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TOPICS IN THIS ISSUE

Transesophageal Echocardiography
Pulmonary Vein Isolation Ablation
US Guided Neuraxial Anesthesia
Preserving Quadriceps Function
Dexmedetomidine for Shivering
Osteogenesis Imperfecta
Periodic Paralysis

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Front Cover:

On the front cover, pictured from left to right, Jack Geoghegan, BSN, RN, Sierra Shively, BSN, RN, Morgan Segrine, BSN, RN, Courtney Davis, BSN, RN (seated), Martina Mikhail, BNS, RN, Kalaivani Panneerselvam, BSN, RN, and Stephanie Lynch, BSN, RN, doctoral students enrolled in the Villanova University M. Louise Fitzpatrick College of Nursing Nurse Anesthesia Program, practice laryngoscopy and intubation using a task trainer during a skills session in the simulation center.

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Table of Contents

Dexmedetomidine for Post-Spinal Shivering During Cesarean Delivery

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Key Words: Dexmedetomidine, shivering, spinal anesthesia, cesarean delivery

Neuraxial anesthesia, specifically spinal anesthesia, is the gold standard for a cesarean delivery (CD). Spinal anesthesia (SA) is associated with shivering, with multiple studies reporting an incidence of shivering after neuraxial anesthesia of approximately 55%.[1-3] In addition to causing distress and discomfort, post spinal anesthesia shivering (PSAS) creates physiologic stress, resulting in increased O_2 consumption, CO_2 production, lactic acid production, plasma catecholamines, and cardiac output.[4,5] PSAS can result in non-optimal surgical conditions and interfere with standard intraoperative monitoring of key vital signs.[3,4] It can also exacerbate postoperative pain, which can interfere with breastfeeding and maternal satisfaction.[5]

Case Report

A 22-year-old, 40w0d, G2P1001 parturient presented for a scheduled repeat CD. The patient denied past medical history and had been receiving regular prenatal care. She reported taking prenatal vitamins, and denied any other medications, including anticoagulants. After the plan and risks for CD and SA were discussed with the patient and her husband, the patient agreed to and signed consent for SA. General anesthesia (GA) and its risks were also discussed, and GA consent was also obtained in case of an intraoperative emergency that necessitated the conversion to GA.

The preoperative assessment was conducted on the obstetric unit where the patient was on standard monitors of pulse oximetry, electrocardiogram and non-invasive blood pressure, as well as a continuous fetal heart rate monitor. While in the preoperative area, the patient received 1 liter of Lactated Ringers' (LR), and a second liter of LR was initiated upon entry to the operating room (OR). Standard noninvasive monitors were reapplied and the patient was positioned sitting with both hips adducted and feet placed on a stool. The patient's intravenous LR infusion was connected to a fluid warming device set to 41°C. After the anesthesia time out, the patient's back was prepped and draped in a sterile fashion. After local infiltration, a 20-gauge introducer needle was inserted at the L3-L4 intervertebral space, and a 25-gauge, 3.5 inch pencil point tip needle was inserted into the intrathecal space through the introducer needle. Correct placement was confirmed with aspiration of cerebrospinal fluid followed by a single-shot injection of 0.75% bupivacaine 1.6 mL, morphine 0.1 mg, and fentanyl 25 mcg. After both needles were removed, the patient was then placed in the supine position with left uterine displacement. A phenylephrine infusion was then immediately initiated at 40 mcg/min and was adjusted to maintain the blood pressure within 20% of the patient's baseline.

After the sensory level was tested, incision occurred. The neonate was delivered without issue. Immediately following the delivery and cord clamping, an intravenous infusion of oxytocin 30

units in 500 mL LR was initiated. Approximately 3 minutes after the delivery, the patient began to develop severe sustained upper extremity shivering, otherwise known as grade 3 shivering per the Crossley and Mahajan Intraoperative Shivering Scale.[3] Warm blankets were applied to the patient's arms and an upper body warming blanket was applied and a forced air warming unit as initiated at the highest setting of 43ºC with no improvement. The patient was noticeably anxious and upset by the constant shivering and she was informed that the shivering is a common side effect of SA. Dexmedetomidine 10 mcg was administered intravenously. Approximately 5 minutes later, the patient stopped shivering, was noticeably more comfortable, and less emotional distress was observed. The patient did not shiver throughout the rest of the perioperative period and remained hemodynamically stable with no fluctuations in blood pressure or heart rate. No complications arose perioperatively and the remainder of the CD occurred without incident.

Discussion

Numerous studies have found dexmedetomidine to be effective in the treatment of shivering post spinal anesthesia, yet the exact dosage is not yet fully agreed upon. A single center, randomized, double-blind, placebo-controlled Canadian study of 155 parturients undergoing CD under SA, found that a single intravenous bolus of dexmedetomidine 30 mcg decreased the duration of shivering for up to 15 minutes during the CD under SA.[3] In 90% of the patients who had received dexmedetomidine, the shivering had completely stopped.[3] Similarly, a Chinese study also found that a dose of dexmedetomidine 0.5 mcg/kg administered by intravenous infusion completely stopped shivering in all parturients who had received it within 15 minutes of its administration.[4] An Egyptian study compared the efficacy of intravenous dexmedetomidine bolus doses of 0.5 mcg/kg, 0.3 mg/kg, and 0.2 mcg/kg for the treatment of PSAS. It was found that the dose of 0.3 mcg/kg delivered by slow intravenous bolus over 2 minutes effectively treated PSAS with modest hemodynamic and sedation effects.[1]

An American study examined the prophylactic utilization of dexmedetomidine to prevent PSAS during CD. [6] In this study, dexmedetomidine 10 mcg was given intravenously for prophylaxis against PSAS immediately after the delivery of the neonate. Post-CD shivering was reduced in 90.7% of patients at 30 minutes and in 100% of patients at 60 minutes.[6] Likewise, several small, single-center randomized double-blind controlled trials have also found prophylactic dexmedetomidine to be effective in preventing PSAS in CDs without significant side effects.[6] The specific doses that these studies found effective for prophylaxis was between 5 mcg and 10 mcg of intravenous dexmedetomidine prior to SA for elective CDs.[6]

Clearly, the literature demonstrates that dexmedetomidine is effective as both a prophylactic against and as a treatment for PSAS in parturients undergoing a CD. Yet, its prophylactic use is controversial when considering its potential side effects such as hypotension, sedation, and bradycardia.[4,6] However, the majority of studies did not report significant hemodynamic instability or sedation.[3,4,6] It is possible that bradycardia may not be a considerable risk in the parturient population, as PSAS in CD occurs when patients are relatively tachycardic due to the abrupt physiologic changes associated with delivery of the neonate.[3]

Historically, anesthesia providers have cautiously used dexmedetomidine in parturients because of the possible risk of uteroplacental transfer to the fetus potentially causing undesirable effects in the neonate.[7,8] Dexmedetomidine is highly lipophilic and recent research demonstrates that the maternal/fetal index is 0.77. This indicates that uteroplacental transfer to the fetus is minimal.[7,8] Cortegiani et al state multiple case reports found that dexmedetomidine has no harmful effects during CD.[8] In particular, one study found that pre-operative administration of intravenous dexmedetomidine in doses of 0.4 mcg/kg/hr and 0.6 mcg/kg/hr does not have adverse neonatal effects.[9] In the case reports reviewed by Nair and Sriprakash, in parturients who received intravenous dexmedetomidine, the neonates were delivered with normal APGAR scores.[7] This suggests that even if there was a small chance of uteroplacental transfer, it does not appear to affect neonatal well-being.[7] Similarly, a study examining the colostrum of parturients who received 0.6 mcg/kg/hr dexmedetomidine showed no significant effects in the mother with negligible amounts in breastmilk.[3]

Overall, PSAS is an extraordinarily common occurrence during CD that has negative consequences. It is imperative that PSAS during CD be treated for best possible patient outcomes. Given its favorable safety profile and demonstrated effectiveness, anesthesia practitioners should consider the utilization of low-dose intravenous dexmedetomidine to treat PSAS in parturients undergoing CD.

