon transfer to the pediatric intensive care unit, the patient was resting comfortably with systolic blood pressure 120 to 130 mm Hg, heart rate 95, respiratory rate 18, and SpO2 100%.

Discussion

Craniotomy for thalamic astrocytoma in pediatric patients requires anesthesia management which focuses on hemodynamic control, prevention of seizures, and prompt recovery from anesthesia. In pediatric patients, cerebral oxygen metabolism (CMRO2) is higher compared to

adults; therefore, pediatric patients are more susceptible to tissue ischemia during periods of hypoxia or decreased CBF.[3] For this reason, it was imperative that the patient in this case study remained normotensive, appropriately oxygenated, and normocapnic. Intraoperative and postoperative hypertension in patients undergoing craniotomy for tumor debunking could result in significant compromise related to cerebral edema and intraventricular hemorrhage, whereas hypotension could lead to cerebral ischemia.[3] The anesthesia professionals in this case study ensured hemodynamic control via arterial blood pressure monitoring. Continuous invasive blood pressure monitoring allowed increased vigilance for acute hemodynamic changes associated with blood loss, venous air embolism, and manipulation of cranial nerves.[3] Also, arterial cannulation provided rapid retrieval of blood samples for evaluation of PaCO2 to guide management of ETCO2 by means of ventilation rate. Cerebral blood flow was optimized by maintaining end tidal CO2 (ETCO2) at 35 mm Hg per surgeon request.

The surgeon requested the administration of dexamethasone 10 mg to prevent significant cerebral edema; however, after discussion with the surgeon, the dose administered was decreased to 8 mg because the patient also required stress dose steroids recommended by endocrinology. The endocrinology team recommended hydrocortisone 60 mg initial dose and hydrocortisone 15 mg every 6 hours after the initial dose. Although dexamethasone would provide adequate exogenous glucocorticoid, if given alone as a stress dose steroid for central adrenal insufficiency dexamethasone could trigger an adrenal crisis as it does not possess any mineralocorticoid activity.[4]

According to a retrospective cohort study of 193 patients requiring craniotomy for tumor resection, a history of prior seizures and smaller tumor size were the independent risk factors for postoperative seizures after craniotomy.[6] However, prophylactic antiepileptic drugs (AEDs) did not reduce the incidence of postoperative seizure in the patients who had a prior seizure history and smaller tumor size.[6] A systematic review which included 10 randomized control trials also found that there was no significant difference between prophylactic treatment with AEDs and no treatment in preventing seizures following craniotomy.[5] However, the incidence of seizure is 15% to 20% after supratentorial craniotomy and may be higher depending on surgical approach and patient risk factors.[5] Although the patient did not have a history of seizure activity, levetiracetam 400 mg was administered prophylactically to prevent intraoperative and postoperative seizures per surgeon request.

The patient's anesthetic was maintained with a balanced approach using multiple agents to optimize hemodynamics and an adequate depth of anesthesia while ensuring rapid awakening from anesthesia so that the surgical team could perform a prompt neurologic assessment. Relying solely on intravenous anesthesia would require a high dose of continuous propofol infusion, potentially resulting in delayed awakening due to the context sensitive half-life. Additionally, because of the surgical approach, the placement of a bispectral index monitor was not feasible to help guide the titration of intravenous anesthetics. The anesthesia practitioners determined that 50% of the minimum alveolar concentration of sevoflurane in combination with a low-dose propofol infusion and remifentanil infusion would ensure an adequate depth of anesthesia and analgesia without relying on a high dose of a single agent which could result in greater hemodynamic fluctuations. The surgeon did not require neuromonitoring during the procedure, allowing for the use of volatile anesthetics and neuromuscular blocking agents.

The craniotomy for debulking of thalamic astrocytoma is a procedure that requires multidisciplinary communication and thoughtful planning to ensure both patient and surgical specific goals are achieved with a safe anesthesia plan. The anesthesia practitioners in this case study should have fostered communication with the endocrinology team to ensure appropriate dosing of stress dose hydrocortisone in conjunction with dexamethasone. The administration of hydrocortisone 60 mg and dexamethasone 8 mg is a significant dose of exogenous glucocorticoid which may have been better optimized to meet both endocrine and surgical goals. Furthermore, anesthesia professionals must ensure unwavering vigilance, anticipation of complications, and prompt resuscitation to optimize outcomes of patients requiring thalamic astrocytoma debulking via craniotomy.[3]

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Mentor: Maria van Pelt, PhD, CRNA, FAAN

Neuromuscular Blockade with a Laryngeal Mask Airway

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Keywords: laryngeal mask airway, neuromuscular blockade, positive pressure ventilation, aspiration

The laryngeal mask airway (LMA) is a less invasive airway device than the endotracheal tube (ETT) and allows better control of ventilation than the face mask. The LMA is also included in the difficult airway algorithm. Increasing in popularity, LMAs are now used in procedures requiring positive pressure ventilation (PPV) and neuromuscular blockade.[1] This case report

aims to review the perioperative considerations regarding LMA use with neuromuscular blockade and mechanical ventilation, the risk of aspiration, and appropriate patient and procedure selection.

Case Report

A 34-year-old male with secondary infertility presented for bilateral microscopic vasovasostomy, scheduled for four hours. Patient demographics included a weight of 113.4 kg, height of 180 cm, and a body mass index (BMI) of 35.9 kg/m^2. He reported an allergy to sulfa. The patient denied all medical history except stress-related gastroesophageal reflux disease (GERD). His past surgical history included an uncomplicated vasectomy in 2009. The patient appeared anxious on the morning of surgery associated with nausea and diaphoresis. After further assessment, he denied fevers, chills, chest pain, shortness of breath, vomiting, diarrhea, or signs and symptoms of an infection.

Midazolam 2 mg was administered intravenously (IV) in the preoperative area. Upon arrival to the operating room, standard noninvasive monitors were applied, and preoxygenation was achieved with oxygen 10 L/min administered via face mask for 5 minutes. General anesthesia was induced using IV lidocaine 100 mg and propofol 200 mg. The patient's airway was secured with a size 5 LMA Unique™ (Teleflex Inc). Identification of an adequate LMA seal was identified via manual ventilation by positive $EtCO_2$, tidal volume of 3 mL/kg, and the absence of an audible air leak at 15 to 20 cm H_2O pressure. Respirations were controlled using pressure control ventilation (PCV). Anesthetic depth was maintained with an inspired sevoflurane concentration of 2%. Antiemetics were administered including ondansetron 4 mg and dexamethasone 4 mg.

Before incision, the urologist requested neuromuscular blockade to improve the surgical visibility under the microscope. Rocuronium 50 mg was administered IV. PCV remained, producing tidal volumes between 300-400 mL with peak inspiratory pressures below 12 cm H_2O pressure.

A decision was made to remove the LMA and place an ETT in order to achieve tidal volumes greater than 6 mL/kg of ideal body weight (IBW). The LMA was removed, and the patient's trachea was intubated with a 7.5-mm ETT using direct laryngoscopy. The placement was verified by positive $EtCO_2$ and equal bilateral breath sounds. Volume control ventilation was initiated, which produced tidal volumes of about 7.5 ml/kg of IBW or 600 ml.

Documented surgical time was 3 hours and 40 minutes; a total of 110 mg of rocuronium was administered throughout the case. At the end of the surgery, neuromuscular blockade was antagonized using sugammadex 220 mg, and the sevoflurane was turned off. The patient resumed spontaneous ventilation, followed commands, and was extubated. He was transported to the post-anesthesia care unit and the postoperative period was uneventful.

Discussion

This case details the anesthetic management of a patient under general anesthesia with an LMA in place requiring neuromuscular blockade. The LMA is a supraglottic airway inserted into the pharynx, allowing ventilation, oxygenation, and anesthetic administration during general anesthesia.[2] It contains a hollow tube and mask-like cuff that sits in the hypopharynx facing the glottis.[2] The LMA cannot protect the lungs from aspiration of gastric contents because the tip of the LMA at the esophageal inlet does not create a perfect seal.[2] Initiation of PPV after neuromuscular blockade may cause excessive gastric insufflation and the aspiration of regurgitated contents.[1]

Laryngeal mask airways are not generally recommended for airway management in obese patients since higher peak inspiratory pressures are required for adequate ventilation, increasing the risk of aspiration by potentially opening the lower esophageal sphincter.[2-3] The risk of aspiration is already high in patients under general anesthesia.[4] Drugs commonly used such as propofol, volatile anesthetic agents, and opioids decrease lower esophageal sphincter tone and level of consciousness while causing the loss of protective airway reflexes.[4] Pulmonary aspiration complicates 1 in every 2-3,000 surgeries and almost half of all patients who aspirate develop a lung injury.[4]

The LMA Unique™ (Teleflex Inc) is a first generation LMA. The manufacturers' instructions indicate its use with either spontaneous or PPV, with or without neuromuscular blockade for fasted patients.[5] The manufacturer also recommends the device should not be used in patient populations who are obese, more than 14 weeks pregnant, with a condition associated with delayed gastric emptying, or using opioid medication before fasting.[5] There are no published reports of long-term morbidity or mortality are associated with the LMA airway after aspiration.[5] Neuromuscular blockade may be used for LMA placement to prevent gagging, coughing, and laryngospasm.[2,6] Neuromuscular blocking agents may also help facilitate PPV with an LMA, especially in airway-irritating procedures such as flexible bronchoscopy, to reduce the chance of laryngospasm.[2] Furthermore, surgeons may request muscle relaxation to improve surgical exposure.[2]

The ventilation modes recommended for LMAs are spontaneous or PPV. Spontaneous ventilation with an LMA allows for opioid administration titrated to the patient's respiratory rate.[2] Spontaneous ventilation also reduces the likelihood of air leaks and gastroesophageal air insufflation and increases the toleration of malposition. PPV with an LMA, however, allows the control of respiratory rate, tidal volume, minute ventilation, and the use of deeper levels of anesthesia with inhalation agents, opioids, and neuromuscular blockade.[2] Pressure-limited ventilation (pressure support or pressure control) is recommended over volume control to prevent gastric insufflation.[2] Peak pressures under 20 cm H_2O further limit gastric insufflation.[2] Second generation LMA designs provide a second seal that allows peak airway pressures of up to 25 cm H_2O and an integrated port that facilitates suction of gastric contents and gastric decompression.[7] To minimize the chance of aspiration, carefully consider the patient and surgical procedure.

Laryngeal mask airway use in indicated for procedures less than 3 hours in duration that do not require prolonged neuromuscular blockade and for patients at low risk of aspiration (no full

stomach, hiatal hernia, small bowel obstruction, gastroparesis, or GERD).[2,5] Maintaining a deep plane of anesthesia to prevent swallowing, removing an LMA at the first sign of rejection during emergence, avoiding too much or too little air in the cuff, minimizing inflation pressure, and using the correct size LMA can further reduce the risk of aspiration.[2,5]

The patient presented in this case study was at high risk for aspiration with an LMA under general anesthesia. He was obese, nauseous preoperatively, had a significant history of stress-related GERD, and the procedure was more than 3 hours requiring prolonged neuromuscular blockade. The literature supports the use of an ETT rather than an LMA. The anesthetic management provided respiratory stability, facilitated successful surgical technique, prevented gastric aspiration, and resulted in an uneventful anesthetic course with rapid recovery.

