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Front Cover:
Doctoral students enrolled in the Yale New Haven Hospital School of Nurse Anesthesia (YNHHSNA) participate in a cardiac dissection lab during their first year in the program. In the photo on the left, from left to right, are Elizabeth Kveton RN, BSN, CCRN and Magdalena Gregorczyk RN, BSN, CCRN. The photo on the right, from left to right, again shows Liz Kveton and Magdalena Gregorczyk, mentored by YNHHSNA clinical instructor Kyle McClintock, MS, CRNA, APRN.

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For additional information, please contact:

Vicki Callan, PhD, CRNA, CHSE
Webster University Department of Nurse Anesthesia
Browning Hall, ISB 107
8274 Big Bend Blvd.
St. Louis, MO 63119
314-246-5928; Intsjna@aol.com

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Case Reports

Zenker's Diverticulum in the Achondroplastic Patient

Alina Mujukian, MS, BSN
Northeastern University

Keywords: Zenker's diverticulum, achondroplasia, dwarfism, airway management

Zenker's diverticulum is a rare, acquired disorder with an estimated incidence of less than 0.5%.[1] Patients presenting with Zenker's diverticulum are at increased risk of aspiration. Dysfunction of the cricopharyngeal muscle results in a herniation of pharyngeal mucosa, forming a pouch in the posterior wall of the hypopharynx.[2] Achondroplasia is another rare condition, occurring in 0.5-1.5 per 10,000 live births.[3] Cervical spine and facial feature irregularities are associated with achondroplasia and produce potential difficulty with ventilation and intubation.[3,4] An achondroplastic patient with Zenker's diverticulum is a unique case with significant airway implications.

Case Report

A 55-year-old, 135 cm, 41.82 kg male with a body mass index of 22.9 kg/m^2 presented for open excision of Zenker's diverticulum and cricopharyngeal myotomy. His past medical history included achondroplasia, dysphagia, gastroesophageal reflux disease (GERD), juvenile arthritis, degenerative joint disease, and recent 20 kg weight loss. Past surgical history was significant for tonsillectomy and adenoidectomy and an unsuccessful transcervical excision of Zenker's diverticulum. Current medications included hydrocodone up to three times a day and daily marijuana use. An airway assessment and physical exam revealed a Mallampati score of 3, a thyromental distance of 3.81centimeters, limited neck flexion and extension, a class C mandibular protrusion test, and poor dentition with multiple missing teeth. Notable facial features included a protruding forehead, large mandible, and short maxilla. A barium swallow performed a few months prior revealed a 12.4 by 7.5 cm Zenker's diverticulum compressing the proximal esophagus. The anesthetic plan and preparation for this patient included aspiration precautions, cervical spine precautions, use of video laryngoscopy, and availability of emergency airway equipment.

A 20-gauge intravenous (IV) catheter was placed in the patient's left wrist preoperatively. The patient was brought into the operating room and standard noninvasive monitors were applied. The patient was placed in reverse Trendelenburg position during preoxygenation with 10L/min of oxygen. Neutral head position was achieved with a foam pillow and additional blankets.

A rapid sequence induction (RSI) was performed with propofol 150 mg, fentanyl 100 mcg, lidocaine 40 mg, and rocuronium 40 mg IV. Cormack Lehane grade 1 view was achieved with a video laryngoscope and a 7.0 mm cuffed endotracheal tube (ETT) was secured without difficulty. ETT placement was confirmed via capnography and auscultation of bilateral breath sounds. The patient was mechanically ventilated to achieved tidal volumes between 6-8 mL/kg. A second IV catheter was inserted immediately after induction of anesthesia. Anesthesia was maintained with inhaled sevoflurane and a remifentanil infusion 0.1-0.2 mcg/kg/min. Dexamethasone 10 mg IV was given for anti-inflammatory as well as antiemetic purposes.

The patient was positioned supine, arms were tucked, and the OR table was rotated 90 degrees towards the surgical team. A Miller blade and small rigid esophagoscope were used by the surgeon in an attempt to expose the larynx and esophagus. Extremely limited neck extension and rotation made attempts at locating the true esophageal lumen unsuccessful. The decision was made to postpone open resection of the diverticulum until gastroenterology could be available to perform flexible upper endoscopy to assist with identifying and intubating the esophagus. Remifentanil infusion was stopped. A train of four (TOF) assessment noted a single twitch and neuromuscular blockade was antagonized with sugammadex 200 mg IV. Ondansetron 4 mg IV was given for antiemetic prophylaxis. The patient was positioned in reverse Trendelenburg position and extubated once fully awake and following commands. In the post-anesthesia care unit, head-up position was maintained, and the patient was notified about the decision to postpone surgical intervention of his Zenker's diverticulum.

Discussion

Zenker's diverticulum is an acquired disorder occurring in a zone of weakness in the posterior hypopharyngeal wall. [2,5] Reported incidence in upper gastrointestinal studies is 1 in 800, typically manifesting after the 6th decade of life.[2] The biological mechanism of this diverticulum formation involves cricopharyngeal muscle (CPM) dysfunction and subsequent dehiscence and sac formation.[1] If the diverticulum becomes large enough, it can become food-filled and compress the esophagus, resulting in dysphagia, halitosis, globus, and coughing food.[2,5] Our patient displayed these symptoms. Due to the location of this diverticulum, patients are at risk for regurgitation of food contents and aspiration in the perioperative period, regardless of fasting.[2,5] This risk is increased in the supine position. Induction of anesthesia in the head-up position is recommended but may make tracheal intubation more challenging.[2] Our patient was preoxygenated, intubated, and extubated in reverse Trendelenburg position using video laryngoscopy with emergency airway equipment nearby.

Since pouch content is alkaline, the use of antacids and H2 blockers may be redundant; nevertheless, patients often present with recurrent aspiration pneumonitis possibly as a result of oral flora in the aspirated material.[2] Preoperative oral medication can become lodged in the diverticular sac and potentially aspirated in the lung and thus were avoided.[2] Esophageal compression and dysphagia can leave these patients malnourished and can negatively influence postoperative outcomes, including wound healing and infection rates.[2] Our patient reported a 20 kg weight loss due to symptoms related to his Zenker's diverticulum. For medically frail patients, a preoperative plan for nutritional optimization prior to surgical intervention would be advantageous.

The airway in a patient with Zenker's diverticulum may be secured with an awake fiberoptic intubation or a rapid sequence induction (RSI) without cricoid pressure.[2] The use of succinylcholine as well as cricoid pressure is contraindicated since applied pressure and fasciculations could induce regurgitation of sac contents into the hypopharynx and increase likelihood of pulmonary aspiration.[2] During this case, cricoid pressure was avoided to prevent dislodgement and aspiration of food particles in the pouch. Preoperative intravenous anxiolysis was avoided as not to diminish natural airway-protective reflexes.

In addition to Zenker's diverticulum, the patient's medical history also included achondroplasia. The pathogenesis of achondroplasia is failure of endochondral ossification resulting in stunted tubular bones and characteristic short stature.[3] Additional complications associated with this skeletal dysplasia include craniocervical instability, foramen magnum compression, midface hypoplasia, adenotonsillar hypertrophy, kyphoscoliosis, reduced vital capacity, as well as unusually collapsible larynx, trachea, and bronchi.[3,4] Facial features like macroglossia, a short maxilla, large mandible, and flat nose can make mask ventilation challenging.[6] Cervical spine abnormalities in achondroplastic patients make direct laryngoscopy positioning problematic and possibly dangerous.[6] Potential craniocervical instability and limited neck range of motion required tracheal intubation without the ability to align the oral, laryngeal, and pharyngeal anatomic axes. The patient's most recent head and neck imaging were reviewed by the anesthesia team during preoperative assessment and displayed for the surgical staff's reference in the operating room. Intubation in the head-up position in an achondroplastic patient necessitated use of laryngoscopy with a video-assisted device. In the event of difficulty, the fiberoptic bronchoscope was also available in the room.