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Challenges in Anesthetic Management for Transesophageal Echocardiography

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Keywords: endoscopy suite, transesophageal echocardiogram, atrial fibrillation, production pressure

Transesophageal echocardiograms (TEE) are procedures typically performed in the endoscopy suite and involve endoscopic visualization of the heart. Anesthetic options for these procedures vary from no anesthesia to general anesthesia. Most of these cases are performed under moderate sedation, which creates unique challenges for the anesthesia professional as they must administer enough intravenous (IV) anesthetics to sedate the patient and suppress the cough reflex while preserving spontaneous respirations and the gag reflex.[1,2] The IV agent most used in these procedures is propofol, a drug whose therapeutic window is very narrow.[1]

Case Report

A 78-year-old, 80 kg Caucasian male presented to the endoscopy suite for a TEE with cardioversion. The patient was admitted from the ER to the medical surgical unit with worsening shortness of breath, a productive cough, and new-onset atrial fibrillation (AFib). Significant patient medical history included hyperlipidemia, hypertension, coronary artery disease, type two diabetes mellitus, and colon cancer; status post rectosigmoid resection, currently in remission. Approximately one month before admission, the patient had coronary artery bypass grafting (CABG) involving two occluded arteries and a left atrial appendage closure. The patient's medication regimen included aspirin, apixaban, amiodarone, dapagliflozin, furosemide, metoprolol, and spironolactone. On admission, his chest radiographic imaging showed bilateral pleural effusions. An electrocardiogram (ECG) confirmed AFib with a rapid ventricular response. A documented echocardiogram was not present in the patient's chart.

The patient arrived at the preoperative unit without supplemental oxygen and an oxygen saturation (SpO_2) of 88%. Oxygen was administered to the patient via nasal cannula 4 L/min to optimize oxygenation. Further preoperative evaluation revealed an alert and oriented, edentulous patient with a beard. Airway assessment revealed a Mallampati 3, with no neck range of motion limitations. The patient had a productive cough and rhonchi were auscultated bilaterally. Other

vital signs obtained via standard noninvasive monitors were within normal limits. Due to the patient's respiratory status, the plan was to administer lidocaine 2% and propofol IV. After the patient entered the procedure room, standard noninvasive monitors were reapplied. The SpO_2 had increased to 92% on O_2 4 L/min. Before the induction of anesthesia, a procedural oxygen mask (POM) attached to a nonrebreather bag was placed on the patient to administer O_2 at 10 L/min and the SpO_2 increased to 94-96%. The patient was positioned in semi-Fowlers, the head elevated 40 degrees, and pillows placed to produce a sniffing position.

As the cardiologist began to prepare for the case, the anesthesia practitioner administered lidocaine 2% 50 mg and propofol 30 mg through a 20-gauge IV catheter. After 3 minutes, the patient remained alert and verbal. Additional propofol 30 mg IV was administered. The patient closed his eyes and was unable to follow verbal commands. The sedation level was evaluated by the lack of stimulation in response to the lash reflex, a jaw thrust was performed, and the cardiologist inserted the TEE probe into the mouth and esophagus. Once the TEE probe was placed, the patient began to cough and gag. Propofol 20 mg IV was administered to blunt the cough reflex. After several minutes, a rise in blood pressure and respiratory rate was noted. Another propofol 20 mg IV was administered. After a few minutes, the patient ceased spontaneous respirations and underwent rapid desaturation. Despite increased oxygen flow to 15 L/min via the POM and administering a jaw thrust, the SpO_2 decreased to 70%. The TEE probe was removed, and manual ventilation with 100% FiO_2 via bag valve mask (BVM) was initiated. Manual mask ventilation was unsuccessful with and without an oropharyngeal airway due to an inability to obtain an adequate seal because of the patient's beard. A size 4 curved AuraOnce laryngeal mask airway (LMA) was placed into the hypopharynx. After 20 minutes of manual ventilation through the LMA, spontaneous ventilation returned. The LMA was removed, and oxygen was provided via a nonrebreather mask. The TEE was completed but the cardioversion was aborted due to the instability of the patient, and he was transferred to the post-anesthesia care unit.

Discussion

Atrial fibrillation is the most common cardiac arrhythmia and is usually associated with advanced age along with underlying cardiac diseases. This ultimately results in myocardial remodeling, particularly in the atria.[3] The dysrhythmia encompasses fibrillating atria that do not beat sequentially with the ventricles or adequately contract during diastole. These issues cause a 20-30% loss in cardiac output (CO), resulting in significant compromise to a person with an already reduced ejection fraction.[4] In this case, the decreased CO was thought to contribute to propofol's slow circulation, resulting in delayed onset and prolonged duration of action.

Due to the stasis of blood in the atria, AFib is associated with an increased risk of blood clot formation and is the leading preventable cause of embolic strokes.[3] Decreased forward flow of blood resulting from AFib can lead to heart failure and pleural effusions. A TEE is performed to rule out the presence of emboli in the heart before performing synchronized cardioversion, which can potentially dislodge thrombi.[4]

Patients undergoing cardioversion typically have other cardiac comorbidities that further present distinct challenges to the anesthesia professional. Pleural effusions compress the lung

parenchyma and reduce all lung volumes, presenting an additional patient hazard. In this case, bilateral pleural effusions resulted in decreased respiratory reserve, and ultimately, rapid oxygen desaturation.[5] The POM with a non-rebreather bag was used to administer a higher oxygen flow to support oxygenation and ventilation. However, during the apneic episode, this was inadequate and required intervention with insertion of an LMA. In summary, many patient risk factors may have contributed to oversedation and subsequent hypoxia. However, institutional and systemic risk factors contributed to this near-miss event.

When the obstruction occurred, the TEE probe in the oropharynx created a barrier to typical airway rescue maneuvers. The anesthesia technique required for this procedure involves a shared airway, challenging the anesthesia practitioner to maintain ventilation while keeping the patient comfortable. Moreover, the anesthesia professional was responsible for keeping the patient sedated and comfortable while awake enough to breathe spontaneously. Consequently, it was important to select IV agents that did not compromise these goals. Due to its respiratory depressant effect, the anesthesia team avoided fentanyl. Propofol was chosen as the anesthetic of choice due to its reliability in sedating patients and its quick onset and offset. Despite its many benefits, propofol has a narrow therapeutic index, making the drug's toxic dose very close to its therapeutic dose. Despite the prevalence of ambulatory procedures performed in the GI suite, researchers have concluded that there is still no sole anesthetic technique that is superior.[2]

The rapid turnover expectation associated with ambulatory procedures performed in the GI suite presented an additional hardship for anesthesia clinicians, as it produced production pressure. Production pressure is widespread so anesthesia practitioners must be highly qualified and experienced to provide safe care under these conditions. Researchers highlight that production pressure is expressed when production is prioritized ahead of patient safety.[6] There is a great deal of perceived stress, increasing the likelihood of errors and lapses in judgment. In the case discussed above, the nurse anesthesia resident (NAR) was given the primary role of anesthesia administration. Learners are regularly under pressure to meet expectations. A room full of staff displaying discontent can cause errors in judgment and rushed behavior to please the staff. This is also problematic when the NAR is not well-versed in managing cardiac patients undergoing moderate sedation. Advocating for patience while waiting for the loss of consciousness when initiating sedation and explaining to staff members that a lower CO delays the onset of IV anesthetics could have allowed initial boluses to take full effect. Increased pauses prior to administering subsequent doses of propofol IV could have potentially prevented apnea and subsequent hypoxia from occurring.