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Anesthetic Management of Endoscopic Metopic Craniosynostosis Repair

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Keywords: craniosynostosis, metopic, trigonocephaly, pediatric anesthesia, craniectomy

Craniosynostosis is the premature fusion of one or more cranial sutures, affecting one in 2100-2500 live births.[1] Treatment options consist of two surgical approaches: open craniotomy or endoscopic repair. Endoscopic repair is the preferred modality due to reduced anesthetic duration; however, it is less effective after six months of age.[2] Anesthetic considerations include preventing excessive blood loss and intracranial hypertension through the pharmacologic and physiologic manipulation of systemic and cerebral vasodilation and vasoconstriction, antifibrinolytic therapies, and early replacement of significant bleeding.[3] Morbidity and mortality of endoscopic repair is 0.1% but reaches 50% in cases with severe bleeding.[1]

Case Report

A 2-month-old male presented for an endoscopic repair of metopic craniosynostosis under general anesthesia. He weighed 6 kg on the day of surgery, had no significant medical history and no known allergies. Prior to surgery, he underwent computed tomography (CT) evaluation, which confirmed metopic craniosynostosis - premature fusion of the metopic suture. All other cranial structures were unremarkable. The patient had no prior surgical or anesthetic history, and his parents denied a family history of anesthetic complications. A review of systems revealed an upper respiratory infection within the preceding month, which had since resolved. Physical examination showed no deficits; the patient had an unremarkable pediatric airway and his lungs were clear to auscultation.

After entering the operating room, the patient was positioned supine on a prewarmed table, and standard noninvasive monitors were applied, followed by an inhalation induction with sevoflurane 6% and O_2 6 L/min. Peripheral intravenous access was obtained in the dorsum of the left hand, through which propofol 10 mg, fentanyl 5 mcg, and rocuronium 4 mg were administered. Direct laryngoscopy was performed using a Miller 1 blade and the patient was orally intubated with a size 3.5 cuffed endotracheal tube. Auscultation of bilateral breath sounds and end-tidal capnography confirmed tracheal placement. Mechanical ventilation was initiated and general anesthesia was maintained with sevoflurane 1% expired, O_2 4.1 L/min, and air 1.3 L/min. Albuterol 6 puffs (540 mcg) was given via the endotracheal tube due to the recent upper respiratory infection, and dexamethasone 3 mg (0.5 mg/kg) was administered intravenously. A second peripheral intravenous catheter was placed in the left foot, in addition to a 24 gauge arterial catheter in the right radial artery, using sterile technique.

Prior to rotating the operating table 180 degrees, an additional propofol 10 mg and rocuronium 3 mg were administered intravenously and the surgical team prepped and draped the patient. Oxygen flow was adjusted to 1.5 L/min and air to 1.4 L/min, with sevoflurane maintained at 1.6%. The patient's vital signs remained stable. A bolus of tranexamic acid 60 mg (10 mg/kg) was administered over 15 minutes, followed by an infusion of 5 mg/kg/hr, maintained

throughout the case. Before the start of surgery, fentanyl 10 mcg was administered intravenously. Additional fentanyl 5 mcg and morphine 0.2 mg were administered intravenously, following the first surgical incision. Throughout the case, SpO_2 remained >96% and $ETCO_2$ ranged 37-49 mm Hg. Normothermia was maintained with an underbody forced-air warmer blanket and the patient's body temperature was monitored using a nasopharyngeal temperature probe. One hour after the start of surgery, anesthesia staff turnover occurred, and fresh gas flows were adjusted as follows: O_2 0.36 L/min, air 0.48 L/min, and sevoflurane 1.8%. At the end of the procedure, neuromuscular blockade was antagonized by administering sugammadex 15 mg. Acetaminophen 60 mg (10 mg/kg) was also administered intravenously for postoperative analgesia. Sevoflurane and air were discontinued and O_2 flow increased to 10 L/min prior to tracheal extubation, which occurred without complication in the operating room. After emergence, the patient was transferred to the pediatric intensive care unit via crib, using a modified Jackson-Rees circuit with O_2 6 L/min and continuous pulse oximetry monitoring. The estimated blood loss for the procedure was 15 mL, and the total fluid administered was 260 ml (60 ml of normal saline and 200 mL of Lactated Ringers.

Discussion

Craniosynostosis can lead to abnormal skull shape, increased intracranial pressure (ICP), and neurologic dysfunction.[1] The primary surgical goal is to provide the brain space for normal development and achieve satisfactory cosmetic appearance.[1] There are two methods for craniosynostosis repair: endoscopic or open craniotomy.[1] Endoscopic repair is most successful until six months of age due to the increased flexibility of infant cranial bones, and is preferred due to shorter surgical time and less associated blood loss and complications.[4] Possible complications include infections such as meningitis, hyperthermia, hematoma, dural tear, cerebrospinal fluid leakage, and bleeding.[1]

There are six sutures in the infant skull: one metopic, one sagittal, bilateral lambdoids, and bilateral coronals. Craniosynostosis is classified according to the affected suture, whether it be simple (single-suture) or complex, and primary or syndromic.[1] Craniosynostosis is often diagnosed in the first year of life by physical assessment and is rarely life-threatening.[2] The most comprehensive assessment of the condition is three-dimensional CT.[1] Preoperative imaging is essential for both confirming diagnosis and surgical planning, as it can evaluate for the presence of additional anomalies within the cranial vault that would increase the risk of surgical complications.[5]

Skull shape variations depend on which suture(s) are affected. The metopic suture runs between the frontal bones and is typically the first to fuse during normal development.[2] This patient exhibited trigonocephaly secondary to metopic synostosis: a widened back of the head and narrow, pointed forehead resembling a triangle.[1] The impact of craniosynostosis on childhood development depends on whether the condition is simple or complex, and primary or syndromic. Restricted brain growth and increased ICP often lead to mild to moderate impaired cognitive development and learning disabilities.[1]

Planning pediatric neurosurgery involves weighing the risks and benefits of a shorter anesthetic for endoscopic repair at a younger age, compared to a longer anesthetic for an open craniotomy

at an older age.[2] During the first year of life, reducing the total anesthetic time by undergoing endoscopic repair may result in fewer neurocognitive impacts.[2] The preferred anesthetic for this procedure is general endotracheal anesthesia with standard noninvasive monitors and two peripheral intravenous catheters.[4] Arterial lines are routinely used for open craniotomies and should be considered for endoscopic repairs in patients with significant comorbidities.[4] While this patient did not have significant comorbidities, opting for continuous blood pressure monitoring via arterial line allowed improved hemodynamic control. If the repair involves the sagittal or lambdoid sutures, the patient would likely be in a prone position, which carries a higher risk of venous air embolism. For this metopic synostosis repair the patient remained supine.[4]

Pediatric neuroanesthesia involves consideration of the uniquely fragile cerebrovasculature.[3] Hemodynamic status must be closely monitored and mean arterial pressure (MAP) maintained close to baseline to avoid cerebral ischemia from low cerebral perfusion or intraventricular hemorrhage resulting from increased cerebral perfusion pressure.[3] The anesthetic goal most impactful on patient outcomes is maintaining cerebral perfusion without injuring the delicate intracranial vessels.[3] Strategies to prevent increased ICP are to avoid hypercapnia and hypoxemia.[4] In a study measuring regional oxygen saturation and cerebral blood flow velocity of full-term patients under six months old, velocity decreased at MAPs below 45 mm Hg, while oxygen saturation increased until the MAP reached 35 mm Hg; both velocity and oxygen saturation decreased when MAPs fell below 35 mm Hg.[3] The same outcomes were found after a similar study of infants less than three months old, suggesting that a minimum MAP of 35 mm Hg is sufficient to maintain cerebral perfusion and meet the metabolic demand.[3]

Another anesthetic goal for this procedure is to minimize bleeding. In this case, we used tranexamic acid for antifibrinolytic prophylaxis. An alternate strategy is the prophylactic administration of fresh frozen plasma (FFP).[3] However, a prospective trial demonstrated that the improved coagulation values from FFP administration did not improve clinical outcomes.[3] Patients weighing less than six kilograms with syndromic craniosynostosis and/or sagittal suture involvement are at higher risk for blood loss, so packed red blood cells should be immediately available in the operating room for these cases.[4]

Due to this patient's young age and low total body weight, continuous monitoring was prioritized secondary to a high risk of the need for blood transfusion. One unit of packed red blood cells was not available at the start of this case; however, a blood sample was sent to the blood bank for cross-matching after induction, and packed red blood cells arrived in the operating room soon after the start of the case. Additional strategies to minimize cerebral bleeding are permissive hypocapnia and permissive hypotension. This patient remained normocapnic to hypercapnic throughout the case. Although this case had a favorable outcome, it may be prudent to place a higher emphasis on avoiding hypercapnia. Permissive hypotension with a minimum MAP of 35 mm Hg may also be warranted to further reduce blood loss.

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Incivility in the Operating Room: A Student's Experience

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Keywords: Conflict management, conflict resolution, incivility, disruptive behaviors, bullying, communication, operating room

The communication and behavior of operating room (OR) personnel can significantly impact patient outcomes.[1] Communication impaired by incivility or other disruptive behavior (DB) within the OR can precipitate inefficiencies and errors during procedures, increasing the risk of complications like medication errors or postoperative infections. Incivility and DB create a stressful and hostile environment for OR personnel, hinder effective communication, and can compromise patient care.[2] Understanding the effects of incivility and other DB is essential because it emphasizes the significance of fostering a respectful and supportive culture in the OR to enhance communication, staff morale, and ultimately improve patient outcomes.

Case Report

A student registered nurse anesthetist (SRNA) entered the OR to begin preparing for the cases of the day. The SRNA said good morning to the surgical technologist (ST) and introduced herself as a student in a friendly manner. The ST acknowledged the introduction with a disgruntled sigh and did not introduce herself. As the ST walked out of the room, she verbally complained to herself, "I didn't know there was going to be a student in here today. I don't like that." Hearing this remark, the SRNA explained, "Yes, I'll be working in this room today."

After the remainder of the case set up was completed in silence, the first patient was brought to the OR. The SRNA performed the induction sequence and secured the patient's airway with an endotracheal tube (ETT) without difficulty. As the ST began to perform the skin preparation for the procedure, she looked past the SRNA and spoke to the precepting certified registered nurse anesthetist (CRNA) saying in an annoyed tone, "This ETT can't be on this side, I need you to move it." While the SRNA immediately moved to adjust the ETT into an appropriate position for the procedure, the CRNA responded to the ST, "She [the SRNA] can fix it for you. She is

performing the anesthesia care for this patient." In response to the CRNA, the ST stated, "That's fine, but I'll only be communicating with you." The CRNA responded, "Okay, but you can communicate with her. She is capable of providing care to this patient and fixing the ETT how you want it." Again, the ST said in a louder, more aggressive tone, "That's fine, but I will only be speaking to you. I'm not communicating with her." At this point, the SRNA had moved the ETT and asked the ST, "Is this a better position?" The ST did not acknowledge the SRNA's question.