Predicting the appropriately sized ETT or emergency airway device in achondroplastic patients can be difficult but should be based on weight rather than age.[3,6] A 7.0 mm ETT was secured without difficulty, however, in retrospect, a 6.0 mm ETT may have been a better choice for a 41.82 kg patient of small stature.

An anesthetic technique that allows for prompt awakening may be desirable for immediate evaluation of neurologic function and return of airway reflexes.[5] In addition to inhaled sevoflurane, this patient was maintained on a remifentanil infusion to facilitate a quick awakening and evaluation of neurological status.

Both Zenker's diverticulum and achondroplasia diagnosis carry significant implications for anesthesia management that were integrated to plan and deliver care for this patient. Awareness of anatomical abnormalities associated with achondroplasia as well risks associated with Zenker's diverticulum are essential in order to create a safe and comprehensive plan for airway and anesthesia management.

References

1. Little RE, Bock JM. Pharyngoesophageal diverticuli: diagnosis, incidence and management. *Curr Opin Otolaryngol Head Neck Surg*. 2016;24(6):500-504. doi:10.1097/MOO.0000000000000309
2. Abdelmalak B, Khanna A. Anesthesia for Zenker's Diverticulectomy. *J Anesth Perioper Med*. 2017;4(1):17-22. doi:10.24015/japm.2017.0003
3. McCaffer CJ, Douglas C, Wickham MH, Picozzi GL. Acute upper airway obstruction and emergency front of neck access in an achondroplastic patient. *BMJ Case Rep*. 2015;2015:bcr2015209614. doi:10.1136/bcr-2015-209614
4. Wright MJ, Irving MD. Clinical management of achondroplasia. *Arch Dis Child*. 2012;97(2):129-134. doi:10.1136/adc.2010.189092

5. Tantawy H, Myslajek T. Diseases of the gastrointestinal system. In Hines RL, Marschall KE. *Stoelting's Anesthesia and Co-Existing Disease*. 7th ed. Philadelphia, PA: Elsevier; 2018: 359-376.
6. Marschall KE. Skin and musculoskeletal diseases. In Hines RL, Marschall KE. *Stoelting's Anesthesia and Co-Existing Disease*. 7th ed. Elsevier;2018:307-538.

Mentor: Janet A. Dewan, PhD, MS, CRNA

Anesthesia Considerations for Whipple Procedure

Dipika Patel, DNP
University of Pennsylvania

Keywords: Whipple, pancreaticoduodenectomy, ampullary adenoma, pancreatic cancer, neuroendocrine tumors

A pancreaticoduodenectomy, or Whipple procedure, is a complex surgery involving the removal of the head of pancreas, first part of the duodenum, gallbladder, common bile duct, and possibly part of the stomach.[1] A Whipple procedure is used to treat tumors and other disorders of the pancreas, intestines, and bile duct. The pancreas, a vital organ lying in the upper abdomen, posterior to the stomach, secretes enzymes that help aide in the digestion of fats and proteins.[1] After removal of the structures listed above, the surgeon reconnects the remaining intestine, bile duct, and pancreas to allow for subsequent normal digestion.

Case Report

A 57-year-old, 106 kg, 167 cm female presented for a Whipple procedure. This operation was scheduled after the patient had an endoscopic retrograde cholangiopancreatography (ERCP) which revealed ampullary adenoma. The patient had allergies to clindamycin. The patient's medical history was significant for Gardner Syndrome, characterized by multiple benign/malignant colorectal polyps. Other medical history included chronic renal disease, asthma, hypertension, and 16 pack year cigarette smoking habit. Surgical history consisted bilateral endovenous ablation and a restorative proctocolectomy. Current medication included amlodipine 5 mg, lisinopril 10 mg, and metoprolol 50 mg. A complete blood count and metabolic panel were normal with the exception of an elevated creatinine of 1.2 mg/dL. The plan for general anesthetic with endotracheal tube (ETT) placement, and a transverse abdominis plane block (TAP) was discussed with the patient.

Once positioned supine on the operating table, standard monitors were placed and preoxygenation was initiated for 5 minutes with O_2 10 L/min. Baseline vital signs included a heart rate of 71 beats/min, blood pressure 132/82 mm Hg, respiratory rate 15/min, temperature 37 ºC, and SpO_2 100%. General anesthesia was induced with fentanyl 100 mcg, lidocaine 100 mg, propofol 200 mg, and rocuronium 50 mg intravenously. The trachea was intubated with size 7.0 mm ETT via direct laryngoscopy. Once endotracheal tube placement was confirmed with end tidal capnography and the presence of bilateral breath sounds, mechanical ventilation was

initiated. Volume control ventilation was implemented with tidal volumes of 450 mL, respiratory rate of 10/min. Peak inspiratory pressures were initially 13 cm H_20 with positive end expiratory pressures of 5 cm H_20. General anesthesia was maintained with sevoflurane 1% inspired concentration in a mixture of air 0.6 L/min and O_2 0.5 L/min. An orogastric (OG) tube and urinary catheter were inserted and a second peripheral intravenous catheter was placed. The radial arterial line was placed using sterile technique and monitored with a FloTrac (Edwards Lifesciences) monitor. Neuromuscular blockade was maintained with a vecuronium infusion ranging from 1-2 mg/hr IV to achieving a 1-2 twitch parameter utilizing peripheral nerve stimulation. Normothermia was maintained with an upper and lower body convective air-warming system and the administration of warm IV fluids.

Before surgical incision cefazoline 2 g and hydromorphone 0.5 mg IV were administered. A minimum systolic blood pressure of 110 mm Hg and mean arterial pressure (MAP) of 65 mm Hg was maintained with a norepinephrine infusion of 0.02-0.05 mcg/kg/min. A ketamine infusion was started at 0.5 mg/kg/hr. A total of 5% albumin 1,000 mL and Plasmalyte solution 2,300 mL were administered. Total output included an estimated blood loss of 450 mL and urine output of 350 mL. Intraoperative blood glucose was checked via glucometer every hour and goal range of 121-180 mg/dL was achieved throughout the case. If the blood glucose was higher than 180 mg/dL, it was treated with human regular insulin infusion starting at 0.5-1 units/hr and increased per institutional protocol.

The surgeon started closure of the incision approximately 5 hours after the start of the case. When incisional closure commenced, ketamine and vecuronium infusions were discontinued. Nausea prophylaxis included administration of ondansetron 4 mg IV. Emergence was initiated by discontinuing volatile anesthetic and increasing O_2 to 10 L/min. The peripheral nerve monitor elicited a response of 4/4 twitches after the administration of sugammadex 2 mg/kg IV, the patient was hemodynamically stable, maintained spontaneous breathing, obeyed commands and the oropharynx was suctioned. The ETT and orogastric tubes were removed without complications and the patient was placed on O2 6 L/min via simple face mask. A TAP block was then performed with 20 mL of Ropivacaine 0.5% by an anesthesia practitioner utilizing ultrasound technique and the patient was transferred to the post anesthesia care unit (PACU) with stable vital signs and controlled pain.

Discussion

Ampullary adenoma is a rare asymptomatic pre-cancerous lesion stemming from the duodenal papilla that occurs sporadically or in the context of genetic syndromes.[2] Survival rate for non-surgical approaches to ampullary adenomas is 2.5%, compared to surgical removal of the adenoma via Whipple procedure, which is 20% on a 5-year scale.[3] Advantages of performing a Whipple procedure as opposed to surgical ampullectomy, or less aggressive approaches, include reduced risk of local recurrence, exclusion of sporadic adenomas and elimination for surveillance endoscopy.[3] The choice of surgical and anesthetic management depends upon characteristics of the adenoma and the presence of concurrent duodenal polyposis. If the neoplasm does not involve mesenteric vessels, mesenteric arterial root, or hepatobiliary structures, a Whipple procedure may be performed.[1] There are two types of Whipple procedures.[3] A conventional Whipple procedure involves excision of the head of the pancreas, entire duodenum, proximal

portion of the jejunum, distal third of the stomach, gallbladder and distal half of the common bile duct.[1] A pylorus-preserving Whipple procedure conserves the gastric antrum, pylorus, and proximal 2-3 cm of the duodenum, which is subsequently anastomosed to the jejunum restoring flow of ingested contents, digestive enzymes and bile.[1] In the current case study, modification of the conventional procedure was used to decrease incidences of postoperative dumping and bile reflux gastritis.