Oversedation is one of the most common complications associated with procedures done under moderate sedation.[7] Therefore, recognition of problems early and quick interventions when complications arise are important. Identifying patients at risk for difficult airways early and having the necessary equipment readily available is a standard of care and allows for immediate action to be taken should complications arise.

Ultimately, communicating with the cardiologist that patience would be required for medications to take full effect or calling for help sooner could have prevented these events. Production pressure is highly prevalent in high-turnover areas such as the endoscopy suite. When production pressure occurs, anesthesia professionals need to advocate for patient safety, stop the line, and

allow sufficient time for pharmacological agents to reach full therapeutic effect. Training for NARs regarding addressing production pressure is essential since patient safety must always be a top priority.

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Pulmonary Vein Isolation Ablation for Atrial Fibrillation Treatment

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Keywords: Atrial fibrillation, pulmonary vein isolation ablation, total intravenous anesthesia, jet ventilation

Atrial fibrillation (AF) is the most frequently encountered cardiac arrhythmia in clinical practice with marked morbidity and mortality.[1] Pulmonary vein isolation (PVI) ablation is an established, minimally invasive, catheter-based procedure to treat symptomatic AF.[1] While varieties of anesthesia, ventilation and oxygenation strategies can be utilized for PVI ablation procedures,[2,3] this case report specifically focuses on using general anesthesia (GA) and high frequency jet ventilation (HFJV) for an adult patient.

Case Report

A 65-year-old female presented for a PVI ablation for AF treatment. The patient's past medical history included AF with rapid ventricular response, hypertension, hyperlipidemia, gastroesophageal reflux disease, prediabetes, and class III obesity (BMI 38.3 kg/m^2). No adverse

anesthesia complications were noted from previous surgeries. The patient previously experienced symptomatic paroxysmal AF and symptoms included dizziness and syncope episodes. The patient underwent electrical cardioversion which failed to restore the normal sinus rhythm (NSR). The patient endorsed that symptomatic AF episodes occurred with increasing frequency which is why a more permanent treatment was sought.

After the completion of preoperative consents and assessment, the patient was ambulated into the electrophysiology (EP) lab and assisted to sit on the operating table with an underbody forced-air blanket in place. EP lab monitor equipment pads were placed on the patient's back, and the patient was assisted to supine position on the table. Standard noninvasive monitors were applied, vital signs were measured and noted to be within 20% of patient's baseline with a heart rate of 65/min and NSR. An anesthesia mask with O_2 at 8 L/min was placed over the patient's nose and mouth to provide pre-oxygenation. GA was induced intravenously with boluses of lidocaine 80 mg, propofol 200 mg, fentanyl 50 mcg and succinylcholine 100 mg. Total intravenous anesthesia (TIVA) was initiated using propofol at 125 mcg/kg/min, remifentanil at 0.2 mcg/kg/min, and phenylephrine at 25 mcg/min infusions.

A direct laryngoscopy was performed with a Macintosh size 3 blade, the trachea was successfully intubated, and mechanical ventilation was initiated using the volume-controlled autoflow mode of the Drager Apollo anesthesia machine (Draeger Inc.). An esophageal temperature probe, soft bite block, and a bispectral index monitor were placed as well. An arterial line was inserted into the patient's right radial artery using an ultrasound guided technique. Baseline arterial blood gasses (ABG) were measured. The patient was then placed on manual ventilation mode via the Drager Apollo machine and connected to the Acutronic Monsoon III (Susquehanna Micro Inc.) jet ventilator via the port located on the endotracheal tube elbow connector.

The surgery team performed right groin punctures, and the femoral vein was accessed under ultrasound guidance. A single transseptal puncture was performed, a three-dimensional map of the heart was created, and ablation was performed around each set of veins as well as the cavotricuspid isthmus. A bidirectional block was achieved. An isoprenaline infusion was utilized by the surgical team to induce AF with no recurrence after the ablation. Body temperature was continuously monitored with an esophageal temperature probe. Intravenous heparin was administered per request from the surgeon to achieve anticoagulation. The activated clotting time and ABG values were also measured throughout the case. The procedure duration was approximately three hours.

At the end of the procedure, intravenous protamine was administered to reverse anticoagulation. Femoral sheaths were removed via an extravascular closure device. Propofol and remifentanil infusions were discontinued, the patient was disconnected from the jet ventilator, placed on pressure support and subsequently transitioned to spontaneous modes on the Drager machine. The patient was emerged from general anesthesia, followed commands, was extubated without complications, and transported to the post anesthesia care unit (PACU). Vital signs in the PACU were within 20% of patient's baseline, and a 12-lead electrocardiogram showed NSR. The patient was placed on bed rest lying flat with the right leg straight and observed for three hours postoperatively.

Discussion

Pulmonary vein isolation ablation for AF treatment can be performed under various anesthetic modalities. Deciding among these is a function of team preference, expertise and available equipment. Anesthetic agent cost and PACU stay times may also be contributing factors.

Pulmonary vein reconnection is considered the main reason for post-PVI AF recurrence. This can occur when the initial ablation procedure does not provide the complete tissue destruction required to prevent recovery of abnormal conduction tissues. This is usually partly attributed to insufficient catheter contact with the target tissue. Therefore, it is thought to be beneficial to improve catheter stability and catheter contact.[2]

For this case, treatment was performed while the patient was under GA via TIVA and tracheal intubation. Ventilation and oxygenation were controlled via a high frequency jet ventilator. A systematic review of anesthesia strategies for PVI ablation found that GA may reduce AF recurrence post-ablation and may shorten ablation duration as compared to conscious sedation.[3] GA was also more recently shown to improve ablation catheter stability and tissue-catheter contact, leading to improved lesion quality and ablation efficiency because of lowered patient movement under GA. Whereas under conscious sedation, movement can be elicited by painful stimulation from the ablation.[4,5]

Deep sedation techniques are another option for PVI ablation. These techniques can provide anesthesia depth approaching GA without requiring tracheal intubation. The patient can breathe spontaneously but may require assistance in maintaining airway patency (e.g., placement of the oropharyngeal airway). Both GA and deep sedation can prevent spontaneous movement from painful stimuli, but GA has the benefit of controlled respiration and improved catheter contact.

GA improves PVI AF ablation outcomes by limiting patient movement and providing controlled respiration.[4] However, positive pressure ventilation from traditional anesthesia machines causes excessive left atrial movement, affecting ablation catheter-tissue contact and impact procedure outcomes.[2] A high frequency jet ventilator delivers low tidal volumes at high frequency to provide oxygenation and gas exchange. The low tidal volume significantly reduces movement of the diaphragm and chest wall excursion to nearly apneic conditions. This provides improved stability of the ablation catheter and achieves effective tissue contact.[2] Despite these benefits, there are adoption barriers: a unique ventilator is needed, disposable equipment parts are expensive, and anesthesia staff need training on jet ventilator use.