Minutes later, the ST began to apply drapes to the patient and in the process clamped a drape to the O_2 supply connected to the anesthesia machine. Noticing this as a patient safety issue but not feeling confident to mention this to the ST due to the history of interactions that morning, the SRNA notified the CRNA. When the CRNA mentioned this issue to the ST and suggested alternatives for hanging the drape, the ST argued that the clamp on the O_2 tubing was not an issue, repetitively interrupted the CRNA's attempts to explain the rationale of why it was an issue, and refused to listen to alternative suggestions or accept aid from the SRNA who attempted to offer tape to hang the drape. After a few minutes of arguing, the circulator nurse hung the drape using tape. No harm came to the patient in this scenario and the remainder of the case was performed without the CRNA or SRNA speaking with the ST. In debriefing with the CRNA after this experience, the SRNA asked if she did something wrong or said something that may have offended the ST, to which the CRNA indicated that this is a chronic behavior directed towards almost all students and new staff members.

Discussion

Disruptive behavior can be described as an action between people that is viewed as intimidating or harmful by those who witness it and goes against the generally accepted expectation of courteous conduct.[3,4] Causes of DB include 3 categories of factors: intrapersonal (e.g., personality traits, psychological conditions), interpersonal (e.g., communications between people, perception of status, hierarchy), and institutional (e.g., mismanagement, stressful environment, workplace inefficiencies).[1,3] The OR is a high-stress environment that requires working quickly while collaborating with clinicians from various personal, cultural, and educational backgrounds, making it an area where the risk of DB is high.[5,6]

The type of DB that predominated in this clinical scenario was incivility. Incivility encompasses a spectrum of behaviors, spanning from minor acts of impoliteness and subversive conduct to explicit forms of bullying.[2] Patients, OR staff, students, and institutions are ultimately harmed by incivility and other types of DB through a variety of mechanisms such as communication failures, increased stress, a decline of clinical performance, decreased confidence, clinician burnout, increased staff turnover, and increased cost.[1,2,7] In the case presented, open and effective communication suffered as the ST was unwilling to communicate with a member of the surgical team. The ST was also unwilling to listen to solutions offered by the CRNA to safely hang the surgical drapes. The incivility that was portrayed through the words and actions of the ST unnecessarily increased stress for the SRNA and CRNA during this surgical procedure, distracting them from patient care which could have resulted in harm to the patient. The SRNA experienced decreased confidence in communicating with the surgical team during this procedure. This decreased confidence in communication could not only affect the care of the

patient in this case, but also potentially affect future patients as the SRNA may be hesitant to communicate with the OR team to avoid further uncivil treatment.

Effective communication between surgical team members is essential for quality patient care and the prevention of poor outcomes.[7] The Joint Commission (TJC) notes that failures in communication and teamwork are among the leading causes of sentinel events.[8] Commonly, clinicians respond to DB with passive, manipulative, or malicious responses, therefore undermining effective communication and patient care.[1] Clinicians may also choose to delay or avoid communication altogether to avoid further mistreatment.[3] This can result in further distance developing between team members, reducing trust and hindering pertinent information from being shared during the care of the patient.[3]

Counterproductive responses to DB may be due in part to the lack of education in healthcare providers on conflict management and effective communication. A study on conflict strategies of OR nurses found that participants who had prior conflict management training were more likely to use effective communication strategies when managing interpersonal conflicts.[6] In the presented case, the SRNA and CRNA had received formal education on effectively communicating and managing conflict and were able to keep the situation from escalating while caring for the patient effectively. Had they chosen to be avoidant or passive in communicating their concerns pertaining to the clamped O_2 supply with the ST, the patient may have been harmed because of their communication failure due to a potential decrease in inspired O_2 during surgery leading to hypoxia and potentially hypoxic brain injury. In addition to the devastating harm that may have come to the patient, damage to the O_2 apparatus would incur unnecessary cost to the hospital.

A lesson gleaned from the research about the issue of DB in the OR is that organizational culture and avoidance of addressing DB can lead to normalizing DB, also called normalized deviance.[3,7] Tolerance of low-level DB paves the way for more serious DB to occur.[7] In the presented case, the culture in the OR relating to this ST is that of avoiding confrontation rather than addressing the regular occurrences of DB. Through debriefing this situation with the CRNA involved in the case, it is evident that the chronic avoidance of addressing DB has led to normalized deviance in the OR. This highlights the importance of organizations and hospital facilities having clear policies and protocols in place for identifying, reporting, and providing interventions to address DB so that normalized deviance does not develop in the workplace.[7] Because of the rampant occurrences of DB within healthcare, TJC implemented a policy for hospital organizations to confront and eliminate disruptive behaviors that jeopardize the performance of healthcare professionals and patient care at every level of the organization.[5] The American Association of Nurse Anesthetists mandates that CRNAs prioritize patient safety and promote collaborative team models to achieve organizational success.[5] Therefore, eradicating a culture where disruptive behaviors are ignored is crucial for maintaining a united, cooperative team approach to patient care.[5]

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Perioperative use of Sodium-Glucose Co-Transporter 2 Inhibitors

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Keywords: sodium-glucose co-transporter 2 inhibitors, SGLT2 inhibitors, euglycemic diabetic ketoacidosis, euglycemic DKA, Dapagliflozin, type II diabetes mellitus

Type II diabetes is the most common form of diabetes mellitus (DM) and is characterized by relative insulin deficiency as well as insulin resistance.[1] Due to the high rate of chronic systemic complications associated with this disease, it is estimated that 25% of patients with type II DM will require a surgical intervention in their lifetime.[1] Sodium-glucose co-transporter 2 inhibitors (SGLT2i) are a second-line oral agent being increasingly prescribed for type II DM when monotherapy has failed.[1] This case study will explore the reasons for canceling a urologic procedure due to continued use of SGLT2i 24 hours prior to surgery.

Case Report

A 65-year-old, 98 kg, 157 cm female presented for cystoscopy with left ureteroscopy, laser lithotripsy, and basket stone extraction. Her past medical history was significant for coronary artery disease, fatty liver disease, cholelithiasis, hyperlipidemia, hypertension, congestive heart failure, obesity, anxiety, diabetes mellitus type II, non-ST-elevation myocardial infarction

(NSTEMI), and renal artery stenosis. Her medication history included amlodipine, aspirin, nadolol, dapagliflozin, dulaglutide, ezetimibe, losartan, naproxen, and pravastatin. Her past surgical history included cardiac catheterization with stent placement, a coronary artery bypass graft, a previous cystoscopy with lithotripsy, and a bare metal stent placement to the right renal artery.

During the pre-operative assessment, it was noted that the patient had not been instructed to hold any medications the day of surgery. After further review of the listed medications, it was confirmed with the patient that she had continued her dapagliflozin up until 24 hours prior to her procedure. The procedure was put on hold pending a conversation between the surgical, anesthesia, and endocrine teams. After consulting with the endocrine service, it was determined that due to the risk of euglycemic diabetic ketoacidosis (eDKA) that continuing SGLT2i into the perioperative period carried, the case should be canceled and rescheduled so the patient could observe the 72-hour hold time for this medication. The patient was counseled on the need to reschedule her procedure and hold her dapagliflozin for 72 hours prior to her new surgery date. She was scheduled for an appointment to follow up with endocrinology one week prior to her new surgical date to come up with a plan to manage her diabetes during the 72 hours that she would be holding her dapagliflozin.

The patient returned 3 weeks later for her scheduled urologic procedure, status post holding her dapagliflozin for 72 hours. To manage her type II DM during the 72-hour hold of her SGLT2i, the endocrine service increased her weekly dulaglutide dosing. On the day of surgery, the patient was scheduled as the first case of the day and received her scheduled urologic procedure with no complications. She was then transferred to the post anesthesia recovery room and discharged to home 2 hours later with a point of care fingerstick glucose of 110 mg/dL. She followed up with endocrinology the next day where her dulaglutide dosing was decreased, and she was restarted on her daily dapagliflozin dosing.

Discussion

The Federal Drug Agency (FDA) first approved SGLT2 inhibitors in 2013 for the 2nd line treatment of type II diabetes.[2] These medications target the SGLT2 receptor located in the proximal convoluted tubule (PCT) in the nephron of the kidney and prevent(s) the reabsorption of glucose and sodium back into systemic circulation.[2] By preventing this reabsorption, they induce glucosuria, or the loss of glucose in the urine. Several clinical trials have shown that this class of medications significantly reduces hemoglobin A1C levels, fasting plasma glucose levels, bodyweight, and lowers both systolic and diastolic blood pressure.[2] However, the effects of this medication class have also shown marked reductions in the mortality and morbidity associated with cardiovascular and renal complications among type II diabetics.[1] These accompanying benefits outside of glucose management may help to explain the increasing rates of prescriptions of SGLT2i.

Over 63 million SGLT2i prescriptions were dispensed between January of 2015 and December of 2020.[2] This reflects an increase in prescription rates of 86% among primary care physicians and more than a 500% increase in prescription rates from cardiologists.[2] With 25% of patients with type II diabetes expected to require surgery in their lifetime[1] and the increase in prescription

rates of SGLT2i, it is reasonable to expect anesthesia professionals to encounter these medications frequently in their practice.

In March of 2020, the FDA adjusted the previous 24 hour recommended perioperative hold time of SGLT2i to 72 hours for dapagliflozin, canagliflozin, and empagliflozin, and 96 hours for ertugliflozin.[3] These recommendations were made following an increase in reported cases of eDKA among patients prescribed SGLT2i. According to the FDA Adverse Event Reporting System, patients who are on SGLT2i have a seven-fold higher risk than their counterparts prescribed alternative oral hyperglycemic medications of developing eDKA.[4] Not only is the risk of developing eDKA higher among these patients, but the mortality associated with eDKA in the presence of SGLT2i use has the highest mortality rate of all DKA diagnoses.[4]

Euglycemic diabetic ketoacidosis has most of the same diagnostic criteria as hyperglycemic DKA. It is characterized by ketoacidosis (pH < 7.30 and bicarbonate level $\leq$ 18 mEq/L) in the presence of a near-normal plasma glucose or mild hyperglycemia of $\leq$ 250 mg/dL.[5] The mechanism by which eDKA develops in the presence of SGLT2i is related to the relative insulinopenia, or low insulin levels, that occurs from glucosuria.[4] When the SGLT2 receptor is inhibited and glucose is lost in the urine, the decreased serum glucose levels result in a fall in insulin levels. In response to low glucose levels glucagon is released in the pancreas, further suppressing insulin release.[4] The increased insulin to glucagon ratio leads to lipolysis, breaking down adipose tissue into free fatty acids which are then oxidized in the liver to ketoacids.[4] The resultant accumulation of ketoacids leads to ketosis, while the continued loss of glucose in the urine from the SGLT2 inhibition maintains a relative serum euglycemia.[4] When this mechanism is placed in the setting of prolonged fasting and increased stress hormones, as seen in the perioperative period, there is a further suppression of insulin which may exacerbate the production of ketoacids.[4]

The diagnosis of eDKA can be difficult to make in the perioperative setting. Common symptoms of DKA such as confusion, tachycardia, dyspnea, hyperventilation, fatigue, nausea, and vomiting[5] can be masked by anesthesia or thought of as post-anesthetic complications. Definitive lab work that can help make the diagnosis would include arterial or venous blood gases showing a pH of < 7.30 and a bicarbonate of $\leq$ 18 mEq/L as well as urine and serum ketone studies showing elevated ketones.[4] Blood glucose levels will be of little diagnostic value if euglycemic DKA is present.