Risk factors for developing pancreatic cancers include a family history of pancreatic cancer, chronic pancreatitis, cigarette smoking and occupational exposure to carcinogens.[4] This patient's risk factor included Gardner syndrome, a form of Familial Adenomatous Polyposis (FAP) caused by mutation in the *APC* gene and inherited in an autosomal dominate manner.[2,5] Symptoms of pancreatic cancer are determined by location of the tumor and include pancreatic duct obstruction, biliary obstruction progressing to jaundice, portal vein occlusion leading to ascites, pancreatitis, steatorrhea, anorexia, fatigue, nausea, vomiting, mid-epigastric or backpain and new on-set of diabetes.[3]

Preoperative, intraoperative, and postoperative management of pancreatic and periampullary cancers poses a considerable challenge to the anesthesia practitioner. Preoperative anesthesia considerations unique to Whipple procedure include a nutritional status, bowl preparation and glycemic control.[3] Weight loss >10-15% may be related to malabsorption from exocrine pancreatic insufficiency and parenteral nutrition and oral supplements can be considered.[3] Bowel prep was not performed in this patient secondary to concern for dehydration, electrolyte imbalance and fluid shift. New-onset of diabetes mellitus has been observed in nearly 80% of patients with pancreatic cancer secondary to pancreatic beta-cell dysfunction.[4] The main concern for the anesthetist in the perioperative management of diabetic patients has been the avoidance of harmful hypoglycemia, thus oral hypoglycemic agents such as metformin must be and were discontinued 24-48 hours prior to surgery in this case. Following a pancreatectomy, insulin receptors are upregulated peripherally, rendering patients more sensitive to hyper and hypoglycemia.[4] Additionally, frequent and precise measurement of serum glucose with utilization of institutional appropriate control measures was the standard of practice for this patient throughout the hospital stay. Lastly, intraoperative blood loss can be significant and a type and cross of at least two units of packed red blood cells should be obtained preoperatively.

The combination of general anesthesia and thoracic epidural anesthesia is the common technique of choice for Whipple procedures.[4] However, general anesthesia with multimodal intervention including TAP block was utilized for intraoperative and postoperative pain control in this case. Studies recommend avoiding intraoperative use of nitrous oxide due to small intestines distension.[4] Another intraoperative consideration includes core temperature monitoring and control of body temperature. The length of the procedure, exposure of large bowel, potential for blood loss and significant amount of fluid administration represents causes of hypothermia. [3] Furthermore, intraoperative hyperglycemia is associated with increased morbidity and mortality.[1,4] For this reason, intraoperative administration of IV dexamethasone, a glucocorticoid steroid was avoided in this patient. Likewise, intraoperative fluid resuscitation is crucial, and literature supports the use of goal directed fluid management by utilizing crystalloids and colloids to decrease visceral and interstitial edema as well as anastomotic leaks.[3] Invasive

hemodynamic line monitoring to guide therapy and monitor central pressure can be contemplated.[3]

The management of a patient undergoing a Whipple procedure is complex and requires expertise in multiple fields with anesthesia practitioners playing a crucial role in the preoperative assessment, intraoperative management, and postoperative assessment. The Whipple procedure has three different anastomoses, giving rise to postoperative complications such as wound site infection, ileus, anastomotic leak, delay gastric emptying and pancreatic fistula formation.[4] Postoperative anesthesia considerations include prevention and management of these complications, early NG/OG tube catheter and drain removal, pain relief, and early oral nutrition.[3]

References

1. Nagelhout JJ. Hepatobiliary and gastrointestinal disturbances and anesthesia. In Nagelhout JJ, Elisha S. *Nurse anesthesia.* 6th ed. Elsevier Saunders; 2018:1728-1730
2. Alexiou K, Ioannidis A, Drikos I, et al. Adenoma of the ampulla of Vater: a case report. *J Med Case Rep.* 2014;8(1):1-4. doi: https://doi.org/10.1186/1752-1947-8-228
3. De Pietri L, Montalti R, Begliomini B. Anaesthetic perioperative management of patients with pancreatic cancer. *World J Gastroenterol.* 2014;20(9):2304-2320. doi: 10.3748/wjg.v20.i9.2304
4. Marandola M, Albanta A. Anaesthesia and pancreatic surgery: Technique, clinical practice and pain management. *World J Anesthesiol.* 2014;3(1):1-11. doi: 10.5313/wja.v3.i1.1
5. Latos W, Kawczyk-Krupka A, et al. Benign and non-neoplastic tumors of the duodenum. *Prz Gastroenterol.* 2019;14(4):233-241. doi:10.5114/pg.2019.90250

Mentor: Dawn E. Bent, DNP, MSN, CRNA

Local Anesthetic Systemic Toxicity with Liposomal Bupivacaine

LT Simon Peter Conrad, DNP, BSN, NC, USN
Uniformed Services University

Keywords: local anesthetic systemic toxicity, liposomal bupivacaine, lipid emulsion, erector spinae plane block

Local anesthetic systemic toxicity is a potentially fatal but rare complication of peripheral nerve blockade estimated to occur in 0.18% of these procedures.[1] The severity of this complication varies with a range of hemodynamic and neurologic effects up to total cardiovascular collapse.[2] Liposomal bupivacaine, a long-acting formulation of bupivacaine, is a novel tool in anesthetic practice that provides up to 72 hours of effect in regional blockade.[3] The following report details a suspected case of local anesthetic systemic toxicity following an erector spinae plane block using a combination of bupivacaine and liposomal bupivacaine for post-operative pain control.

Case Report

A 27-year-old, 160 cm, 57 kg female presented to the ambulatory surgery center for laparoscopic cholecystectomy. The patient's medical history included cervicalgia, gastro-esophageal reflux disease, depression, anxiety, post-traumatic stress disorder, anemia, and gallstones. She had active prescriptions for celecoxib, cyclobenzaprine, gabapentin, hydrocodone with acetaminophen, and a transdermal contraceptive patch. Her only past surgery was a surgical abortion. The patient endorsed social alcohol use. Preoperative vital signs were as follows: blood pressure 104/79 mmHg, heart rate 54/minute, respiratory rate 14/minute, SpO_2 100% on room air.

The patient was consented for a pre-operative bilateral erector spinae plane block followed by general anesthesia with an endotracheal tube for the operative portion. We placed non-invasive monitors and nasal cannula oxygen for the erector spinae plane block. She received intravenous (IV) midazolam 2 mg. Skin wheals of lidocaine were performed to minimize procedural pain. Bilateral erector spinae plane blocks were performed in the prone position using ultrasound guidance with 10 mL liposomal bupivacaine, 20 mL 0.25% bupivacaine, and 10 mL normal saline injected per side. After these injections the patient was assisted into the supine position and medicated with 50 mcg IV fentanyl for reported abdominal pain. The patient remained on monitors and within close observation of the preoperative registered nurses.

Approximately 15 minutes after the block procedure concluded, the patient was unresponsive to verbal stimulus with eyes open and exhibited non-purposeful, repetitive movements of the extremities. Nursing staff called the anesthesia practitioners back to the patient's bedside. Vitals remained stable on noninvasive monitors and were as follows: blood pressure 112/79 mm Hg, heart rate 62/min, respiratory rate 16/min, SpO_2 100% on 2 L nasal cannula oxygen. The anesthesia team provided face mask oxygen at 10 L/min and administered 3mg IV midazolam for the suspected seizure activity. Following midazolam, the patient became unresponsive with regular respirations. Local anesthetic systemic toxicity was suspected and a 250 mL bolus dose of IV lipid emulsion was administered by gravity infusion. The patient remained hemodynamically stable with regular respirations throughout the bolus infusion. Approximately 15 minutes after the lipid emulsion bolus finished, the anesthesia team questioned the initial diagnosis of local anesthetic systemic toxicity given the patient's overall hemodynamic stability and began to suspect over-treatment with midazolam. No additional IV lipid emulsion was administered after the bolus dose. We then administered 0.2 mg IV flumazenil. The patient rapidly regained consciousness, becoming tachycardic, hypertensive, disoriented, and tearful. On exam, motor function was normal, and the patient was completely alert and oriented within 10 minutes of flumazenil administration.