In the case presented, TIVA was utilized to provide anesthesia because delivering an inhalation anesthetic agent was not possible with HFJV. Moreover, the end tidal CO_2 could not be monitored, so intermittent ABG samples were used to assess gas exchange and oxygenation. HFJV settings were adjusted to maintain appropriate pH and normocapnia for the patient.

At our facility, we generally initiate the HFJV with a driving pressure (DP) at 18 to 36 psi, frequency at 90 to 130 cycles/minute, FiO_2 at 70% to 100%, inspiratory time at 35%, and pause pressure at 28 cmH_2O. When the ABG results show evidence of respiratory acidosis, we incrementally increase the DP by 1 to 2 psi (up to 40 psi) to improve gas exchange. In addition, we decrease the frequency to allow more time for passive expiration, especially when the frequency is high. This is contrary to traditional positive pressure ventilation where higher respiratory frequency increases CO_2 elimination. However, if the ABG results show respiratory alkalosis, we lower DP and increase the frequency. Importantly, if the patient experiences persistent desaturation, or worsening ABG results while on HFJV, we may convert to traditional positive pressure mechanical ventilation. Since this ventilatory technique increases chest movement during the ablation procedure, the plan must be communicated to the team.

It is noteworthy that the patient's temperature was monitored via an esophageal probe to detect excessive rises in temperature during ablation, to prevent esophageal thermal damage. However, according to the Oesophageal Probe Evaluation in Radiofrequency Ablation of Atrial Fibrillation trial,[6] esophageal lesions occur regardless of esophageal temperature monitoring and such monitoring did not demonstrate a lower occurrence of esophageal damage. The study showed that the peak esophageal probe temperature appeared to not correlate with the incidence of endoscopically diagnosed esophageal lesions.[6]

In summary, many anesthesia techniques and monitoring modalities can be utilized for PVI AF ablation procedures. The decision to select one technique over another depends on multiple factors as discussed. General anesthesia with TIVA and HFJV was the chosen technique at this facility as it seems to facilitate desirable outcomes for the procedure.

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Scoliosis Repair for Patient with Osteogenesis Imperfecta

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Keywords: osteogenesis imperfecta, scoliosis, spinal fusion

Osteogenesis imperfecta (OI), affecting approximately 1 in 10,000-20,000 births, is a rare inherited disorder. Due to various genetic mutations, OI results in development of fragile bones that fracture and deform easily.[1-5] OI is classified into subtypes based on its widely variable clinical presentation that may include growth deficits, osteoporosis, ligament laxity, abnormal dentition, blue sclera, coagulopathies, hearing loss, cardiac anomalies, and impaired respiratory function.[1,2,4,5] Patients with OI often require surgical interventions for their deformities. They pose many challenges for anesthesia providers as they are at increased risk for difficult airway, hyperthermia, blood loss, uncontrolled pain, and inadvertent intraoperative injury.[1,4]

Case Report

A 16-year-old male presented to the operating room (OR) for a T2-T12 posterior spinal fusion to correct his scoliosis. In addition to OI, the patient's history was significant for postoperative nausea and vomiting (PONV), frequent nosebleeds, and bilateral femur fractures requiring surgical repairs with rod placement. The patient was 154 cm tall and weighed 41 kg, with a BMI of 17.3 kg/m^2, classifying him as underweight. He had no known drug allergies. Outpatient medications included zoledronic acid, a bisphosphonate that inhibits osteoclastic-mediated bone reabsorption to improve osteoporosis.[4] All preoperative laboratory values, electrocardiography, and echocardiogram findings were within normal limits. A preoperative exam revealed a Mallampati score of 2 with poor dentition, limited cervical spine range of motion, and a patient-reported inability to lay flat due to numerous contractures.

The patient was wheeled into the OR on a stretcher with the head of the bed elevated to the patient's comfort level. Anesthesia was induced in this position with midazolam 2 mg, fentanyl 50 mcg, lidocaine 20 mg, and propofol 150 mg intravenously (IV). A video laryngoscopy was performed for endotracheal intubation with the patient still in the upright position. After successful intubation and initiation of mechanical ventilation, an orogastric tube (OGT), bilateral gauze bite blocks, and urinary catheter with temperature monitoring capability were placed. An arterial line was placed in the left radial artery for continuous blood pressure monitoring. A second arterial line was placed in the right radial artery due to poor blood pressure correlations between the arterial line and the noninvasive blood pressure (NIBP) cuff. Unfortunately, the second line demonstrated the same problem, so NIBP measurements were taken on the patient's thigh throughout the procedure. The patient was then placed into the lateral decubitus position for spinal anesthesia where morphine 280 mcg was injected into the intrathecal space.

After induction, the patient was placed on the operative table in the prone position. Prior to incision, albumin 500 mL, dexamethasone 4 mg, cefazolin 1.2 g, gentamicin 200 mg, and rocuronium 15 mg were administered IV, and an IV infusion of tranexamic acid (TXA) was initiated at 1 mg/kg/hr. The patient was maintained under anesthesia with propofol and remifentanil IV infusions, and neuromonitoring was performed throughout the case. Phenylephrine was given via IV boluses and a continuous IV infusion to maintain a mean arterial pressure (MAP) greater than 75 mm Hg. A lower body forced-air warming blanket was utilized to maintain intraoperative normothermia.

At the end of the case, the patient received ondansetron 4 mg, acetaminophen 1 g, hydromorphone 0.2 mg, ketorolac 15 mg, and sugammadex 200 mg. A deep extubation was performed uneventfully. The estimated blood loss was 600 mL

In the post-anesthesia care unit (PACU), the patient demonstrated low age-appropriate blood pressures requiring support with albumin 500 mL and phenylephrine. Additionally, the patient displayed prolonged sedation with oxygen desaturation and was ultimately given naloxone 60 mcg IV with positive effect.

Discussion

Much of the anesthetic management for a patient with OI involves attempting to prevent intraoperative injury. Every intervention, from airway management to positioning to blood pressure monitoring, must be performed with an abundance of caution and collaboration as these patients are highly vulnerable to trauma. This is especially true while they are under general anesthesia as they are unable to assist or express discomfort.

Airway management for a patient with OI can be challenging due to the likelihood of cervical spine anomalies, facial deformities, and dental abnormalities.[1,2] Manipulating the patient into a proper sniffing position may be dangerous or even impossible. Additionally, laryngoscopy can cause mandibular fracture, cervical instability, and dental damage.[1] Video laryngoscopy, fiberoptic bronchoscopy, and intubating laryngeal mask airway are recommended when appropriate to avoid these dangers.[1] In this case, video laryngoscopy was performed without incident, allowing the patient to maintain a comfortable upright position during endotracheal intubation.

Intraoperative hyperthermia has been observed in patients with OI, which is attributed to hypermetabolism.[1,4] It has been suggested that volatile agents and succinylcholine be avoided in patients with OI as some argue that this hyperpyrexia may be mistaken for malignant hyperthermia. Furthermore, fasciculations following the administration of succinylcholine may cause fractures.[1] Despite neuromonitoring being required for this case, which often warrants the use of shorter-acting neuromuscular blockade as seen with succinylcholine, the patient was given longer-acting rocuronium for safety. Volatile agents were also avoided during this case; the patient was able to cooperate with IV placement and therefore did not require an inhalation induction, and anesthesia was maintained with total intravenous anesthesia (TIVA) to avoid volatile-associated impedance of neuromonitoring.[6] Intraoperatively, the patient's maximum temperature was 37.3°C, which is considered normothermic.[4]

Continuous intraarterial hemodynamic monitoring is recommended for multilevel spinal fusions to allow anesthesia practitioners to monitor blood pressure continuously and have easy access to blood sampling.[6] However, after the anesthesia practitioners were unsuccessful in placing an arterial line twice, they decided to obtain NIBP measurements on the patient's thigh for the duration of the case. While NIBP cuffs on non-rodded extremities may cause fractures with inflation, this was deemed acceptable by the anesthesia clinicians as the patient's thigh had previously been surgically rodded.