Treatment of eDKA is almost identical to hyperglycemic DKA and begins with fluid resuscitation with crystalloids.[5] This is especially important in the presence of SGLT2i due to the osmotic diuresis that is seen related to the mechanism of glucosuria. Following fluid replacement, a continuous insulin infusion is indicated as well as a dextrose infusion to maintain serum glucose levels while correcting the acidosis.[5] During this time frequent electrolyte monitoring is required to ensure potassium levels do not drop dangerously low from intracellular shifting.[5] Additionally, frequent blood glucose monitoring is also important to ensure hypoglycemia does not occur, since these patients are euglycemic when insulin therapy is initiated.

Through careful consideration of the benefits and risks associated with proceeding with this elective urologic procedure, it was decided that the safest option for the patient would be to reschedule the procedure. Continued dapagliflozin use within 72 hours of surgery, combined with an extended fasting period and the patient's history of type II DM, increases the risk of developing eDKA and ultimately patient mortality during the intra- and post-operative periods. By being cognizant of updated FDA recommendations and current research regarding SGLT2i medications, we as anesthesia providers can continue to provide safe, evidence-based care to our patients.

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The Opioid Allergic Patient and Use of Opioid-Free Anesthesia

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Keywords: Opioid allergy, opioid-free anesthesia, opioid-free analgesia, multimodal analgesia

Allergic reactions to opioid medications are a common complaint cited by patients; however, actual hypersensitivity reactions such as anaphylaxis are rare, occurring in less than two percent of patients.[1] During surgery, opioids are utilized intraoperatively and postoperatively to maintain anesthesia and analgesia. When a patient endorses an opioid allergy, anesthesia practitioners should develop a collaborative anesthetic plan in alignment with the practice consideration listed by the AANA American Association of Nurse Anesthesiology for opioid-tolerant patients.[2]

Case Report

A 44-year-old, 78 kg, 163 cm female presented for a robotic-assisted hysterectomy and bilateral salpingectomy indicated for menstrual cycle irregularities, uterine bleeding, and findings of uterine fibroids on diagnostic imaging. Additional medical history included asthma, anxiety, depression, hypertension, gastroesophageal reflux, migraines, and irritable bowel syndrome. Her prior surgical history included wisdom teeth extraction as a teenager and a cholecystectomy at 33 years old. Medications taken included clonazepam, duloxetine, fexofenadine, furosemide, gabapentin, and omeprazole. During her preoperative interview, the patient shared a history of IgE-mediated reactions to meperidine, fentanyl, hydromorphone, and morphine. After her cholecystectomy, the patient reported angioma edema and prolonged intubation secondary to bronchospasm with a subsequent positive opioid provocation. The surgical and anesthetic practitioners initiated a collaborative discussion, and the decision was made to proceed with an opioid-free anesthetic plan of care.

Preoperatively, the patient was given acetaminophen 650 mg and gabapentin 600 mg by mouth and midazolam 2 mg intravenously (IV). Upon arrival to the operating room, she self-transferred onto the operating table and was positioned supine ensuring comfort. All standard monitors were applied. Dexmedetomidine 10 mcg was administered, and general anesthesia was induced with lidocaine 80 mg, propofol 120 mg, ketamine 20 mg and rocuronium 50 mg IV. After easy bag-mask ventilation, tracheal intubation with a 7.5mm oral ETT was achieved and confirmed by auscultation and waveform capnography. Mechanical ventilation was initiated with pressure control ventilation at a respiratory rate of 12/min, a peak inspiratory pressure of 20 cm H_2O, and a peak end expiratory pressure of 6 cm H_2O.

Anesthesia and analgesia were maintained using sevoflurane 2% inspired concentration in O_2 1 L/min and air 1 L/min, dexmedetomidine 0.5 mcg/kg/hr, and propofol 20 mcg/kg/min. The patient was given dexamethasone 8 mg IV before surgical incision and an additional ketamine 20 mg IV throughout the maintenance phase. All vital signs remained within 20% of their preoperative baseline.

Thirty minutes before extubation, ondansetron 4 mg and ketamine 10 mg IV were given. Residual neuromuscular blockade was antagonized with sugammadex 200 mg IV, and sevoflurane administration was discontinued. Spontaneous respirations were achieved, and the patient was extubated without issue and transitioned to O_2 6 L/min via face mask. Following extubation, the patient was transferred to the post-anesthesia recovery room. She endorsed a postoperative pain score of 4 on a 10-point numeric rating scale and subjectively reported feeling "comfortable." Total surgical length was approximately 122 minutes. After an uneventful hospital course, the patient was discharged the following day.

Discussion

Opioid medications can contribute to effective pain relief; therefore, they are commonly utilized in the operating room by anesthetic practitioners to promote analgesia as part of the overall anesthetic plan.[3] However, opioids can contribute to adverse perioperative events such as opioid use disorder, addiction, untoward side effects, or allergic reactions. Most patients' declared

allergies prove to be intolerances to known side effects. However, a rare patient population presents with genuine opioid-induced hypersensitivity reactions, such as anaphylaxis.[1] Because of true allergies, patient desire, or provider concerns for opioid administration, anesthetic practitioners must be knowledgeable about the practice of achieving appropriate levels of surgical analgesia via the use of opioid-sparing multimodal strategies.

Less than 2% of patients present with a genuine opioid allergy. The gold standard for an opioid IgE-mediated hypersensitivity reaction diagnosis is an opioid drug provocation test (DPT).[1] Because the patient endorsed a positive DPT with severe reactions of bronchospasm and angioedema and requested opioid-free anesthesia, the use of opioids was avoided in this case.

Various protocols and methods for achieving opioid-free anesthesia have been devised.[3,4] Recent metanalyses and systematic reviews have demonstrated strong evidence that opioid-free anesthesia promotes intraoperative and postoperative analgesia like those of opioid-inclusive anesthesia.[5,6] While strategies do differ, the vast majority of opioid-free anesthesia plans are multimodal and focus on two key perioperative phases: preoperative and intraoperative. Preoperative medications are preventative, and intraoperative analgesics are given in response to acute events to maintain hemodynamic stability and analgesia.

Most preoperative medication strategies focus on preventing spinal cord neurons from reaching a state of hyperexcitability, preventing transmission and propagation of pain pathway signals to the brain. This promotes pain control not only in the intraoperative period, but postoperatively as well.[7] Two preoperative analgesic drugs were selected for use in this case: acetaminophen and gabapentin. Acetaminophen promotes analgesia through various anti-inflammatory actions and cyclooxygenase enzyme inhibition.[8] While IV formulations may potentially produce improved analgesia with a faster onset, institutional availability precluded its use in this case.[8] Gabapentin, although most often seen in the treatment of neuropathic pain, has been used in the perioperative setting to promote lower pain scores and reduce overall postoperative opioid-consumption following surgery.[8] Ultimately, the decision to utilize acetaminophen and gabapentin was appropriate for this patient given their commonality of use within various evidence-based multimodal opioid-free protocols.[3,8]

Within the literature, a wide variety of opioid-free analgesic combinations are presented. The most common drugs for non-opioid perioperative analgesia are ketamine and dexmedetomidine.[5,6] Ketamine is an NMDA receptor antagonist used in sub-anesthetic doses to confer profound analgesic properties.[7] Because ketamine demonstrates a half-life of two to three hours, the decision was made to use boluses instead of a continuous infusion, as is sometimes seen.[8] Additionally, to mitigate any psychomimetic or dissociative effects, the patient was given midazolam 2 mg IV and the total dose of ketamine was kept to 50 mg IV. Dexmedetomidine is an alpha-2 adrenergic receptor agonist and is believed to promote analgesia through a reduction in central nervous system stimulation and decreased firing of nociceptive neurons.[7] The 10 mcg initial IV bolus, followed by the infusion of 0.5 mcg/kg/hr, is consistent with current recommendations demonstrating dexmedetomidine as an effective sole analgesic when utilized in laparoscopic surgeries.[8]

Upon review, the anesthetic management employed in this case was successful as evidenced by its uneventful course and the patient's subjective statements of postoperative comfort. In retrospect, the opioid-free anesthetic plan could have been improved by the addition of other adjuncts often cited within the literature, such as a magnesium bolus or lidocaine infusion.[5,6] It should be noted that while regional anesthetic techniques were initially considered, both the surgeon and the patient rejected their inclusion within the anesthetic plan. Intravenous ketorolac was withheld due to reactive airway concerns. By using non-opioid analgesics, the anesthesia clinicians were able to avoid opioids and satisfy the patient's request. Practitioners should familiarize themselves with modalities that allow for the elimination of opioids from the anesthetic plan should similar instances arise in future practice.

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Modified Blalock-Taussig Shunt and Postoperative Acute Shunt Occlusion

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Keywords: Modified Blalock-Taussig shunt, tricuspid atresia, single ventricle, hypoxemia, acidosis, cardiac catheterization laboratory

A Modified Blalock-Taussig shunt (MBTS) is a palliative intervention for neonates with congenital heart disease (CHD) who suffer poor oxygenation.[1] Tricuspid atresia is the failure of the tricuspid valve to develop, creating a single ventricle physiology, and ductal dependent blood flow.[2] A MBTS is a graft which connects a branch of the aorta and the pulmonary artery. It improves blood flow to the lungs thus improving oxygenation.[2] This case study will explore a MBTS occlusion in the immediate postoperative period and subsequent successful MBTS stenting.

Case Report

A 5-day old, 3.67 kg, 44 cm male presented for a MBTS and pulmonary artery reconstruction due to tricuspid atresia. Past medical history included Noonan's syndrome and congenital heart disease with an echocardiography report of tricuspid valve atresia, pulmonary valve atresia, severe hypoplasia of the right ventricle, discontinuous pulmonary arteries, large atrial communication with a shunt of right to left flow, and a torturous patent ductus arteriosus. The patient was in the cardiac intensive care unit (CICU), receiving prostaglandin E1, total parenteral nutrition, intralipids, and hypotonic saline with dextrose. He was receiving O_2 at 4 L/min via a nasal cannula. His vascular access consisted of an umbilical cord arterial and venous central line, and a 24-gauge peripheral intravenous catheter. Physical examination was positive for a short thick webbed neck, large protruding forehead, and micrognathia consistent with Noonan's syndrome.

In the operating room, standard and invasive monitoring continued. An inhalation induction was initiated via anesthesia facemask with O_2 6 L/min and sevoflurane at 6% inspired concentration. Additional adjunct intravenous (IV) medications, ketamine 7 mg, glycopyrrolate 40 mcg, and fentanyl 37 mcg was administered. Vecuronium 0.7 mg IV administered after successful mask ventilation was demonstrated. A nasal tracheal intubation with a 3.0 cuffed ETT was successfully performed using a #1 straight CMAC video laryngoscopy blade (Karl Storz Endoscopy-America Inc.). Mechanical ventilation was initiated, and general anesthesia was maintained with sevoflurane 4% inspired concentration in a mixture of air 0.6 L/min and O_2 0.4 L/min. A post-intubation and mechanical ventilation, arterial blood gas (ABG) was completed revealing the following results: pH 7.382, $PaCO_2$ 44.5 mmHg, PaO_2 45 mmHg, base excess (BE) 1, HCO_3 26.4 mEq/L, SaO_2 80%.