After consultation with the surgeon, the anesthesia team agreed on a two-hour observation period before proceeding with the operation. The patient exhibited no further seizure activity, altered mental status, or hemodynamic instability while under observation. The general anesthetic and laparoscopic cholecystectomy were uneventful. The patient recovered in the post-anesthesia care unit without incident and was discharged home on the same day.

Discussion

Local anesthetics of both the ester and amide classes share a common mechanism of action that cause toxic effects at high serum concentrations. These drugs inhibit neuronal conduction via blockade of voltage-gated sodium channels producing loss of sensory and motor function when applied to peripheral nerves. When sufficient quantities enter the blood stream through inadvertent vascular injection or absorption from peripheral tissues early symptoms of central nervous system toxicity such as lightheadedness or tinnitus occur.[4] Seizures manifest early in the process from general central nervous system excitation, followed by respiratory depression and coma.[4] Cardiovascular manifestations require higher serum concentrations than central nervous system effects and usually follow their onset.[4] This may include hypotension, dysrhythmias, myocardial depression, cardiovascular collapse, and complete heart block.[4]

The patient in this case exhibited the more severe central nervous system signs of local anesthetic systemic toxicity, with none of the early sensory disturbances. The manifestations were delayed, suggesting absorption rather than intravascular injection, and there was no apparent cardiovascular instability. This was not the classic picture of local anesthetic toxicity involving direct intravascular injection. Recent case report data indicate a trend toward atypical presentations of this complication with onset times delayed up to 60 minutes and a tendency toward isolated central nervous system manifestations.[2] The anesthesia practitioners considered the possibility of adverse drug reactions to midazolam or fentanyl in the differential diagnosis.

The current local anesthetic systemic toxicity resuscitation standards are written with the most severe cardiac arrest scenario in mind, but were readily applied to this atypical, delayed presentation. Recommendations from the American Society of Regional Anesthesia and Pain Medicine include basic airway management, early administration of lipid emulsion, seizure control with benzodiazepines, and standard resuscitation protocols with exceptions: reduced doses of epinephrine to ≤1 mcg/kg and avoidance of calcium channel blockers, beta blockers, vasopressin, large doses of propofol, and other local anesthetics.[5] Lipid emulsion is a specific antidote in local anesthetic systemic toxicity and case reports of successful resuscitations after cardiac arrest support its early application.[6] Nedialkov et al[6] report that the lipid sink theory, whereby the long chain triglycerides in the emulsion entrap local anesthetic particles, remains the dominant rationale for its cardioprotective effects. In keeping with the aforementioned recommendations this patient received early treatment with lipid emulsion therapy and immediate treatment of seizure activity with benzodiazepines. Early application of lipid therapy in this case appears to have had no adverse effects.

A unique feature of this clinical scenario is the use of liposomal bupivacaine, the extended-release formulation of bupivacaine, widely known as the most toxic local anesthetic. Liposomal bupivacaine is nearing a decade in clinical use and its approved and off-label uses have continued to expand.[3] Neal et al[2] found a relative paucity of data on adverse events associated with liposomal bupivacaine and recommend anesthesia practitioners take the same safety measures as with any local anesthetic injection. Liposomal bupivacaine requires additional precautions because contact with chlorhexidine and povidone iodine may causing premature release of the drug.[3] While syringe admixture with bupivacaine is approved by the manufacturer, contact with other local anesthetics may cause an early and potentially toxic release of the

encapsulated drug.[7] Our mixture included 100 mg (40 mL) total of 0.25% bupivacaine, less than the recommended maximum single-dose for this 57 kg patient.[4] The manufacturer of liposomal bupivacaine recommends no more than 53 mL of 0.25% bupivacaine be admixed with the maximum liposomal bupivacaine dose of 266 mg, or less than a 1 to 2 bupivacaine to liposomal bupivacaine ratio by mg dosing.[8] Despite the total 0.25% bupivacaine dose in the admixture for this case having been below that maximum level, we still observed toxicity.

Peripheral nerve blocks are a valuable tool in pain control and opioid-sparing techniques, but all anesthesia practitioners must recognize their inherent risks and follow standard safety protocols. Liposomal bupivacaine is a growing tool in regional anesthesia, but there are dangers unique to this drug given its possible interactions with other local anesthetics. Although the exact first manifestations of toxicity are unclear from this case, neurological signs appeared within 15 minutes of the regional procedure which confirms the trend toward delayed presentation and the need for continued monitoring after every peripheral nerve block. This case highlighted the importance of recognizing local anesthetic systemic toxicity early and timely treatment with lipid emulsion therapy by trained practitioners.

References

1. Mörwald E, Zubizarreta N, Cosowicz C, Poeran J, Memtsoudis S. Incidence of local anesthetic systemic toxicity in orthopedic patients receiving peripheral nerve blocks. *Reg Anesth and Pain Med*. 2017;42(4):442-445.
2. Neal J, Barrington M, Fettiplace M, et al. The third American Society of Regional Anesthesia and Pain Medicine practice advisory on local anesthetic systemic toxicity executive summary 2017. *Reg Anesth and Pain Med*. 2018;3(2):113-123. doi:10.1097/AAP.0000000000000720
3. Malik O, Kaye A, Kaye A, Belani K, Urman R. Emerging roles of liposomal bupivacaine in anesthesia practice. *J Anaesthesiol Clin Pharmacol*. 2017;33(2):151-156. doi:10.4103/joacp.JOACP_375_15: 10.4103/joacp.JOACP_375_15
4. Lin Y, Liu SS. Local anesthetics. In Barash P, Cullen B, Stoelting R, et al, eds. *Clinical Anesthesia*. 8th ed. Lippincott Williams & Wilkins; 2017: 564-583.
5. Neal J, Woodward C, Harrison K. The American Society of Regional Anesthesia and Pain Medicine checklist for managing local anesthetic systemic toxicity: 2017 Version. *Reg Anesth and Pain Med*. 2018;43(2):150-153. doi:10.1097/AAP.0000000000000726
6. Nedialkov A, Umadhay T, Valdes J, Campbell Y. Intravenous fat emulsion for treatment of local anesthetic systemic toxicity: Best practice and review of the literature. *AANA J*. 2018;86(4):290-297.
7. El-Boghdadly K, Pawa A, Chin KJ. Local anesthetic systemic toxicity: current perspectives. *Local Reg Anesth*. 2018;11:35-44. doi:10.2147/lra.s154512
8. Pacira Pharmaceuticals Inc. Exparel (liposomal bupivacaine injectable suspension [package insert]). US Food and Drug Administration. Revised April 2019. Accessed April 27, 2021. https://www.accessdata.fda.gov/drugsatfda_docs/label/2015/022496s019lbl.pdf

Mentor: CDR Chad Moore, DNP, CRNA, CHSE, NC, USN

Annular Rupture During a Transcatheter Aortic Valve Repair

Albert Federico, DNAP, BSN
Yale New Haven Hospital School of Nurse Anesthesia

Keywords: Transcatheter aortic valve repair, aortic stenosis, annulus rupture, cardiopulmonary bypass

Transcatheter aortic valve repair (TAVR) procedure is indicated for symptomatic aortic stenosis ranging from intermediate to severe, with the best outcomes occurring at the intermediate level.[1] TAVR involves obtaining femoral artery access and use of fluoroscopy to pass a crimped prosthetic replacement valve into the aortic annulus. Rapid ventricular pacing decreases cardiac output during balloon valvuloplasty and eprosthetic valve deployment.[1,2] Though considered a relatively safe procedure, aortic annular rupture (AR) is viewed as a rare but catastrophic complication with a reported 47-67% mortality rate.[2] Hence, early recognition of annular rupture and prompt management by the anesthesia practitioner is paramount.