Patients with OI are susceptible to increased intraoperative bleeding due to capillary fragility and platelet dysfunction.[1,2] Additionally, scoliosis repairs are often associated with high volumes of intraoperative blood loss, ranging from 500-2,000 mL.[6] Preoperative testing for platelet quantity and function, such as a complete blood count (CBC), thromboelastogram (TEG), or rotational thromboelastometry (ROTEM) may be indicated. A CBC can also assess baseline hemoglobin and hematocrit (H/H) levels, which may help predict and guide the patient's need for intraoperative red blood cell transfusion. This patient had normal preoperative H/H levels of 13.9 g/dL and 43.1%, and a normal platelet level of 368, though their functionality was not tested via TEG or ROTEM. For this patient, intraoperative bleeding was deemed to be well-controlled, and the patient did not require a blood transfusion.

Perioperative pain control for patients with OI may be challenging due to their high requirement for surgical interventions and therefore repeated exposure to opioids and other analgesics, putting them at risk for tolerance and inadequate analgesia over time.[3] Moreover, patients undergoing complex spine fusion surgery are at risk for moderate to severe postpreparative pain due to its invasive nature.[6] Furthermore, patients with spinal deformities requiring surgery often experience chronic pain.[6] Many studies have demonstrated the benefits of preoperative administration of intrathecal morphine for pediatric spine surgery including postoperative long-term pain control, reduced blood loss, enhanced bowel function, decreased time to ambulation and urinary catheter removal, and shorter hospital stay.[6,7] However, there remains debate regarding the recommended dose, with guidelines ranging from 2-20 mcg/kg. One study by Skaggs and colleagues suggests a dosing regimen of 4-5 mcg/kg with a maximum dose of 200 mcg to provide adequate pain control while avoiding adverse side effects, most notably somnolence and respiratory depression.[7] In this case, 280 mcg—roughly 7 mcg/kg— of intrathecal morphine proved to be an excessive dose, as the patient required postoperative naloxone for opioid reversal due to over-somnolence.

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Preserving Quadriceps Function in Athletes after ACL Reconstruction

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Keywords: Adductor canal block, IPACK block, femoral nerve block, quadriceps function
Femoral nerve blockade has long been used as an effective modality to control postsurgical pain in patients undergoing various knee surgeries. However, due to the motor nerve fiber blockade, it can delay immediate aggressive rehabilitation especially in athletes where quadriceps function is essential for safely returning to athletics. With the introduction of the adductor canal block, more evidence supports the use of this block as it produces equivalent analgesia while better preserving quadriceps strength. This case report explores these two blocks and their impact on immediate and long-term postoperative rehabilitation.

Case Report

A 24-year-old, 85kg, 182 cm female presented to the preoperative holding area for a left anterior cruciate ligament (ACL) reconstruction four weeks after rupturing her ACL. Pertinent past medical history included controlled gastroesophageal reflex disease (GERD), and Ehlor's Danlos Syndrome. Past surgical history included an initial right knee ACL reconstruction in 2020 and a redo right ACL reconstruction in 2022; both cases were without anesthetic complication.

Upon entering the preoperative area, consent was obtained, surgical site marked, and preoperative laboratory results were reviewed. A 20-gauge right wrist intravenous catheter was inserted, and standard noninvasive monitors were applied. Supplemental O_2 2 L/min by nasal cannula was provided. The patient was positioned supine with the left leg abducted and externally rotated. A timeout was performed. Fentanyl 100 mcg and midazolam 3 mg were administered. The medial thigh and popliteal fossa were prepped using chlorhexidine and alcohol solution. A sterile cover was applied to the ultrasound probe and a cross section view of the anteromedial thigh between the middle and distal third of the thigh was obtained for an adductor

canal block (ACB). The superficial femoral artery was identified, the skin was localized with 1% lidocaine, and an 80 mm 21-gauge blunt tip needle was inserted into the vastoadductor membrane under direct visualization between the medial border of the sartorius muscle and medial border of the adductor longus muscle, anterior to the femoral artery. Aspiration of the needle was negative for blood and 0.5% ropivacaine 20 mL with dexamethasone 4 mg was incrementally administered. Local anesthetic spread around the artery was confirmed under ultrasound.

The ultrasound probe was then repositioned in the popliteal fossa and the popliteal artery was located in cross-section. Another block needle was inserted from the lateral side of the knee under direct visualization towards the medial femoral epicondyle for infiltration between the popliteal artery and capsule of the knee (IPACK block). The needle was positioned beneath the popliteal artery and into the fascial plane adherent to the medial femoral epicondyle. Aspiration of the needle was negative for blood and another 20 mL of 0.5% Ropivacaine with 4 mg of dexamethasone was injected. The nurse anesthesia student performed both blocks. The patient tolerated both the procedures well and was then transported to the operating room. Following preoxygenation for three minutes, general anesthesia was induced with lidocaine 80mg, propofol 200mg, and rocuronium 50mg. The trachea was intubated successfully, mechanical ventilation instituted, and anesthesia maintained with sevoflurane in oxygen. For multimodal pain therapy, the patient received intravenous ketamine 40 mg, magnesium sulfate 2 g, and acetaminophen 1 g. Overall, the surgical procedure and anesthetic course were uneventful, the repair was completed, the patient emerged from anesthesia, and she was transported to the post-anesthesia care unit.

Discussion

The majority of ACL injuries often occur as the result of landing from a jump and lateral cutting (non-contact).[1] Muscle atrophy and quadriceps weakness after acute ACL injury and subsequent reconstruction is a focal issue for athletes returning to sport. As opioid-sparing techniques become commonplace in ambulatory surgery centers, utilizing regional anesthesia techniques will continue be a highly utilized tool to decrease incisional pain and discomfort after surgery while decreasing opioid consumption and delays in PACU times.[2,3-5] When localizing the femoral nerve, the patient can expect to have numbness covering the entire anterior aspect of the extremity. For those undergoing isolated ACL reconstruction, this has been shown to decrease immediate postoperative ambulation, increase the risk of falls, and decrease quadriceps activation.[2-4] For patients receiving the adductor canal block, the motor neurons innervating the quadriceps muscles are generally spared while the anterior aspect of the knee is still covered through pure sensory blockade. Literature consistently supports the adductor canal block as an equivalent analgesic option in this population.[2,3-6] Because the adductor canal block is a motor sparing technique, most patients can participate in quadriceps specific exercises.