Surgery proceeded uneventfully. Upon completion and chest closure, a post-surgery ABG revealed the following results: pH 7.370, $PaCO_2$ 50.2 mmHg, PaO_2 23 mmHg, BE 3, HCO_3 29, SaO_2 36%. Mechanical ventilator settings were changed to O_2 10 L/min, TV 50 and RR 25,

while the surgeon reopened the chest to verify the anastomosis integrity, which was secure and appeared patent. Inhaled Nitric Oxide (iNO) was added to the ventilatory circuit, and a larger size 3.5 uncuffed nasotracheal tube was placed and then verified under radiograph in hopes of improving oxygenation. Phenylephrine was titrated to maintain stable hemodynamics while blood products were transfused. A decision was made to quickly transfer the patient back to the CICU and a Mapleson D circuit was used to maintain ventilation and decrease rebreathing of CO_2 during transport. A repeat ABG in the CICU showed little improvement: pH 7.425, $PaCO_2$ 47.3 mmHg, PaO_2 30 mmHg, BE 5, HCO_3 31.1, SaO_2 57%.

Shortly after arriving to the CICU, it was determined that the patient should immediately go to the cardiac catheterization laboratory (CCL) to assess the patency of the MBTS. Once in the CCL angiogram revealed that the MBTS had almost completely occluded with very little flow traversing the shunt. Two stents were placed via the femoral access the interventionalist achieved, into the MBTS with notable improvement of oxygenation status. The final post stent ABG showed the following results: pH 7.54, $PaCO_2$ 31.4 mmHg, PaO_2 55 mmHg, BE 4, HCO_3 28.2, SaO_2 88%. After revascularization, the patient remained hemodynamically stable and was transferred back to the CICU with no further adverse events.

Discussion

Tricuspid atresia completely separates the right atrium from the right ventricle.[2] In this specific pathophysiology, the hypoplastic right ventricle is isolated from the remaining pathways of the heart, being completely obstructed from circulation and creating a single ventricle physiology, the left ventricle.[2] In addition, there was a large atrial communication flowing from right to left which combines deoxygenated and oxygenated blood in the left heart. A patent ductus arteriosus (PDA) is crucial as it is the only supplier for delivering mixed blood to the lungs.[2] A PDA can be maintained for short periods of time with a specific infusion of prostaglandin, but a long-term surgical solution is required to sustain life.[2] A surgical intervention with MBTS is necessary to continue delivering blood to the lungs over a sustained period when the PDA closes.[2]

At baseline, the patient experienced a large amount of blood shunting from the right to the left side of the heart due to the tricuspid atresia and large atrial septal defect. To assist with cardiopulmonary stability, it was important for anesthesia to optimize the shunt's flow until the MBTS could be completed by maintaining balance between systemic vascular resistance (SVR) and pulmonary vascular resistance (PVR).[2] Factors that favor right to left shunting include increased PVR, increased right ventricular outflow tract obstruction, and decreased SVR.[2]

After the MBTS is placed, there are two postoperative problems that are commonly encountered, over-shunting and under-shunting.[1] Over-shunting refers to an increase in blood passing through the MBTS causing fluid overload and respiratory complications. In the presence of over-shunting, it is important to decrease SVR and to avoid pulmonary vasodilators in order to prevent worsening pulmonary edema.[1] Systemic vasodilators like sodium nitroprusside and alpha blockers may be used to decrease SVR in over-shunting.[1] The complication encountered in this particular case was under-shunting caused by an occlusion which resulted in a decreased blood flow passing through the MBTS.[1] The anesthetic management for under-shunting are to increase SVR and decrease the PVR which both aid in increasing flow to the lungs while also maintaining systemic tone.[1] Measures to increase SVR include the use of vasopressors like phenylephrine

which was used during this case. PVR may be decreased with the use of medications like iNO which was also added during this postoperative course.[1] The anesthetic managements goals of under-shunting are only temporary at best as surgical intervention is necessary for the revascularization of the MBTS, which was the outcome for this patient.[1]

An early or late MBTS occlusion post operatively is life threatening and only occurs in approximately 10% of cases.[3] This can be caused by various events such as thrombosis or kinking which are extremely detrimental and require immediate intervention.[3] The most common sign of acute occlusion is profound hypoxemia due to the absence of pulmonary blood flow which can lead to hemodynamic compromise and cardiac arrest.[4] MBTS occlusion in immediate postoperative period is typically caused by an acute thrombosis which obstructs the shunt lumen and occurs approximately 20 percent of all occlusions. [3,4] It has been repeatedly demonstrated that percutaneous intervention is a safe and effective method for saving a blocked MBTS.[3]

This patient demonstrated a typical presentation of an acute MBTS occlusion including severe hypoxemia, acidosis, hypotension, shock, and all was resistant to medical management.[3] Rapid recognition is critical to managing this lethal post operative complication as measures are only supportive until blood flow can be restored via revascularization. Immediate adjustments to mechanical ventilation, FIO_2, and hemodynamic support should all be considered necessary albeit temporary, until surgical correction is established. iNO should also be considered as a pulmonary vasodilator to decrease pulmonary vascular resistance and support any remaining pulmonary blood flow across the shunt.[5]

A MBTS is a life prolonging surgical correction to deliver adequate blood flow to the lungs when neonates have a congenital heart disease which prevents sufficient blood from entering the pulmonary vasculature.[1] Emergency surgical intervention is immediately necessary to restore pulmonary blood flow if the MBTS occludes post operatively.[3] Percutaneous intervention has been demonstrated to be an effective solution to this occurrence and will return the neonate to hemodynamic stability.[3]

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Awake Deep Brain Stimulation Insertion in a Spanish-Speaking Patient

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Keywords: Deep brain stimulation, anesthesia, Parkinson's disease, disparities

Deep brain stimulation (DBS) is an effective surgical treatment of Parkinson's disease (PD) that helps manage chronic motor symptoms to improve PD patients' quality of life.[1] The treatment involves implanting electrodes into specific brain regions while using microelectrode recordings (MER) of the brain that require the patient's full cooperation to make necessary adjustments in lead location.[2] An awake DBS procedure poses significant challenges for the anesthesia provider and the patient. This case report describes DBS surgery in a Spanish speaking PD patient under minimal sedation with conscious cooperation, with an anethesia provider fluent in Spanish.

Case Report

A 48-year-old, 62 kg male patient with a 7-year history of progressive Parkinson's disease presented for bilateral awake MER-guided subthalamic nucleus (STN) DBS lead placement. His symptoms included worsening left-sided rigidity, bradykinesia, and resting tremor. He had been taking sinemet and trihexyphenidyl for his motor symptoms but had developed severe fluctuations and dyskinesias that impaired his gait, speech, and sleep. His physical examination revealed a conversant tremulous voice, bradykinesia, increased tone greater on his left limbs, and resting tremor in both upper limbs. He had no other significant medical history or allergies. His preoperative laboratory tests were within normal limits.

The patient stopped taking his antiparkinsonian medications 12 hours prior to the morning of surgery. His symptoms significantly worsened, and he had severe location pain (visual analog scale 9/10), which made him doubt whether he could tolerate the procedure awake. After thoroughly discussing expectations for each part of the procedure in his native language, Spanish, the patient agreed to proceed as planned with minimal sedation and an anesthesia provider fluent in Spanish. A peripheral intravenous line was inserted.

The patient was brought to the operating room, seated in a wheelchair. Basic standard anesthetic monitors were applied and he was premedicated with fentanyl 100 mcg and propofol 50 mg to facilitate local anesthesia injection by the surgical team. The airway was not manipulated, and oxygen via nasal cannula was applied. A stereotactic frame was used for DBS electrode placement, which required placing four pins. Local anesthetic was strategically injected by the surgeon for a scalp block. The patient was then moved into the computed tomography (CT)

scanner to identify the subthalamic nucleus. At one point during the CT scan, the machine stopped taking images, delaying the procedure, and further increasing the patient's anxiety and tremors. By engaging in purposeful inquiry in Spanish, we uncovered relevant details about the patient's experiences and concerns, which played a crucial role in reassuring him until the scanner resumed functioning. To mitigate the tremors, which were impeding image quality, additional doses of fentanyl (50 mcg) and propofol (40 mg) were administered to the patient.

After obtaining appropriate CT images, the patient was positioned on the operating table with his head fixed in the frame attached to the ROSA ONE (Zimmer Biomet) robot holder. Calm communication with the patient in his native Spanish along with midazolam 0.5 mg, fentanyl 25 mcg, and propofol 30 mg were used during the initial phase of surgery, which involved scalp incision, drilling two burr holes in the skull, opening the dura, and inserting microelectrodes at the STN. The optimal location of the electrodes was determined by awake intraoperative stimulation testing of the patient's motor response and relief of symptoms. When the sedation effects diminished, he expressed neck discomfort and nausea, which were effectively treated with acetaminophen 1 g and ondansetron 4 mg. The intraoperative testing lasted 180 minutes, and the patient showed a significant reduction of tremors and improvement in tone.

During closure and removal, the patient became hypertensive (150/90). Esmolol 50 mg and a temporary low dose clevidipine infusion at 2 mg/hr were initiated. He was transferred to the post-anesthesia care unit (PACU) awake, orientated, and with minimal postoperative pain. His postoperative course was uneventful, and he was discharged two days later. After the DBS activation, he reported reduced motor symptoms, improved tone, sleep, and overall quality of life.

Discussion

DBS is a well-established surgical treatment for many patients with advanced'PD who have insufficient symptom control with medications alone.[3] According to the Parkinson's Foundation, about one million people in the United States live with PD.[4] Of this group, 4% have developed symptoms under the age of 50.[4] Young-onset PD (YOPD) often occurs in patients with a familial history of PD causing earlier and more frequent dyskinesias and dystonia, making these patients ideal candidates for DBS.[4] Additional demographics from the Parkinson's Foundation patient database reveal that 6.5% of PD patients are Hispanic or Latino.[4]

The anesthetic management for DBS surgery ranges from conscious sedation utilizing propofol and dexmedetomidine to general anesthesia with endotracheal intubation. The techniques most commonly used for conscious sedation include asleep-awake-asleep (AAA) and scalp block with light sedation.[2,5] An AAA anesthetic plan involves discontinuing general anesthesia before MER testing.

Sedation management for awake DBS surgery utilizes local anesthesia and short-acting sedatives to keep the patient responsive throughout the procedure. The awake technique allows the patient to provide verbal feedback regarding symptoms and the appearance of side effects from the testing.[5] This technique excludes patients who will not tolerate the procedure due to disabling

off-medication symptoms or medical comorbidities, such as obstructive sleep apnea, claustrophobia, or uncontrolled hypertension.[6]

The multidisciplinary team made the choice of anesthesia for this patient after considering the patient's primary language, age, low BMI, general condition, procedure length, and preferences. The patient agreed to an awake anesthetic as long as he could easily communicate in Spanish with a bilingual anesthesia provider throughout the procedure. Appropriate anesthetic agents were chosen for this patient to achieve anxiolysis without over-sedation and provide pain relief without affecting neurocognitive testing and his ability to cooperate. Research suggests avoiding the use of benzodiazepines for anxiolysis as they can cause oversedation in PD patients.[5] Our patient was given a single small dose of midazolam while waiting for the CT scanner to be reactivated, and it did not impair his clarity for testing.