Case Report

A 77-year-old, 172 cm, 95 kg patient with severe aortic stenosis was scheduled for a TAVR procedure. The planned anesthetic was heavy sedation versus general anesthesia. Upon induction, midazolam 2 mg and fentanyl 50 mcg were administered intravenously (IV). A propofol infusion was started at 75 mcg/kg/min. The patient was unable to lay still despite the absence of surgical stimulation. The propofol infusion was increased to 120 mcg/kg/min without resolution of the patient's restless legs. The decision was made to convert to general anesthesia with a laryngeal mask airway (LMA). An additional 120 mg of propofol was administered. After three attempts to place the LMA by two different practitioners, an endotracheal tube (ETT) was inserted to secure the patient's airway. This was achieved after administration of an additional 100 mg of propofol, rocuronium 50 mg, and fentanyl 50 mcg IV. The patient's hemodynamics remained stable throughout the induction with the titration of phenylephrine 200 mcg and ephedrine 10 mg IV. Maintenance of anesthesia was achieved with sevoflurane 2% expired concentration mixed with O_2 1 L/min and air 1 L/min. A postinduction femoral arterial line and a transvenous pacemaker was placed by the surgical team. Transesophageal echocardiogram (TEE) was performed by the anesthesiologist to assess cardiac function. Cerebral oximetry was also placed to monitor cerebral saturation.

Initial dilation and placement of the prosthetic valve was unsuccessful related to new aortic regurgitation, demonstrated on TEE. The choice to redilate the aortic root was made by the surgical team. The procedure continued without further complication and the prosthetic valve was threaded into the aortic root via dilation during rapid pacing. After valve placement, the arterial line revealed a precipitous drop in blood pressure to a systolic of 50 mm Hg with marked tachycardia on ECG. Phenylephrine 200 mcg IV was given and cardiac function was immediately reevaluated via TEE. Upon inspection, a pericardial effusion was noticed and ascribed to an aortic AR. The surgical team was notified, and the decision was made to proceed with a sternotomy to control the bleeding. Emergency cardiopulmonary bypass was initiated through the left femoral artery and right atrium. During this time, the anesthesia practitioner

placed a central venous catheter to aid in resuscitation. Heparin 300 units/kg IV was administered prior to institution of cardiopulmonary bypass (CPB). Mass transfusion protocol (MTP) was initiated and albumin 25 g IV was administered. A total of 4 units of packed red blood cells were administered along with 1500 mL of cell saver return over the course 6 hours. Throughout the entire procedure, the cerebral oxygen saturation did not fall below 75%. After the AR was stabilized, the surgical team proceeded with an aortic valve repair (AVR). Once the AVR was completed, the patient was separated from bypass and the heparin was reversed with protamine 1 mg/100 units administered heparin. The chest was closed with two pericardial drains in place. After chest closure, the TEE was repeated to confirm aortic valve function and lack of effusion or leak. The patient remained intubated and was transferred to the cardiac intensive care unit. He was discharged on post-operative day 5 without complication.

Discussion

Aortic annular rupture (AR) describes an injury in the region of the aortic root.[2-5] The scalloped shaped structure is part of the fibrous skeleton that connects the left ventricular outflow tract (LVOT) and the ascending aorta.[2,3] It is comprised of the sinutubular junction, aortic sinuses, and the basal ring.[3] The sinutubular junction at the top of the aortic root continues as the ascending aorta.[3] The basal ring is formed at the insertion of the basal attachment of the aortic valve leaflets.[3] Adjacent to the basal attachments of the leaflets are three interleaflet triangles. These fibromuscular leaflets extend toward the left ventricle. The first triangle is found between the right and left coronary leaflets. The second triangle is found between the left coronary and the noncoronary leaflets.[3] These two triangles communicate directly with the pericardial space and rupture will result in cardiac tamponade.[3] The last triangle between the noncoronary and right coronary leaflets make up the membranous septum.[3] Rupture of the last triangle will result in a ventricular septal defect (VSD) between and the left and right ventricles.[3] The area between the left fibrous trigone and the left/right commissure is considered the weakest area of the LVOT.

The incidence of AR during TAVR is roughly one percent.[2-5] Injury to the annulus can occur from balloon dilation of the aortic valve, deployment of the prosthetic valve, or valve re-dilation for a perivalvular leak.[2-5] Aggressive oversizing of the transcatheter valve > 20% is the strongest predictor of annular rupture.[2-4] Other factors that increase the risk for annular rupture include < 20 mm aortic valve size and a narrow aortic root. Calcification of the aortic valve leaflets, annulus, LVOT, walls of the sinuses of Valsalva adjacent to the annulus, bicuspid valve, and other subannular structures significantly increase the risk for annular rupture.[2-5] In this case, the patient had two risk factors that could have lead to AR: redilation of the aortic root and oversizing of the prosthetic valve. After deployment the of 1st valve, there was perivavular leak evidenced on fluoroscopy. The decision was made to redilate the aortic root and replace the prosthetic valve with a larger size, which likely resulted in the devastating procedural complication.

The clinical manifestations of annular rupture vary and range from initially asymptomatic to catastrophic.[3,5] Overt signs of rupture are pericardial tamponade with precipitous hypotension, bleeding, hemodynamic instability, and acute myocardial failure. Subtle signs that may be less diagnostic of AR are pericardial effusion, subepicardial hematoma at the base of the heart, periaortic hematoma, new aortic wall thickening, hematoma between the pulmonary artery and

the aorta, new-onset atrioventricular valve regurgitation, and conduction disturbances. Sudden hemodynamic instability as evidenced by severe hypotension was the first indicator of annular rupture in this case, promptly confirmed as a pericardial tamponade via TEE by the anesthesia practitioner.

Rapid identification of AR is imperative to the survival of the patient. As a general rule, if there is blood around the pericardium without a known cause, the anesthetist should immediately consider AR. Clinical diagnosis may be made with the use of transthoracic echocardiogram, angiography, and/or TEE. TEE and angiography are readily available in the operating room setting and are vital for early diagnosis of AR. Angiography is especially useful in detection of supra-annular rupture but is limited in its ability to identify infra-annular and valvular-aortic problems.[3]

Treatment is based on the type of AR and its manifestations.[3,4,5] Restoration of hemodynamic stability and maintenance of cerebral and coronary perfusion are the primary goals that practitioners should use to guide therapy. Surgical treatment of AR may be achieved by an isolated pericardial drain, conservative therapy, or conversion to an open procedure.[3,5] An isolated pericardial drain is usually reserved for patients with mild pericardial effusion, aortic wall hematoma, or wall thickening. This conservative approach is used for patients with relatively small injuries without any signs and symptoms of AR. Optimization of coagulation status and close surveillance is the mainstay of this therapy.[3,5]

Conversion to an open procedure involves sternotomy and immediate CPB followed by repair of the lesion and an aortic valve replacement (AVR).[3,5] This case required rapid conversion to an open AVR and CPB so that perfusion could be maintained. CPB is vital in maintaining hemodynamic stability, cerebral perfusion, and coronary perfusion. Ideally, femoro-femoral CBP is initiated; however, in cases of severe peripheral vascular disease, central CPB is required through median sternotomy.[3] Central CPB via median sternotomy was utilized in this case over the femoro-femoral approach due to the patient's poor vascular status. While CBP is initiated, the anesthesia practitioner should actively pursue volume replacement and inotropic support.[3] In this case, the anesthesia team promptly prepared for bypass and managed the hemodynamic status of the patient through initiation of vigorous fluid replacement and administration of pressors. Following annulus repair and AVR, the surgeon may implant a pacemaker and/or intra-aortic balloon pump (IABP) for support during the postoperative phase.[3] This patient received a transvenous pacemaker which remained in place for the postoperative period. However, the surgical team determined that the patient did not require an IABP.