One systematic review analyzing the short-and long-term effects of lower extremity regional techniques in 655 patients who underwent ACLR. Patients who received the ACB, compared to the FNB, had better quadriceps function in the first 24 postoperative hours. However, there was no difference in functional ability between the two groups at 6 months.[6] A similar systematic review revealed that those receiving an ACB were found to have short-term benefit in strength

preservation and voluntary isokinetic movements compared to the FNB within the first 24 hours after surgery; however, no strong recommendations could be made regarding the use of one block over another when it comes to long-term quadriceps function.[2] Other studies comparing ACB and FNB yielded similar results; patients who received a FNB over the ACB had reduced quadriceps strength with one study stating deficits persisted for as long as 6 weeks postoperatively, but resolved by the 6-month follow up.[3,5-7]

One study in particular assessed different types of anesthesia (FNB only, general only, spinal and combined techniques) and found no significant difference at 6-months regardless of technique.[7] This is particularly important as it has been thought that regional techniques further accentuate overall quadriceps weakness. Additionally, one study comparing 4,093 patients concluded that only 19.6% (or 1:5) of patients achieved symmetrical limb function regardless of the use of regional techniques, pointing to a need of improved rehabilitation protocols rather than poorer outcomes related to regional technique implementation.[8]

Although many studies support the use of the ACB over the FNB for early, postoperative rehabilitation and muscle activation, there is insufficient evidence at this time to demonstrate that ACBs preserves quadriceps function better at 6-month assessments.[2-7] Furthermore, data is limited to correlate FNBs causing measurable deficits in functional outcomes and return to sport testing at 6 months.[3,4,7] Based on current knowledge of physiological and neuromuscular changes that happen throughout the body following injury, the ACB has been widely accepted as the preferred block for anterior knee procedures because of its attractive profile for clinicians and patients as is spares many of the motor fibers while adequately controlling pain similar to the FNB.[2,3,6] The ACB, compared to the FNB limits the risks of falls and allows patients to start early rehabilitation, which is essential for early quadriceps neuronal activation and muscular function for those recovering from isolated ACL reconstruction.[5]

The ACB is also a technique that is not difficult to deliver and is usually one of the first blocks performed by novice providers, making it a more attractive option for providers and students. Regardless, practitioners should familiarize themselves of both techniques for individualizing of techniques to each patient's needs. Further research should aim towards obtaining adequate, long-term follow-up assessments, standardizing back-to-sport rehabilitation protocols, limiting heterogeneity in surgical approaches, and highlighting the impact of regional techniques on specific graft sites and overall surgical extremity function.

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Periodic Paralysis: A Case Report and Review of Anesthetic Management

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Keywords: Periodic Paralysis, transient paralysis, generalized weakness, postoperative

Periodic paralysis is a rare group of genetic neuromuscular disorders characterized by episodes of muscle weakness or paralysis, typically sparing the respiratory muscles.[1-3] These episodes vary in duration and severity, leading to temporary paralysis.[1-2] The underlying cause is often abnormal ion channel function, disrupting the flow of ions, such as potassium, sodium, or calcium, into and out of muscle cells.[1-2] The prevalence of periodic paralysis varies depending on the specific genetic variant, with the most common form occurring in approximately 1 in 100,000 individuals.[1-2] This case study focuses on a postoperative episode of transient paralysis and discusses the management strategies used.

Case Report

A 29-year-old male, weighing 91.7 kg and measuring 177.8 cm (BMI 29 kg/m²), was scheduled for a bilateral tonsillectomy and adenoidectomy. The patient's medical history included gout. He was recently treated with allopurinol. The patient's previous surgical history was wisdom teeth extraction under conscious sedation with local anesthetic. He had no anesthesia complications

noted during that procedure. Notably, the patient denied any history of neuromuscular disorders, either personally or within his family.

Preoperatively, the patient was administered intravenous (IV) midazolam 2 mg. Upon arrival in the operating room (OR), he self-transferred to the operating table and was positioned supine. Standard noninvasive monitoring was applied, and preoxygenation was performed using O_2 10 L/min via a face mask for 5 minutes. Induction of general anesthesia was achieved with IV fentanyl 100 mcg, lidocaine 100 mg, and propofol 200 mg. After confirming adequate bag-mask ventilation, rocuronium 50 mg IV was administered for neuromuscular blockade. Endotracheal intubation was performed using a 7.5 ETT, confirmed by auscultation of bilateral breath sounds and end tidal carbon dioxide ($ETCO_2$) waveform capnography. Mechanical ventilation was initiated with a volume-controlled mode, set to deliver a tidal volume of 500 mL, a respiratory rate of 12/min, and a peak end-expiratory pressure of 5 cm H_2O.

Anesthesia was maintained with sevoflurane at an inspired concentration of 2.2% in a 1:1 mixture of O_2 and air (1 L/min each). Prior to incision, the patient was given IV dexamethasone 10 mg and fentanyl 50 mcg. During the surgical procedure, the patient also received IV acetaminophen 1 g and an additional fentanyl 50 mcg. Vital signs fluctuating within 20% of baseline.

The surgery was uneventful. At the conclusion of the surgery, 8 mL of liposomal bupivacaine was administered locally to the surgical site by the surgeon. At this time, the patient's train of four was checked, which showed four of four twitches. The Neuromuscular blockade was antagonized with IV sugammadex 200 mg. Sevoflurane was discontinued. Spontaneous ventilation returned, but the patient's tidal volumes were initially less than 100 mL. Pressure support was applied at 15cm H_2O, and the tidal volumes improved to over 600 mL. The patient remained unresponsive. The peripheral nerve stimulator was rechecked and showed four of four twitches; a second dose of sugammadex 200 mg was administered. The patient eventually responded to verbal and tactile stimulation. He was placed back on spontaneous ventilation, demonstrated adequate tidal volumes, and was extubated. He was then transferred to the post-anesthesia care unit (PACU) on O_2 8 L/min via a simple face mask (SFM).

Upon arrival in the PACU, the patient's vital signs remained stable, and he responded appropriately to verbal stimuli. However, shortly thereafter, the anesthesia practitioner was alerted to his difficulty breathing and inability to move his limbs. Upon reassessment, the patient was noted to be breathing without distress and had an oxygen saturation of 100% on 8 L/min SFM. Patient exhibited tachypnea (21-27/min) and hypertension (systolic blood pressure 135–156 mm Hg, diastolic blood pressure 82–98 mm Hg). Despite the peripheral nerve stimulator showing four of four twitches, another sugammadex 200 mg was administered. The patient, however, reported being unable to move all four extremities but retained sensation. Bilevel positive airway pressure (BiPAP) was initiated to evaluate tidal volumes and provide respiratory support. Neurology was consulted. An MRI of the brain and spine was performed, revealing no significant abnormalities.

The patient was subsequently transferred to the intensive care unit (ICU) for further monitoring. Over the next several hours, he gradually regained voluntary movement in all four limbs,

although muscle weakness persisted. Oxygen was weaned to 2 L/min via nasal cannula. The patient reported that while he had previously experienced generalized weakness after physical activity during college, he had never encountered symptoms as severe as this. Genetic testing was ordered to assess for a potential diagnosis of periodic paralysis. His neuromuscular status returned to baseline within 48 hours, and he was discharged with a scheduled follow-up appointment with the neurology department. On his follow-up several months later, no clear etiology for his symptoms was determined, and genetic testing did not identify a pathogenic causal abnormality.

Discussion

Periodic paralysis is classified into two broad categories: primary and secondary.[4] Primary periodic paralysis is further subdivided into variants based on serum potassium levels: hypokalemic, normokalemic, and hyperkalemic periodic paralysis.[4] Secondary causes of periodic paralysis can occur in the context of systemic conditions such as thyrotoxicosis, primary aldosteronism, or metabolic disturbances associated with diabetes and renal tubular acidosis.[4] In addition to these causes, periodic paralysis can be triggered by a variety of factors, including strenuous exercise, exposure to cold temperatures, stress, and dietary changes such as fasting or increased carbohydrate intake.[1-2]

Although attacks of generalized muscle weakness typically begin in childhood or adolescence, the diagnosis of periodic paralysis can often be delayed for years or even decades.[1-2] This delay in diagnosis is due, in part, to the episodic nature of the condition, with patients sometimes experiencing long periods of normal function between episodes.[1-2] In this case, the patient had a history of generalized weakness after physical activity during college, which he believed was "normal." This detail only emerged during a thorough postoperative interview. Furthermore, the lack of any family history of neuromuscular disorders made it difficult to suspect periodic paralysis prior to the patient's postoperative episode.