A scalp block administered by the surgeon was essential to the patient's comfort and allowed for minimal opioid and sedative requirements. The discomfort the patient experienced was related to his "off" symptoms from not taking antiparkinsonian medications. To help relieve some of the symptoms, he was given propofol and fentanyl, with good analgesic effect. Given the neurodegenerative disease, PD patients often need a lower-than-average propofol dose.[5] Dexmedetomidine is an analgesic alternative as it preserves movement disorder symptoms and respiratory drive, but it was avoided in this patient due to risks of bradycardia.

Toward the end of the procedure, the patient felt nauseated and was hypertensive. Ondansetron was administered and alleviated his nausea. Metoclopramide and haloperidol were avoided as they block dopamine receptors and can cause extrapyramidal side effects that could interfere with DBS assessments.[5] An essential consideration for DBS surgery is maintaining systolic blood pressure parameters below 140 to decrease the risk of intracranial hemorrhage.[5] To achieve parameters the patient was treated with bolus doses of a short-acting beta-blocker and a calcium channel blocker infusion. Beta-blockers are sometimes avoided as they can mask or complicate intraoperative tremor testing.[5] The patients' tremors were not impacted by administering esmolol.

This case describes a successful six-hour awake DBS surgery despite obstacles such as equipment malfunction and a patient whose primary language is not English. Recent literature suggests the asleep DBS technique has similar outcomes to awake DBS, with increased patient comfort, shorter procedure times, and no requirement to stop dopaminergic medications.[7] Having an anesthesia provider who could speak with the patient in Spanish, fluently, facilitated seamless communication during this procedure and made the awake technique the safest, ideal anesthetic plan. As DBS for PD patients becomes more accessible and access for ethnically diverse patients increases, language communication barriers will be an essential consideration for anesthetic techniques.

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Case Study of a Laboring Parturient with Mast Cell Activation Syndrome

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Keywords: Anesthesia, pregnancy, mast cell activation syndrome, mast cell, mast cell activation disease, mastocytosis

Mast cell activation syndrome (MCAS) is a rare and chronic disorder characterized by a vast array of cardiovascular, pulmonary, endocrine, hematologic, integumentary, and gastrointestinal symptoms.[1-7] The syndrome occurs due to the binding of immunoglobulin E (IgE) mediators to antigen receptors, which initiate abnormal mast cell proliferation and degranulation releasing over 200 inflammatory mediators.[1] This leads to anaphylactic or anaphylactoid reactions.[1] Mediator release is triggered by a multitude of mechanisms including stress, trauma, abnormal environments, and pharmacological agents.[4] While studies are scarce regarding MCAS during pregnancy, research in other areas guides the standard of care for this vulnerable population.

Case Report

A 25-year-old gravida 1, para 0 female presented for induction of labor at 38 weeks gestation. Significant medical history included mast cell activation syndrome, asthma, gastroesophageal reflux disorder, obstructive sleep apnea, diabetes mellitus type 2, hypothyroidism, hypertension, moderate depressive disorder, and anxiety. Her daily medications consisted of albuterol and budesonide inhalers, diltiazem, cetirizine, cromolyn, dupilumab, famotidine, folic acid,

gabapentin, levothyroxine, metformin, metoclopramide, omeprazole, and ondansetron. She had multiple food and drug allergies including escitalopram, citalopram, duloxetine, metoprolol, nifedipine, topiramate, lecithin, potatoes, avocado, oat, mustard, corn, carrots, garlic, citrus, coconut, peanuts, shellfish, soy, tree nuts, animal dander, grapes, oranges, pears, pineapples, apples, strawberries, sunflower seeds, and blue, pink, red, and green dyes. All listed allergies had reactions of difficulty breathing and anaphylaxis. Her past surgical history included wisdom teeth removal only. She was 157 cm and 91.2 kg, resulting in a body mass index (BMI) of 36.76 kg/m^2. Her airway examination revealed a Mallampati III, a thyromental distance greater than 3 fingerbreadths, and an interincisor distance greater than 3 fingerbreadths. Her lower incisors could be brought in line with the upper incisors (mandibular protrusion class B), and she had full neck mobility.

Both obstetric and anesthetic teams were aware of the patient's impending delivery which allowed for the development of a safe medical management plan. She was admitted prior to labor to manage and treat any potential complications. Upon admission, she was brought to a quiet corner room to prevent an environment that could produce unnecessary stress. Two intravenous (IV) lines were established. An oxytocin IV drip was initiated at 2 milliunits/min and titrated by 2 milliunit intervals per unit protocol. Vital signs were monitored per protocol. The medical team discussed with the patient that an early epidural was recommended to prevent unnecessary stress and uncontrolled pain which could lead to mast cell activation.[1,6] Once cervical dilation and effacement was recognized, the epidural was placed by the most experienced provider. A test dose of lidocaine 1.5% with 1:200,000 epinephrine 3 mL was administered with a negative response. An epidural infusion of bupivacaine 0.125% with fentanyl 2 mcg/mL was initiated at a rate of 10 mL/h, with an 8 mL patient-demand bolus dose available every 12 minutes (maximum 2 bolus doses per hour).

The patient had an uneventful labor and delivered a healthy baby via vaginal delivery. Throughout labor, noise and stress levels were kept to a minimum. Medications known to cause histamine release were avoided. A few hours after labor, the patient developed significant hypertension with a systolic blood pressure of 170 mm Hg with chest pressure. An emergent electrocardiogram was obtained showing nonspecific ST/T wave changes. Laboratory analysis assessing for pre-eclampsia including a complete blood count to evaluate platelets, liver function tests, and a basic metabolic panel including serum creatinine and BUN were all normal. Hydralazine 10 mg IV was then administered resulting in a systolic blood pressure of 140 mm Hg. Hydralazine 25 mg by mouth three times a day was initiated.

The following day the patient experienced a second episode of chest pain and hypertension. Hydralazine 10 mg IV was administered with a positive effect. A repeat electrocardiogram showed sinus tachycardia in the 140s/min. To assess for a pulmonary embolus, a d-dimer was obtained and determined to be elevated at 798 ng/mL. A chest CAT scan and an echocardiogram were ordered. Both test results were negative for pulmonary embolus. The patient's daily diltiazem dose was increased from 120 mg to 180 mg, to be initiated once discharged. The patient remained admitted until the pharmacy team could locate a diltiazem formulation without dye due to her history of anaphylactic allergies to numerous dyes. The patient was discharged home once the correct formula was found. The patient had a successful labor without the initiation of mast cell activation.

Discussion

Mast cell activation syndrome causes repeated episodes of mast cell proliferation, degranulation, and anaphylaxis.[5] Mast cells of the immune system originate in the bone marrow and mature in their specific peripheral tissues.[2] The binding of IgE to an antigen causes mast cell activation resulting in a release of inflammatory mediators such as histamine and prostaglandin.[1] Symptoms of MCAS are diverse and range in severity. These include irritation, fatigue, cognitive dysfunction, mood disorders, migraines, seizures, dystonia, vision changes, hypotension, angioedema, dyspnea, paresthesia, pruritis, urticaria, bruising, flushing, rashes, eye irritation, chronic pain, abdominal pain, nausea, vomiting, diarrhea, and/or dysuria.[1]

Patients who suffer from MCAS often have a long list of comorbidities and allergies.[1] Criteria for diagnosis requires increased mast cell activity, infiltrates of mast cells in bone marrow and extracutaneous organs, abnormal morphology in >25% of mast cells with genetic changes, and above normal levels of mast cell mediators.[1] Mast cell mediators evaluated include tryptase, histamine, N-methyl-histamine, chromogranin A, prostaglandin D2, 11-B-prostaglandin F2A, and leukotrienes.[1]

Mast cell activation syndrome occurs in 1:1000 to 1:8000 people, with a greater incidence in females.[4] Up to 1.1 million pregnancies in the United States are affected with MCAS.[1] Pregnancy in a patient with mast cell activation syndrome requires extensive planning, assessment, and treatment to prevent catastrophic outcomes. Pregnancy is accompanied by significant physical stress related to hormonal changes and labor, as well as substantial psychological stress. Stress, pain, and pharmacological agents commonly used during pregnancy and labor can trigger severe mast cell activation.[1,6] After a major stressor, cytokine storms can lead to somatic mutations in mast cells resulting in more extensive dysfunction and future complications.[1]

There is not one step or intervention that completely controls MCAS in everyday life or during pregnancy and labor. The parturient suffering from MCAS should be provided with the least stressful environment possible during labor. Avoidance of triggers is the most important anesthetic consideration in these patients.[1-6] Baseline medication regimen of antihistamines, mast cell stabilizing agents, and leukotriene inhibitors should be continued.[2] Histamine releasing medications such as morphine, succinylcholine, mivacurium, and rocuronium should be avoided if the situation allows.[4] Research regarding neuromuscular blocking agents produce conflicting results as to whether they are acceptable for use. Cisatracurium should be administered for a planned intubation, followed by antihistamines and corticosteroids.[4] However, due to its prolonged onset, cisatracurium is not sufficient to achieve a rapid sequence intubation (RSI). Succinylcholine has been used successfully to achieve RSI without mast cell activation when administered following diphenhydramine 50 mg, famotidine 20 mg, and methylprednisolone 125 mg IV.[7] Other pharmacological agents that are appropriate for use in patients with MCAS include fentanyl, sufentanil, remifentanil, midazolam, propofol, etomidate, ketamine, pancuronium, ropivacaine, and volatile agents.[4]

Induction of labor and vaginal delivery is preferred. The parturient with MCAS should have a planned induction of labor to prevent the physical and psychological stress associated with spontaneous rupture of membranes. More research is needed to assess the best gestational age for induction of labor. Research has indicated that cesarean sections are more physically, emotionally, and psychologically stressful due to increased risk of hysterectomy, hemorrhage, anemia, infection, thrombosis, fatigue, insomnia, and polyuria.[1] Cesarean sections are associated with increased blood loss in the parturient when compared to vaginal delivery.[1] The activation of mast cells increase the potential for postpartum hemorrhage due to the increase of endogenous heparin release and fibrinolysis.[1] While vaginal delivery is preferred, the obstetric team should assess all maternal and fetal characteristics to determine the safest delivery method.

Early signs of onset of MCAS include headache, loss of concentration, peripheral vasodilation and hypotension, cutaneous flushing, urticaria, and gastrointestinal symptoms.[2] If mast cell activation occurs, the patient should be placed on FiO2 1.0, histamine-1 and histamine-2 receptor antagonists administered, and all members of the care team notified immediately. Grade 3 anaphylactic reactions presenting as severe hypotension, tachycardia or bradycardia, cardiac arrhythmias, or severe bronchospasm should be treated with 100-200 mcg of epinephrine IV every 1-2 minutes until hemodynamic stability is achieved.[6,8] If repeat dosing is required, an epinephrine infusion starting at 0.05 mcg/kg/min may be required, titrated to hemodynamic response.[6,8] Grade 4 anaphylactic reactions and cardiac arrest should follow advanced cardiac life support (ACLS) guidelines.[6,8]

Untreated mast cell activation syndrome can lead to catastrophic outcomes in the parturient. Further research and education regarding diagnosis, recognition, and treatment of MCAS is essential to prevent these consequences and provide the patient with the best care possible.

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The Erector Spinae Plane Block for Improved Recovery after Spinal Surgery

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Keywords: erector spinae plane block, ESPB, postoperative pain, analgesia, opioid consumption, and spine/spinal surgery alone, and in combination.