Anesthesia practitioners caring for patients undergoing TAVR should have a keen understanding of cardiac anatomy, pathophysiology of aortic valve disease, and potential complications associated with the procedure. Operating room awareness and communication by the anesthetist can aid in the anticipation and rapid identification of AR and can guide lifesaving therapies. Due to knowledge of potential intraoperative complications, preparation for conversion to an open procedure, rapid response to sudden hemodynamic instability, and prompt identification and verification of AR by the anesthesia team, this patient was stabilized and survived a rare but dangerous complication of TAVR with no sequelae.

References

1. Chung M, Vazquez R. Non-operating room anesthesia. In Gropper M, Cohen, N, Eriksson L, et al., eds. *Miller's Anesthesia.* 9th ed. Elsevier; 2020:2307-2310.
2. Coughlan JJ, Kiernan T, Mylotte D, Arnous S. Annular rupture during transcatheter aortic valve implantation: predictors, management and outcomes. *Interv Cardiol*. 2018;13(3):140-144. doi:10.15420/icr.2018.20.2
3. Pasic M, Unbehaun A, Buz S, Drews T, Hetzer R. Annular rupture during transcatheter aortic valve replacement: classification, pathophysiology, diagnostics, treatment approaches, and prevention. *JACC Cardiovasc Interv.* 2015;8:1–9.
4. Tsuda M, Mizote I, Mukai T, Sakata Y. Aortic root rupture during balloon-expandable transcatheter aortic valve replacement in a patient without recognized risk factors for aortic root rupture: a case report. *Eur Heart J Case Rep*. 2020;4(3):1-4. doi:10.1093/ehjcr/ytaa073
5. Langer NB, Hamid NB, Nazif TM, et al. Injuries to the aorta, aortic annulus, and left ventricle during transcatheter aortic valve replacement: management and outcomes. *Circ Cardiovasc Interv*. 2017;10(1) doi:10.1161/CIRCINTERVENTIONS.116.004735

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

Emergent Awake Tracheotomy during the Covid-19 Pandemic

Jonathan Pinson, MSN
Westminster College

Keywords: tracheotomy, COVID-19, aerosol-generating procedures, precautions, transmission

The novel coronavirus disease 2019 (COVID-19) outbreak, caused by Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2), has rapidly spread throughout the world and has been declared a pandemic by the World Health Organization.[1] SARS-CoV-2 remains viable in aerosols for up to 3 hours, leading to the recommendation to avoid aerosol-generating procedures (AGPs), such as tracheotomy, in patients with COVID-19.[1,2] However, in patients with head and neck cancers that cause airway obstruction, a tracheotomy may be necessary. This case report aims to review important perioperative considerations for an awake tracheotomy in a patient with a large transglottic mass causing airway obstruction.

Case Report

A 56-year-old male presented to the emergency department (ED) with dyspnea, wheezing, and stridor, for which the otolaryngology service was consulted. He endorsed a 6-month history of throat pain, dysphonia, and dysphagia leading to a 2.2 kg weight loss over the past week. He also reported a 14 pack-year smoking history with occasional alcohol consumption.

Physical examination was remarkable for stridor, wheezing, and increased work of breathing. Computed tomography (CT) scan revealed enhancing right glottic and subglottic exophytic mass with posterior extension across the midline. There was arytenoid cartilage destruction with

suspicion of anterior extra-laryngeal spread into the subglottic infrahyoid strap muscles, and associated severe airway narrowing. Given his tenuous airway, the surgical and anesthesia team made the decision to perform an emergent awake tracheotomy with direct laryngoscopy, rigid bronchoscopy, and biopsies.

The patient did not receive a COVID-19 polymerase chain reaction (PCR) test because of a lack of testing supplies. Due to his unknown status, the procedure was performed as if the patient were infected. The procedure took place in a negative pressure operating room with donning of appropriate personal protective equipment (PPE): N95 respirator mask, gloves, goggles or a face shield, and a surgical cap.

The patient was positioned in the supine position with a shoulder roll in place. Midazolam 2 mg intravenously (IV) was administered, and the patient remained awake and breathing spontaneously. A nasal cannula with O_2 2 L/min was placed in the nares with a surgical mask on top. The patient's baseline SpO2 was 94%. Lidocaine 1% with 1:100,000 epinephrine 6 mL was infiltrated into the subcutaneous tissues of the neck overlying the cricoid cartilage. Just before incision, ketamine 20 mg IV was administered to achieve light to moderate sedation. The incision was made, and dissection was carried down and through the median raphe of the strap muscles, revealing the thyroid isthmus, which was transected with electrocautery. A cricoid hook was inserted underneath the patients' cricoid and lifted superiorly. At this point, the patient began to obstruct and the SpO_2 decreased to 75%. The O_2 was increased to 5 L/min via nasal cannula with no improvement. The nasal cannula was removed and the patient was ventilated using a jaw thrust maneuver via face mask with a high efficiency particulate air (HEPA) filter, with the SpO_2 improving to 87%. A stab incision was made between the first and second tracheal rings and a 7.0 mm cuffed tracheostomy tube was inserted. The balloon was inflated, and positive pressure ventilation was established. Propofol 100 mg and rocuronium 30 mg IV were administered to convert to a general anesthetic. A laryngoscope was used to visualize a large bulky mass that incorporated both false vocal cords and completely obscured vision of the larynx. A biopsy was taken, which came back as squamous cell carcinoma. Instrumentation was removed from the patient, and his care was turned over to the anesthesia team. The patient emerged from anesthesia in the operating room without complications and transported to the postoperative adult care unit in stable condition.

Discussion

A tracheotomy is an AGP with a significant risk for viral spread.[3] Aerosol generating procedures, particularly those that disrupt mucous membranes, have the highest risk for SARS-CoV-2 transmission.[3] Unless emergent, AGP's should only be undertaken after ascertaining the COVID-19 status.[1,3,5-7] Therefore, urgent and emergent AGPs pose significant management challenges due to a lack of time for adequate testing and preparation. Awake tracheotomies are particularly high-risk procedures due to the potential for coughing and airway distress during the procedure.[1,3] This case highlights important considerations for tracheotomies during the current COVID-19 pandemic. These considerations include preoperative viral testing, appropriate PPE, room preparation, patient transport, and limited staff.

The best way to prevent transmission of the SARS-CoV-2 virus is through adequate testing and identification of infected individuals. Unfortunately, when this patient presented to the ED for care, testing supplies for COVID-19 were in short supply. Only patients who were symptomatic or had close contact with those who tested positive, or recently traveled to high-risk areas were candidates for testing. However, even if a test is performed, healthcare workers must be aware that a negative result does not ensure that the patient is not contagious. Throat rt-PCR swabs have been estimated in studies to have a sensitivity of 71%.[4] Therefore, negative test results should not give a false reassurance that there is no risk of exposure. It has been proposed that two negative tests may be required to rule out the risk of viral transmission confidently.[4] Consequently, the availability of repeat testing is vital in preventing transmission to healthcare personnel. However, in an emergent case, such as this, which does not allow time for multiple tests to be administered, all precautions should be maintained to prevent transmission to healthcare personnel. Additionally, due to the unreliability of preoperative viral testing, some suggest that all precautions be considered for mucosal operations, despite a negative test result.[5]

It is paramount to minimize exposure and risk to staff, so the number of staff involved should be limited to those necessary. Staff involved, including ancillary staff, should be in full PPE. When participating in AGPs, personnel should wear a gown, gloves, eye protection (goggles or a disposable face shield that covers the front and sides of the face), and airway protection with N95 masks or powered air-purifying respirators (PAPRs).[7] It is essential to perform proper hand hygiene before putting on and after removing PPE. Procedures for proper donning and doffing, disposal of contaminated PPE, and cleaning contaminated reusable PPE and anesthesia equipment should be established.[7] It is recommended that facilities provide education and training in the use of PPE, including having health care workers "demonstrate competency with donning and doffing."[7]