From an anesthetic perspective, the primary concern was the possibility of incomplete antagonization of neuromuscular blockade, especially after the initial doses of sugammadex. Despite the peripheral nerve stimulator showing four of four twitches, the patient exhibited signs of incomplete antagonization of rocuronium, including tachypnea and hypertension.[5] These signs prompted the anesthesia team to re-dose sugammadex, even though the peripheral nerve stimulator exhibited 5 seconds of sustained tetany. This unusual response led to the decision to initiate BiPAP and consult with neurology for further evaluation.

The patient's postoperative weakness, including the inability to move all four extremities, along with preserved sensation, raised concerns about a neuromuscular disorder. Neurology was consulted. An MRI of the brain and cervical spine was performed to rule out conditions such as cerebrovascular accidents (CVAs), spinal cord stenosis, or spinal vascular injury. Fortunately, the MRI findings were unremarkable, and these differential diagnoses were ruled out. In addition, an arterial blood gas (ABG) was collected. The results were normal, ruling out metabolic causes for the patient's symptoms. Alternative differentials that were considered but subsequently ruled out due to inconsistent symptomatology included total subarachnoid spinal

block resulting from the inadvertent subarachnoid injection of liposomal bupivacaine, or systemic toxicity arising from the inadvertent vascular injection of liposomal bupivacaine.[1]

After the consultation with neurology, a diagnosis of periodic paralysis was suspected, and genetic testing was ordered to confirm this. The results of genetic testing are not always conclusive, as up to 30% of patients with periodic paralysis may have no identifiable genetic mutation.[2] One key test that was not performed but would have been important in this case is a thyroid panel to assess for thyrotoxic periodic paralysis (TPP).[3] TPP is a rare form of periodic paralysis that is associated with hyperthyroidism and occurs in 0.1-0.2% of patients with hyperthyroidism.[3] It is most common among Asian males, making it a particularly relevant consideration in this patient.[3] The patient's ethnicity and the absence of other systemic abnormalities suggest that TPP could be a potential cause of his symptoms, though it was not specifically tested for in this case.

This case highlights the need to consider rare neuromuscular disorders, like periodic paralysis, in the perioperative setting. Despite lacking a known history of neuromuscular disease, the patient experienced severe muscle weakness after surgery, raising concerns about periodic paralysis. A timely consultation with neurology and appropriate tests helped confirm the diagnosis and guide management.

The case also illustrates the complexities of managing periodic paralysis during surgery. During general anesthesia, depolarizing neuromuscular blockades, corticoid steroids, and glucose infusions should be avoided in these patients. When unusual symptoms arise, a thorough evaluation is crucial. Fortunately, the patient’s symptoms resolved with supportive care and monitoring, leading to a full recovery within 48 hours. This emphasizes the importance of being vigilant for rare neuromuscular conditions in atypical postoperative situations.

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Ultrasound Guided Neuraxial Anesthesia in the Obese Patient

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Keywords: ultrasound guidance, neuraxial anesthesia, spinal, epidural, obese

Introduction

According to the 2021 National Health and Nutrition Examination Survey report,[1] 41.9% of adults 20 years and older are considered obese with an average body mass index (BMI) ≥ 30kg/m^2.[1] This percentage of obese adults presents unique challenges that have shifted healthcare delivery by practitioners to maintain patient safety. According to Şalvız,[2] obese patients have a greater risk of developing cardiopulmonary alterations along with co-morbidities that predispose them to higher perioperative morbidity and mortality under general anesthesia. Therefore, neuraxial anesthesia should be explored by anesthesia professionals when appropriate.

Neuraxial anesthesia involves the placement of local anesthetics and adjuncts in either the epidural and/or intrathecal space for analgesia and anesthesia. Historically, anesthesia providers have utilized anatomic landmark palpation (ALP) to identify the interspinal spaces for needle insertion. The ALP method is more challenging in obese patients, given the anthropometric changes and increased adipose tissue, and may challenge the practitioner in ways that can potentially cause harm. In fact, a failure rate of 27 to 32% in obese patients when utilizing the traditional ALP method has been observed.[3] Multiple passes of the needle may cause trauma, leading to bleeding, injury, and other complications. As a result, alternative methods that accurately identify the interspinal spaces are beneficial.

Ultrasound (US) is a viable option to decrease unsuccessful attempts when performing neuraxial anesthesia in the obese population. Ultrasound enhances the efficacy and safety of combined spinal epidural (CSE) procedures.[4] Although many anesthesia providers embrace US technology, the ALP method is traditionally used. This article compares the ALP method to the US method to evaluate the benefits of US guidance in neuraxial anesthesia. The primary outcome examined between the ALP and US methods is the first-attempt success rate. In addition to comparing first-attempt success rates, secondary outcomes of procedure duration and complications were evaluated.

Methods

A research question utilizing the population, intervention, control, and outcomes (PICO) format was developed. The PICO asks, “In adult obese patients receiving neuraxial anesthesia, is there a statistically significant difference in first-attempt success rate between an US-guided neuraxial technique and traditional anatomic landmark palpation?” The inclusion criteria for articles of interest were patients with a BMI ≥ 30kg/m^2, ultrasonography use, neuraxial anesthesia, and

adults ≥19 years of age. Conversely, the exclusion criteria were articles involving patients <19 years of age, animal studies, regional anesthesia procedures, opinion articles, and literature studies greater than ten years.

With the help of a research librarian, medical literature analysis and retrieval system online (Medline), and Excerpta Medica (Embase) databases were searched via PubMed and OVID, respectively. The literature search used the keywords o*besity, ultrasound, neuraxial anesthesia, epidural anesthesia, and spinal anesthesia*. In addition, medical subject headings terms *obesity, morbid obesity, maternal obesity, epidural anesthesia, spinal anesthesia, neuraxial anesthesia, and ultrasonography* were utilized in PubMed. Altogether, 221,284 articles resulted from Medline, and 145 articles from Embase. The number of articles was consolidated by applying Boolean operators and filters, *full text, ten years, English, and human*. Two hundred and eighty-six articles were identified: 230 and 56 from Medline and Embase respectively.

Sixty of those articles were detected as duplicates by a citation manager and were eliminated. Of the 226 abstracts screened, 28 were excluded for incorrect population, 102 for incorrect subject matter, and 15 for further duplication not identified by the citation manager. Of the remaining 81 articles, 55 were retrieved and assessed for further eligibility as 26 were unretrievable. Three of the 55 articles were excluded due to animal study; eight did not satisfy procedural method, 15 failed to meet population criteria, and 21 contained unrelated content. A total of eight articles were deemed acceptable for review.

By using Google Scholar, an additional effort was made to locate the 26 articles that could not be retrieved. Eleven articles were located with two articles remaining inaccessible. Of the remaining nine, seven articles were excluded due to wrong population and not satisfying the procedure method thus resulting in two additional articles for review. A total of 10 articles were reviewed; however, three articles were excluded due to being published more than eight years ago. Of the seven articles, five were randomized controlled trials (RCTs) and two were case studies.