Introduction

Spinal surgeries are commonly performed orthopedic procedures that are generally elective based on patient needs. Nearly all spine surgeries involve invasive surgical incisions and include dissections of various structures leading to a significant amount of intense postoperative pain that can be difficult for anesthesia professionals to control. The etiology of pain following spine surgery is likely attributed to a disruption in the dorsal rami of spinal nerves. These posterior spinal nerves innervate several structures that are dissected during surgery such as various tissues, muscle, fascia, bones, vertebrae and ligaments. Traditionally, opioids have been the main pharmacologic approach for managing pain after spinal surgery. However, this can be problematic because high dose opioid administration has several adverse side effects including nausea and vomiting, drowsiness, respiratory depression, hypotension, and could potentially lead to opioid dependence.

Within the last decade, experts have highly recommended a multimodal analgesic approach to enhancing recovery after surgery (ERAS). This approach combines a variety of pharmacologic and non-pharmacologic therapies, including regional anesthesia, for decreasing postoperative complications such as pain. Ultimately, this multimodal approach leads to less opioid consumption and improved patient outcomes and satisfaction.

The erector spinae plane (ESP) block is a newly evolved regional anesthetic technique utilized to decrease pain after a variety of surgical procedures. The novel ESP block, first described by Forero in 2016, works by injecting local anesthetic into the facial plane deep to the erector spinae muscles and superficial to the transverse process.[2] The local anesthetic injected into the facial plane spreads in a craniocaudal direction and horizontally by passing through vertebral foramen or fenestrations in ligaments to reach spinal nerve roots in the paravertebral space.[2] The anesthetic spread anesthetizes both the dorsal and ventral rami of the spinal nerves at the level of injection.[2] Ultimately, this blocks the cutaneous/somatic pain and the visceral branches that are associated with deep pain fibers as well. Recently published literature have examined the

effectiveness for this block and may show an advantage in managing postoperative pain proceeding spinal surgeries.

Methods

Evidence-based Practice Model
To guide research and provide a framework for the literature review process for this evidence-based review, a population, intervention, comparison, and outcome (PICO) research question was created. "In adult patients undergoing posterior spinal surgery (P) what are the effects of bilateral ultrasound guided erector spinae plane block (I) on postoperative pain scores and postoperative opioid requirements (O) compared to patients who did not receive ESP block (C)?"

Search methods
A comprehensive literature review was performed to identify the best current evidence by searching the following electronic databases: PubMed, CINAHL, Medline, and Google Scholar. The keywords used for search involved: erector spinae plane block, ESPB, postoperative pain, analgesia, opioid consumption, and spine/spinal surgery alone, and in combination. The studies that met the inclusion criteria for analysis were: 1) Level I and II evidence articles; 2) published between years 2020-2022 in a peer reviewed journal; 3) published in English; and 4) contained the keywords. A total of 21 potential studies were identified for review based on publish date, titles, and abstracts. After further analyzation, a total of 9 high-level evidence articles were found for the final literature review that met the inclusion criteria. The data from 3 meta-analyses and 6 randomized control trials (RCTs) was critically evaluated and organized into a research matrix (Table 1 below).

Literature analysis

The literature was analyzed to determine the efficacy of ESP blocks on postoperative pain scores and postoperative total opioid consumption (TOC) in adults undergoing general anesthesia for posterior spinal surgery. Posterior spine procedures consisted of lumbar discectomies, laminoplasties, decompressions, single and multi-level fusions with and without instrumentation, and posterior internal fixation for fractures. Most studies compared the treatment (ESP block) group to the control group which consisted of no block, or a sham block performed with normal saline injection. One RCT performed in 2022, compared the ESP block group to the standard wound infiltration technique (control group) with equal doses of local anesthetic (LA) in patients undergoing lumbar spine surgery.[5] Standard technique was defined as instilling LA using an intramuscular needle into the subcutaneous tissue and paravertebral muscles.[5] All evidence sources evaluated postoperative pain as a primary dependent variable by using the Numeric Rating Scale (NRS) or Visual Analog Scale (VAS) at specific time intervals in the postoperative phase. Both scales measure pain on a 0-10 level; with 0 meaning no pain and 10 meaning the worst pain.

Postoperative Pain

Postoperative pain scores were reduced following ESP blockade in patients receiving lumbar surgery. All three meta-analyses showed a statistically significant decrease in postoperative pain

scores at rest in the ESP group after 6, 8, 12, and 24 hour time intervals (P<0.05).[6–8] There was no statistical difference in pain scores at rest at the 48-hour mark in all 3 meta-analyses.[6–8] A reduction in pain scores with movement was shown at 6, 12, and 24 hours postoperatively in the ESP blockade group (P<0.05).[6–8] Additionally, two meta-analyses reported a statistically significant reduction in pain scores at the 48 time interval with movement in the ESP group compared to the control group.[6,7]

Three out of 6 RCT's showed the ESP block to be highly effective (P<0.05) in reducing pain levels by1-2 points at the 12 and 24 hour time intervals postoperatively.[3,4,9] Another RCT showed about a 23% reduction in pain scores at 3 hours and a 13% reduction in pain scores 6 hours postoperatively in the ESP group.[10] Results from Sonbol et al. found statistically significant reduced pain scores in the ESP groups at 6 hours postoperatively, but not at 12 hours (P=0.118).[11] The final RCT published in 2022 involved 40 total patients; 22 undergoing a 1 level decompression and 18 undergoing a multilevel decompression. Each group was evenly divided into ESP block or surgical wound infiltration technique done by the surgeon and evaluated for postoperative surgical incision wound pain and VAS postop pain scores.[5] Beltrame et al. found the ESP block was superior over the surgical wound LA infiltration injection technique. The ESP group had reduced pain scores by 1-2 points in single level lumbar decompressions and reductions by 77% (P=0.007) or roughly 3 points (P=0.0046) in 2 or more multi-level lumbar decompressions at 24 hours postop compared to the infiltration group. Ultimately, across all studies postoperative pain scores with rest and with movement were reduced by various amounts in the ESP group at some time frame within 24 hours postoperatively when compared to the control group.

Postoperative Opioid Consumption

Evidence shows performing ESP blockade decreases postoperative TOC compared to the control groups in patients undergoing spine surgery. All 9 studies analyzed found a statistical and clinical significance (P<0.05) in reducing the postoperative consumption of opioid medications 24 hours after surgery in the ESP groups. Liang et al. found a substantial decrease in TOC in the ESP group with 18-20mg lower consumption of morphine compared to the control group after 24-48 hours postoperatively.[7] Results from Ma et al. showed a statistically significant effect of ESP blocks reducing TOC 24 hours after surgery.[8] Results from Oh et al. found a decrease in morphine consumption by about 14.55mg in the ESP group versus the control group 24 hours after spine surgery.[6] ESP blocks significantly reduced 24 hour postop morphine consumption in 2 RCTs by 61%,[9,10] and another RCT by 64%.[11] There was a 22% decrease in total oxycodone consumption 48 hours after surgery in the ESP group (23.10 mg vs 36.40 mg).[4] Additionally, ESP blockade decreased total fentanyl consumption 24 hours postoperatively by over 50mcg.[3] Regardless of postoperative analgesic medications utilized, TOC requirements were decreased after ESP blockade when compared to the control group in the first 24 hours after spinal surgery in all studies.

Postoperative nausea and vomiting.

An adverse side effect of opioid consumption following an extensive spinal procedure can result in PONV. The implementation of ERAS protocols or a multimodal regimen with regional

anesthesia can aid in pain control and help prevent PONV through requiring fewer opioid medications. One meta-analysis pooled the data from 11 RCTs and the ESP block group had a 62% decrease in PONV compared to the no block group ($P < 0.001$).[8] Another meta-analysis comprised data from 9 RCTs and found a 46% reduction in PONV with the ESP group ($P=0.005$).[7] The final the meta-analysis assessed PONV in 7 RCTs including 456 patients, and discovered similar positive results; PONV was decreased in the ESP group by 64% ($P = 0.001$).[6] Ultimately, these meta-analyses revealed a 46-64% reduction in PONV with ESP blockade compared to the control group.

Patient Satisfaction

Evidence has shown that ESP blocks decrease pain, opioid consumption, and PONV, all of which result in better patient satisfaction. Oh et al. found 3 RCTs with 176 patients reported ESP blocks to increase patient satisfaction scores (0-10 scale) (MD = 2.38; 95% CI, 2.10 to 2.66; $P < 0.00001$).[6] Furthermore, one RCT found patient satisfaction scores to be significantly higher in the ESP group than the control group (9.52 ± 0.65 vs 8.22 ± 0.79; $p < .001$).[3] Finally, Sonbol et al. found surgeon satisfaction was significantly improved ($P=0.001$) with regard to a decrease in intraoperative bleeding (292.86mL ± 80.570 mL vs 464.29mL ± 122.217mL; $P < 0.001$) in the ESP group versus the control group.[11]

Table: Summary of Literature on Utilization of ESP blocks for Spine Surgery

Author(s), Design	**Sample size, Surgical procedure**	**Dose (for each side), Timing of ESP block**	**Significant data/ Outcome Results**
Oh et al.[6] (2022) Systematic review and meta-analysis	N=665 pts (12 RCT's) Lumbar spine surgery	20 mL 0.25% bupivacaine (5 RCT) 30 mL of 0.25% bupivacaine (1 RCT) 20 mL 0.4% bupivacaine (1 RCT) 20 mL 0.5% bupivacaine (1 RCT) 25 mL 0.3% ropivacaine (1 RCT) 30 mL 0.375% ropivacaine (1 RCT) 20 mL (1:1) mixture of 0.25% bupivacaine and 1.0% lidocaine (1 RCT) Mainly performed after induction in prone position.	• Showed a statistically significant decrease in pain scores both at rest and with movement at 4, 6, 8, 12 and 24 hours after surgery in the ESP group • The ESP group required less opioids within 24hrs of the postoperative setting by approximately 14.5mg of morphine • Less PONV was reported in the ESP group after surgery: RR 0.36; 95% CI [0.20 to 0.67]; $P = 0.001$ • Patients that received the ESP block were more satisfied overall. ($P < 0.00001$)
Liang et al.[7] (2021) Systematic review and meta-	N=696 pts (12 RCT's) Spinal surgery	20 mL 0.4% or 0.5% ropivacaine (4 RCT) 25 mL 0.3% ropivacaine (1 RCT) 20 mL 0.375% ropivacaine (1 RCT) 20 mL 0.25% or 0.5% bupivacaine (4 RCT) 30 mL 0.25% bupivacaine (1 RCT) 20 mL (1:1) mixture of 0.25% bupivacaine	• A statistically significant decrease in pain scores both at rest and with movement at 8, 12, and 24 hours after surgery in the ESP group • The ESP group required less

analysis		and 1.0% lidocaine (1 RCT) Mainly performed after induction in prone position.	opioids within 24hrs of the postoperative setting by approximately 18.6mg of morphine • Less PONV was reported in the ESP group after surgery: RR 0.54; 95% CI [0.36 to 0.83]; p= 0.005
Ma et al.[8] (2021) Systematic review and meta-analysis	N=828 (12 RCT's) Spinal surgery	15 mL 0.5% ropivacaine (3 RCT) 20 mL 0.375% or 0.4% ropivacaine (4 RCT) 10 mL 0.375% ropivacaine (1 RCT) 20 mL 0.25% or 0.5% bupivacaine (4 RCT) Mainly performed after induction in prone position.	• A statistically significant reduction in pain scores both at rest and with movement at 6, 12, and 24 hours after surgery in the ESP group • The ESP group required less opioids within 24hrs of the postoperative setting: SMD − 1.834; 95%CI [− 2.752 to − 0.915]; p < 0.001 • Less PONV was reported in the ESP group after surgery: RR 0.380; 95%CI 0.272, 0.530; p<0.001
Goel et al. [3] (2021) Double blinded, prospective RCT	N=100 • ESP= 50 • Control=50 Single level lumbar spine fusion	ESP Group: 20 mL 0.25% bupivacaine -performed after induction in prone position.	• A statistically significant reduction in pain scores was found at 12, 24, and 48 hours in the ESP group • The total dose of fentanyl after induction were lower in the ESP group by about 57 mcg 24hrs postoperatively (p= <.001) • Total patient satisfaction was increased in the ESP group 48hrs after surgery (p=<.001)
Beltrame et al. [5] (2022) Double-blinded RCT	N=40 • ESP=20 • ST*=20 Single and multilevel lumbar decompression	ESP group: 20 mL 0.25% bupivacaine - performed at the end of surgery in prone position ST group: 20 mL 0.25% bupivacaine -performed after induction in prone position	• With 1 level decompressions and multilevel decompressions, pain scores were lower in the ESP group at 1, 7, and 24hrs postop compared to the standard injection technique performed by the surgeon • The ESP group consumed approximately 3.5mg less of morphine 24hrs postoperatively