A specific OR at negative pressure relative to the surrounding areas and a minimum of 6 air changes per hour (12 air changes per hour are recommended for new construction or renovation) should be designated for all COVID-19 cases.[4,5,7] The room should be out of the way of high traffic areas and should have direct access from the preoperative area and the intensive care unit (ICU).[4,5,7] If possible, the room should have an anteroom for donning and doffing PPE with instructional posters demonstrating proper technique.[4,5,7]. Only the materials needed to do the procedure should be inside the room.[4,5,7] Materials that are not necessary for the procedure should be left outside of the OR.[4,5,7] This would include cell phones, pagers, pens, and stethoscopes. Disposable materials should be discarded at the end of the case, and the room subjected to a terminal clean.[4,5,7] A HEPA filter should be placed between the Y-piece of the breathing circuit and the patient's mask or tracheal tube.[7] A HEPA filter should also protect the gas sampling tubing, and gases exiting the gas analyzer should be scavenged and not returned to room air [7]

All traffic in and out of the OR should be minimized.[4,5,7] Support staff should be dedicated to the OR to provide all materials needed throughout the case, with exchanges performed using a material exchange cart placed immediately outside the room or in the anteroom. [4,5,7]

All recommended precautions were followed during this case, except for determining the patient's infection status preoperatively. When this case was conducted, the supply of testing

materials was critically low, and it is the opinion of the staff that the prevention of disease transmission was the best that it could have been, given the limitations to testing.

References

1. Crossley J, Clark C, Brody F, Maxwell JH. Surgical Considerations for an Awake Tracheotomy During the COVID-19 Pandemic. *J Laparoendosc Adv Surg Tech A*. 2020;30(5):477-480. doi:10.1089/lap.2020.0239
2. Workman AD, Welling DB, Carter BS, et al. Endonasal instrumentation and aerosolization risk in the era of COVID-19: simulation, literature review, and proposed mitigation strategies. *Int Forum Allergy Rhinol*. 2020;10(7):798-805. doi:10.1002/alr.22577
3. Thamboo A, Lea J, Sommer DD, et al. Clinical evidence based review and recommendations of aerosol generating medical procedures in otolaryngology - head and neck surgery during the COVID-19 pandemic. *J Otolaryngol Head Neck Surg.* 2020;49(1):28. doi:10.1186/s40463-020-00425-6
4. Takhar A, Walker A, Tricklebank S, et al. Recommendation of a practical guideline for safe tracheostomy during the COVID-19 pandemic. *Eur Arch Otorhinolaryngol*. 2020;277(8):2173-2184. doi:10.1007/s00405-020-05993-x
5. Heyd CP, Desiato VM, Nguyen SA, et al. Tracheostomy protocols during COVID-19 pandemic. *Head Neck*. 2020;42(6):1297-1302. doi:10.1002/hed.26192
6. Parker NP, Schiff BA, Fritz MA, et al. Recommendations During the COVID-19 Pandemic. *American Academy of Otolaryngology-Head and Neck Surgery*. Published June 18, 2020. Accessed August 15, 2020. https://www.entnet.org/content/tracheotomy-recommendations-during-covid-19-pandemic.
7. Centers for Disease Control and Prevention. Interim Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Healthcare Settings. https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html. Update March 23, 2020. Accessed July 23, 2020.

Mentor: Art Shimata, DNAP, MAE, CRNA

Management of Acute Postpartum Hemorrhage During Cesarean Delivery

Susie Chairez-Rincon, DNP, BSN
Uniformed Services University

Keywords: postpartum hemorrhage, uterine atony, uterotonics, tranexamic acid, cesarean delivery.

Postpartum hemorrhage (PPH) is the leading cause of maternal mortality worldwide responsible for 25% of deaths yearly.[1] In the United States, PPH complicates 3.2% of deliveries and accounts for 12% of maternal deaths.[2,3] The American College of Obstetricians and Gynecologists (ACOG) defines PPH as a cumulative blood loss of at least 1,000 mL or abnormal bleeding with signs and symptoms of hypovolemia within 24 hours after childbirth.[4] Uterine atony is the most

common cause of PPH, identified in 80% of cases.[4,5] This case report discusses the intraoperative management of a patient with PPH during cesarean delivery.

Case Report

A 32-year-old female at 37 weeks 2 days gestation presented for cesarean delivery of twins with breech and transverse presentations. Her medical history included elevated blood pressure (BP) for the past 2 weeks, diet-controlled gestational diabetes, mild gastric reflux, obesity, and infertility status post in vitro fertilization resulting in monochorionic-diamniotic twin gestation. The patient had three previous pregnancies resulting in two live births and one ectopic pregnancy. Her last pregnancy was complicated by preeclampsia and required an emergency cesarean delivery. She also experienced PPH at that time due to retained placental fragments requiring transfusion therapy.

Preoperative laboratory values included a hemoglobin of 11.1 gm/dL, hematocrit of 35.1%, and platelets of 238, 000 mm^3. The patient was considered high risk for PPH based on her clinical risk factors including multifetal gestation, prior cesarean delivery, and maternal obesity. A type and crossmatch for 2 units of packed red blood cells (PRBCs) was ordered.

Once in the operating room (OR), the patient was placed in the sitting position and standard monitors applied. Her initial vital signs (VS) included a BP of 163/101 mm Hg, heart rate (HR) of 86/min, and SpO_2 of 100% on room air. Approximately 700 mL of lactated Ringers were infused intravenously over 15-20 minutes. A surgical time-out was performed with all team members present. After the administration of a subarachnoid block, the patient was placed supine on the OR table with left uterine displacement and slight head elevation. A phenylephrine infusion was started to maintain BP at pre-anesthetic levels. A T4 sensory block was confirmed before surgical skin preparation. A second 18-gauge intravenous (IV) catheter was inserted, and blood products were brought into the OR before surgical incision.

Following cord clamping of Twin B, a continuous infusion of oxytocin 30 units in 500 mL of normal saline was started. The estimated blood loss (EBL) following delivery of both twins was 1,000 mL. The obstetric team requested administration of carboprost 250 mcg intramuscular (IM) followed by misoprostol 800 mcg sublingual for ongoing hemorrhage. Tranexamic acid (TXA) 1 g was given IV over 10 minutes to decrease bleeding. Crystalloid fluid resuscitation 1,500 mL total, albumin 5% 500 mL, and 1st unit of PRBCs were initiated intraoperatively for EBL of 1,500 mL. Intravenous phenylephrine boluses were given to treat hypotension. Despite the use of multiple uterotonic agents, the right fundus remained distended and atonic per the surgical team. The surgeon placed a B-Lynch suture to compress the right fundus and control bleeding. Upon skin closure, the uterus was vigorously massaged and approximately 500 mL of blood and clot were expressed vaginally. The total EBL was 2,000 mL. The patient was taken to the post-anesthesia care unit in stable condition with oxytocin and IV fluids infusing. Postoperative VS included a BP of 112/75 mm Hg, HR of 100/min, and SpO_2 of 98% on O_2 6 L/min via a simple mask.

Ninety minutes after delivery, the patient became hemodynamically unstable. The BP monitor was unable to obtain a reading due to extreme shaking, HR increased to 110-120/min, and SpO_2

decreased to 95% on O_2 15 L/min via a non-rebreather. The point-of-care ultrasound showed no free fluid in the abdomen, the pelvic examination was normal, and the postoperative EBL was 200 mL. The anesthesia team administered an additional 1,000 mL bolus of crystalloid, 2nd unit of PRBCs, and 1 unit of fresh frozen plasma. The patient's status improved and was later transferred to the Mother-Baby Unit. She was discharged home 3 days postpartum.