Literature Analysis

First-attempt success rate, procedure duration, and complications were assessed across the seven articles with first-attempt success rate being the primary outcome of interest. Only five of the seven articles compared first-attempt success rate and a synthesis table compares the primary outcome measure (Table 1). Across the articles, procedure duration was inconsistently defined, and complications were not universally reported.

Three of the seven articles reviewed [4-6] were RCTs that observed first-attempt success rate by comparing US to ALP in obese patients; however, neuraxial type and approach varied. One of the three articles reported on the epidural technique,[5] one on the spinal technique,[6] and the other on the CSE technique.[4] All the studies except one utilized the US before needle insertion (pre-procedural scanning), while Jiang et al.[5] used real-time US guidance. The three trials all demonstrated a statistically significant ($p<0.05$) higher first-attempt success rate in placing neuraxial anesthesia in the US group.

Ni et al.[4] observed 80 obese parturients with 40 in each US and ALP group. A first-attempt success rate of 72.5% in the US group was observed, whereas the success rate was only 40% in the ALP group ($p = 0.003$). Jiang et al.[5] included a sample size of 60 obese parturients of which 30 were in the US group and 30 in the ALP group. Results obtained included a first-attempt success rate of 56.7% with US guidance and 30% with the ALP method ($p =0.037$). Li et al.[6] observed 80 obese parturients, of which 40 were included in the US group and 40 in the ALP group, with a first-attempt success rate of 87.5% with the US guidance and 52.5% with the ALP method. Additionally, Li et al.[6] further stratified the first-attempt success rate *p*-values by the patient's BMI class: BMI of 30-34.9 kg/m^2, $p=0.407$; BMI of 35–39.9 kg/m^2, $p=0.011$; BMI of 40–43 kg/m^2, $p =0.41$.

Two additional articles[7-8] were case studies discussing first-attempt success rate with the use of pre-procedural US. Compagnone et al.[7] reported a first-attempt success on one obese parturient (BMI = 64.5 kg/m^2) when placing an epidural and Lebbi et al.[8] reported a first-attempt success on one obese patient (BMI = 53 kg/m^2) with spinal anesthesia.

Five of the seven articles [4-6,9-10] discussed procedure duration. It is important to note procedure duration had variable start and end points across the studies leading to difficulty in drawing a conclusion. Two of the seven studies[5,9] demonstrated a statistically significantly greater procedure duration in the US group as compared to the ALP group *(*$p <0.001$; $p <0.001$). Alternatively, two articles [6,10] reported a greater procedure duration in the ALP group ($p <0.001$; $p <0.01$). Only Ni et al.[4] did not demonstrate statistically significant results ($p =0.573$).

Four of the seven articles reported information regarding complications during neuraxial placement.[4-6,9] The list of possible complications reported included: bloody CSF tap, accidental dural injury, paresthesia, back pain, pain at puncture site, post dural puncture headache (PDPH), headache not related to PDPH, ecchymosis, difficulty in catheterization or traumatic catheterization, and unsuccessful or asymmetrical blockade. Results amongst the trials were inconsistent and difficult to draw conclusions. However, paresthesia was reported in all four articles,[4-6,9] two of which [4-5] reported lower rates of paresthesia in the US group compared to the ALP group. Of these two articles,[4-5] only Ni et al.[4] showed a statistically significant result (7.5% vs 45%; $p \leq 0.001$).

Although results indicate the use of US is favorable to improve first-attempt pass rates in the obese population, limitations do exist. The most substantial limitation is that, of the seven articles, five[4-7,10] involved only parturients, which does not represent a substantial portion of patients who may receive neuraxial anesthesia. It would also be of interest to focus on the morbidly obese population (BMI $\geq$ 40 kg/m^2) given that these individuals' body habitus is more altered than those deemed merely obese. Perhaps there is an additional advantage for these patients. To further strengthen results, an effort should be made to utilize the same anesthesia professionals throughout each study to mitigate potential variability in skill levels. ~~Additionally~~, It would be beneficial if the US type and method in which US was utilized for neuraxial anesthesia were consistent. Jiang et al.[5] used a real-time US guidance approach, whereas two other studies[4,6] used the pre-procedural scanning method. Despite the limitations, three RCTs[4-6] produced results demonstrating the use of US guidance increases the first-attempt success rate in placing a neuraxial block in the obese population when compared with ALP technique. The

utilization of US in obese patients for neuraxial anesthesia should be implemented for anesthesia practitioners to improve first-attempt success rate.

Table 1. Ultrasound Guided Neuraxial Anesthesia and First-Attempt Success Rate

Article	Level of Evidence	Neuraxial Anesthesia Type and Technique	Results
Compagnone et al,[7]	Case Study	Epidural Real-time US	Epidural placed in single attempt with US No *p*-value reported
Jiang et al,[5]	RCT	Epidural Real-time US vs. ALP	First attempt success rate in US group, 56.7% First attempt success rate in ALP group, 30% $p = .037$
Lebbi et al,[8]	Case Study	Spinal Pre-procedure US	Spinal placed in single attempt with US No *p*-value reported
Li et al,[6]	RCT	Spinal Pre-procedure US vs. ALP	First attempt success rate in US group, 87.5% First attempt success rate in ALP group, 52.5% First attempt success rate subgroup analysis by BMI; BMI 30-34.9 kg/m^2 ($p = .407$), BMI 35-39.9 kg/m^2 ($p = .011$), BMI > 40 kg/m^2, $p = .041$)
Ni et al,[4]	RCT	CSE Pre-procedure US vs. ALP	First attempt success rate in US group, 72.5% First attempt success rate in ALP group, 40% $p = .003$

Abbreviations: BMI, body mass index; US, ultrasound; ALP, anatomic landmark palpation; RCT, randomized controlled trial; CSE, combined spinal epidural

Conclusion

The population in the United States is reaching an all-time high obesity rate, which will be reflected in the surgical population. This population is more likely to develop cardiopulmonary complications in the perioperative period from general anesthesia and it is therefore prudent to consider a different modality of anesthesia, such as neuraxial or regional anesthesia when applicable.

Traditionally, ALP is the method anesthesia practitioners utilize to administer neuraxial anesthesia. Though beneficial, this method can be challenging for obese patients due to less obvious landmarks from excess subcutaneous tissue. This can lead to more attempts, whether it be redirecting the needle or taking the needle out and reattempting all together. This literature review indicated ultrasound guidance can improve the first-attempt success rates in this population.

However, the study limitations have also been observed. The majority of studies were related to parturients, which is not the general population. It would be beneficial to conduct more studies on the morbidly obese (BMI $\geq$ 40 kg/m^2). In addition, consistency in variables such as the anesthesia practitioner and the method in which the US was used to guide neuraxial anesthesia placement (real-time vs. pre-procedural scanning) may potentially strengthen the findings from

this review. Overall, despite the limitations, the use of US in obese population when administering neuraxial anesthesia is recommended to improve first-attempt success rate.

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Mentor: Peter Slivinski, DNP, CRNA

Editorial

I often use this platform to thank the numerous volunteer editors and reviewers who support the ISJNA. This time I'd like to focus on the mentors who encourage (or require :-) their students to submit their work for publication and guide them through the process. Your involvement is essential to the success of this journal, and I appreciate the effort it takes to mentor a student through the preparation and revision of their submission. Thank you for taking the time to shape the future leaders of our profession and expose them to the importance and satisfaction of contributing to our body of knowledge!

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 ^{o}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