Zhu et al.[4] (2021) RCT	N=40 • ESP=20 • Control=20 Posterior lumbar fusion	ESP Group: 20 mL 0.375% ropivacaine Mock control: 20 mL saline per side -performed in preoperative setting	• There were statistically significant lower pain scores in the ESP group at 6, 12, and 24hrs postop, both with rest and with movement • ESP group required less oxycodone postoperatively by approximately 4.8mg within 24hrs after spine surgery (P=0.009)
Sonbol et al.[11] (2022) Prospective RCT	N=70 • ESP=35 • Control=35 Single or multi-level lumbar or thoracic spinal surgery with instrumentation	Per side: 8 mL isobaric bupivacaine 0.5%, 3 mL 1/10000 adrenaline w/ saline, 1 mL contrast dye -performed after induction in prone position using fluoroscopy	• Pain scores were statistically lower in the ESP group at 1, 3, and 6hrs postop • Pain scores at 12hrs were slightly lower in the ESP group but not statistically significant • ESP group required less morphine postoperatively (P<0.001)
Asar et al.[9] (2022) Double blinded, prospective RCT	N=70 • ESP=35 • Control=35 Single or multi-level spinal surgery with instrumentation	ESP Group: 10 mL 0.5% bupivacaine + 10 mL 1% Lidocaine -performed at the end of surgery, in prone position	• There was a statistically significant decrease in pain scores at 12 and 24hrs postop in the ESP group • The ESP group required less morphine postoperatively by approximately 4mg within 24hrs after surgery (P=0.000))
Jin et al.[10] (2021) Double blinded, prospective RCT	N=62 • ESP=30 • Control=32 Multi-level lumbar laminoplasty	ESP Group: 20 mL 0.375% ropivacaine -performed after induction in prone position	• Found a statistically significant reduction in pain scores at 1, 3, and 6hrs postop in the ESP group • The ESP group required less morphine postoperatively by approximately 7.5mg within 48hrs after surgery (P= 0.001)

*ST= standard technique

Conclusion

Erector spinae plane blocks have a high safety profile, are quick and easy to perform, and provide pain control similar to epidurals, but are much further from the spinal cord.[3] When the ESP block is executed under ultrasound or fluoroscopy guidance, the target group of erector spinae muscles for injection is far from organs including the pleura, major blood vessels, and the spinal cord itself leading to a low risk for complications.[12] In addition, when compared to epidurals and other neuraxial blocks, the ESP block avoids serious and potential complications such as dural puncture, epidural hematomas, and hypotension.[10] Although potential

complications of ESP block do include infection, bleeding, nerve damage, or pneumothorax, zero complications were reported in any study included in this review. Furthermore, evidence has shown ESP blocks do not interfere with intraoperative neuromonitoring (a decrease in waveform amplitude or latency) or the early postoperative neurological motor examination.[13] This is likely due to the lower LA drug concentrations used, in addition to the limited cephalocaudal spread over 3-5 spinal levels.[5] There were no reports of interference with neuromonitoring in any of the studies analyzed for this evidence based analysis.

The extensive surgical incisions and dissections involved with most spine surgeries can lead to severe postoperative pain that may remain a challenge to control, ultimately leading to a decrease in patient's healing phase and overall satisfaction. Of 9 evidence sources evaluated, three meta-analyses and 5 RCTs showed the ESP block to be highly effective in reducing postoperative pain scores within the first 24 hours, both at rest and upon movement.[3,4,6–10] The ESP block was shown to be superior over a surgical wound LA infiltration injection technique, as the ESP group had reduced pain scores by 1-2 points in single level lumbar decompressions and reductions of 77% in the multilevel lumbar decompressions at 24 hours postop compared to the infiltration group.[5] In addition, all 9 evidence sources reported a statistically significant reduction TOC by up to approximately 60% 24 hours after spine surgery for patients receiving ESP blocks. ESP blocks also lower the prevalence of PONV ($P<0.05$) by 46-64% when compared to the control group.[6–8] Finally, patients that received ESP blocks had higher satisfaction scores ($P<0.001$) compared to no block.[3,6]

The ESP block reduces pain intensity, provides efficient postoperative analgesia at rest and with movement, reduces total opioid consumption, lowers the incidence of PONV, and increases patient satisfaction after spinal surgery. Performing the bilateral ESP block after induction of anesthesia in the prone position or in the preoperative phase is an effective analgesia technique and allows for improved patient comfort during administration of the block. The ESP block is typically performed with LA concentrations ranging from 0.25% - 0.5% ropivacaine or bupivacaine, with volumes of 10-30 mL bilaterally, however further studies are needed prior to recommendation of a specific dose and concentration of LA.

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Reducing Postoperative Nausea and Vomiting in One-Day Surgery

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Keywords: postoperative nausea and vomiting, quality improvement, prophylaxis, one-day surgery, antiemetics.

Introduction

Postoperative nausea and vomiting (PONV) is a common complication following surgery, second only to pain; however, many patients consider PONV the worst complication. The institution's subjective observation of elevated PONV rates resulted in identifying this as a needed area for quality improvement (QI) as adherence to treatment of PONV was inconsistent due to a lack of an established institutional guideline. Synthesis of literature revealed PONV was significantly decreased when the number of antiemetics administered matched the patient's

PONV risk. Current guidelines[1] and recent literature[2] were utilized to develop a QI project focused on decreasing PONV incidence in patients undergoing surgery in a One-Day Surgery (ODS) center in a large metropolitan hospital in a southern state utilizing the Lewin's Change Model.

Design and Methods

Lewin's Change Model (*Unfreeze, Change, Refreeze*)[3] was the theoretical framework guiding this QI project. During the *Unfreeze* stage, collaboration with anesthesia practitioners and pharmacists led to development and approval of a PONV protocol. This included adding questions to ODS patient tracking face sheets to determine PONV risk and creation of a PONV order bundle in electronic medical records. After institutional approval, ODS preoperative and postoperative nursing staff received an in-service on utilization of the protocol. Anesthesia practitioners were provided an emailed video link with the protocol and weekly updates on process improvements.

In the *Change* stage, documentation of patient reported history or known PONV risk factors, application of the PONV prophylaxis order bundle was triggered. This enabled anesthesia practitioners to prescribe three or more antiemetic classes. The order bundle was expected to increase PONV protocol adherence by simplifying antiemetic ordering by anesthesia practitioners and decreasing incidence of PONV in susceptible patients, reinforcing the value of the protocol.

The *Refreeze* stage included integration of PONV protocol and modifications to workflow. Effectiveness of this QI initiative was evaluated via practitioner adherence to the protocol. Additionally, patients with a history of PONV were asked to report any improvements (compared to previous experiences) in symptoms after undergoing surgery. This was completed by reviewing ODS face sheets (which accompanied patient charts) and tracking events from admission through discharge.

Outcome

Data were collected for six weeks following implementation of the PONV protocol with 508 face sheets reviewed. Prescriber education was reinforced and positive patient outcomes further increased adherence by anesthesia practitioners and ODS nursing staff. Initially, 85% of patients with history of PONV who received ≤2 antiemetics reported *Worse/Same* PONV symptoms. Upon implementation of PONV protocol, of 126 patients reporting a positive history of PONV, 87 received ≥3 antiemetics, with 96.5% reporting *Better/None* PONV symptoms. A 69% anesthesia practitioner adherence rate was observed. Anticipated outcomes include this protocol becoming the standard of care in the organization, as this process is currently being implemented in a second preoperative area.

Conclusion

Current guidelines[1] support matching the number of antiemetics with patient risk[2] to reduce incidence of PONV. The result of this project indicate administration of at

least three prophylactic antiemetics to patients with PONV history was effective in decreasing or eliminating PONV symptoms. Providing education and decision support tools facilitated practice changes for anesthesia practitioners, ODS nursing staff, and resulted in improved patient outcomes and satisfaction.

Recommendations include incorporating an additional PONV risk scoring system to further reduce PONV incidence; prophylactically treating all patients with increased risk for PONV (females and non-smokers); and incorporating the protocol to pre-operative order bundles, rather than as a stand-alone bundle. Implementation and evaluation of this project was limited by the two-month timeframe. A longer project duration with reinforcement of the change could increase organizational adherence.

References

1. Gan TJ, Belani KG, Bergese S, et al. Fourth consensus guidelines for the management of postoperative nausea and vomiting. *Anesth Analg.* 2020;131(2):411-448. doi:https://doi.org/10.1213/ane.0000000000004833
2. Thomas JS, Maple IK, Norcross W, Muckler VC. Preoperative risk assessment to guide prophylaxis and reduce the incidence of postoperative nausea and vomiting. *Journal of PeriAnesthesia Nursing.* 2019;34(1):74-85. https://doi.org/10.1016/j.jopan.2018.02.007
3. Hussain ST, Lei S, Akram T, Haider MJ, Hussain SH, Ali M. Kurt Lewin's change model: A critical review of the role of leadership and employee involvement in organizational change. *Journal of Innovation & Knowledge.* 2018;3:123-127. https://doi.org/10.1016/j.jik.2016.07.002

Mentor: Michelle Gonzalez, PhD, CRNA, FAANA, CHSE-A, CNE

Editorial

The ISJNA serves as a venue for the publication of nurse anesthesia resident submissions, and I am hopeful that all levels of practitioners benefit from the wide variety of case reports and evidence-based work presented in this journal. Over the years, I have learned about new technology, pharmacology, procedures, and anesthetic techniques long before they became mainstream in our practice. An added bonus is the discussion these articles generate not only after publication, but during the review process as well. I've had multiple editors share how items they reviewed resulted in thoughtful consideration amongst their colleagues and re-evaluation of their departmental practices. I'm grateful the ISJNA contributes toward the principle of lifelong learning for nurse anesthesia practice.

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