Discussion

Obstetric hemorrhage can lead to severe morbidity and mortality therefore prevention, early diagnosis and treatment are essential to improve maternal outcomes. Risk factors associated with PPH include prolonged labor, induction and augmentation of labor, multiple gestation, fetal macrosomia, chorioamnionitis, preeclampsia, maternal obesity, maternal anemia, advanced maternal age, and cesarean delivery.[3,4] However, PPH can present in parturients without risk factors requiring diligent assessment during the intrapartum and postpartum period.[1,4,6] The ACOG and the World Health Organization (WHO) recommend prophylactic administration of uterotonic agents after all births to prevent PPH caused by uterine atony.[4,6] Uterine atony presents as a soft and poorly contracted uterus with vaginal bleeding due to inadequate uterine contractions.[5] Agents used to manage uterine hemorrhage by increasing the tone, rate, and amplitude of uterine contractions include oxytocin 10-40 units per 500-1000 mL via continuous IV infusion or 10 units IM, methylergonovine 0.2 mg IM re-dosed every 2-4 hours, carboprost 0.25 mg IM re-dosed every 15-90 minutes (max dose 2mg), and misoprostol 600-1000 mcg per rectum, sublingual, or buccal.[3-5]

Oxytocin remains the first-line drug for the prevention and treatment of PPH as it can be administered IV or IM, has few side effects, and no relative contraindications.[3,5,6] In this case, oxytocin was the initial treatment for postpartum uterine atony. However, carboprost and misoprostol were used in rapid succession when oxytocin alone failed to provide adequate uterine tone in the presence of ongoing hemorrhage. In 3-25% of PPH cases, a second uterotonic agent is required to manage refractory atonic bleeding.[4] Selection of second-line uterotonics is based on patient comorbidities and relative contraindications. For example, carboprost is a 15-methyl prostaglandin $F_{2\alpha}$ that can precipitate bronchospasms therefore is contraindicated in asthmatic patients.[3,4] Carboprost was used during this case because the patient did not have a history of reactive airway disease. Methylergonovine is an ergot alkaloid that can cause severe hypertension therefore is contraindicated in patients with hypertensive disorders.[3,4] This medication was not used because the patient had a new onset of hypertension for 2 weeks and prior history of preeclampsia. Misoprostol is a prostaglandin E_1 analogue without contraindications commonly used as an alternative agent when oxytocin is unavailable.[3,5,6] It was used during this case as a supplemental uterotonic after oxytocin failed to control uterine hemorrhage. The WHO also recommends early administration of TXA in parturients diagnosed with PPH. TXA is an antifibrinolytic agent that prevents the breakdown of fibrin clots thus decreasing hemorrhage. TXA 1 gram is given IV over 10 minutes within 3 hours of childbirth and re-dosed 30 minutes later for ongoing bleeding.[7] TXA was used early in the case per facility PPH protocol with the intent to decrease maternal bleeding.

When conservative measures including uterotonics, uterine massage, uterine compression, and manual extraction of blood clots fail to control PPH invasive treatment strategies must be rapidly

implemented.[4] These include intrauterine packing or tamponade, uterine compression sutures, uterine artery embolization, internal iliac artery ligation, and emergency hysterectomy.[3-5] In this case, B-lynch compression sutures were utilized by the surgical team as a secondary treatment to manage uterine atony refractory to pharmacological interventions. Although no other invasive interventions were necessary, the patient had been counseled by the surgical team regarding the possible need for blood products and additional surgical interventions to control PPH. The blood bank was also notified during the preoperative period to ensure the availability of blood products and expedite the implementation of a massive transfusion protocol if needed.

The anesthetic technique used for this patient was spinal anesthesia. However, cesarean delivery can be performed under other neuraxial techniques or general anesthesia depending on maternal and fetal condition, urgency, and duration of the proposed procedure. Regardless of the anesthetic technique used, a multidisciplinary approach must be implemented in the presence of PPH to maintain hemodynamic stability while actively treating the source of bleeding.[4,5] Additionally, prompt escalation of treatment with or without surgical intervention is paramount to preserve maternal life.[4,6] In the case presented, oxygen supplementation, fluid replacement therapy, blood transfusion, uterotonics, antifibrinolytic therapy, vasoactive support, and uterine compression sutures were utilized to control PPH while vigilantly monitoring VS, EBL, and urine output. All of these interventions align with current evidence-based practice guidelines found in literature.

References

1. Ngwenya S. Postpartum hemorrhage: incidence, risk factors, and outcomes in a low-resource setting. *Int J Womens Health*. 2016;8:647-650. doi: 10.2147/IJWH.S119232
2. Reale SC, Easter SR, Xu X, Bateman BT, Farber MK. Trends in postpartum hemorrhage in the United States from 2010 to 2014. *Anesth Analg*. 2020;130(5):e119-e122. doi: 10.1213/ANE.0000000000004424
3. Evensen A, Anderson JM, Fontaine P. Postpartum hemorrhage: prevention and treatment. *Am Fam Physician*. 2017;95(7):442-449. PMID: 28409600
4. Committee on Practice Bulletins-Obstetrics. Practice Bulletin No. 183: Postpartum hemorrhage. *Obstet & Gynecol.* 2017;130(4):e168-e186. doi: 10.1097/AOG.0000000000002351
5. Banayan JM, Hofer JE, Scavone BM. Antepartum and postpartum hemorrhage. In: Chestnut DH, Wong CA, Tsen LC, et al. *Chestnut's Obstetric Anesthesia: Principles and Practice.* 6th ed. Elsevier; 2020:901-936.
6. World Health Organization. WHO Recommendations: Uterotonics for the prevention of postpartum haemorrhage. *World Health Organization*. 2018. Accessed November 22, 2020. http://apps.who.int/iris/bitstream/handle/10665/277276/9789241550420-eng.pdf?ua=1&ua=1
7. World Health Organization. Updated WHO recommendations on Tranexamic Acid for the treatment of postpartum hemorrhage. *World Health Organization*. 2017. Accessed November 22, 2020. https://apps.who.int/iris/bitstream/handle/10665/259379/WHO-RHR-17.21-eng.pdf?sequence=1

Mentor: Maj Julie L. Petsche, DNP, MSN, CRNA, NC, USAF

Anesthesia Considerations for the Patients with Cerebral Palsy

Touraj Sedigh, BSN
University of Southern California

Keywords: cerebral palsy, anesthesia, hypotension, hypothermia, aspiration risk

Cerebral palsy (CP) refers to a group of conditions involving permanent, non-progressive neurological, sensory, and motor dysfunction with a broad spectrum of clinical presentations.[1] Prevalence of CP is estimated between 1.5 to 4 per 1,000 live births.[2] The following report describes the anesthetic management of a patient with cerebral palsy.

Case Report

A 38-year-old male with CP presented for ureteroscopy for renal calculi removal. The patient had allergies to cephalexin and sulfa drugs. He was wheelchair-bound with spasticity, and was non-interactive. Past medical history included seizures, gastroesophageal reflux disease (GERD), and neurogenic bladder. An indwelling gastrostomy tube (G-tube) and suprapubic catheter were present. Past surgical history included G-tube placement, suprapubic catheter placement, and ureteroscopy. No anesthesia complications were noted. The patient was receiving oxcarbazepine, esomeprazole, and oxybutynin. The patient had no food or drink for the past 8 hours.

The patient weighed 49 kg with a body mass index (BMI) of 18 kg/m^2. Pre-procedure vital signs were: blood pressure 107/71 mm Hg, heart rate 77/min (sinus rhythm), SpO_2 98% on room air. The airway assessment included a Mallampati class III airway with a normal thyromental distance. Neck range of motion was not assessed due to the patient's cognition level. His preoperative laboratory values were within the normal range. Informed consent for anesthesia was obtained from the mother of the patient.

Due to existing extremity contractures, the patient was transferred to the operating room table with extra precautions to avoid skeletal and nerve injury, and foam pads were used on pressure points to minimize the risk of injury to the skin. The patient was preoxygenated for 5 minutes with O_2 6 L/min. A rapid sequence induction was performed with lidocaine 60 mg, fentanyl 100 mcg, propofol 140 mg, and succinylcholine 80 mg intravenously. Clindamycin 600 mg over 20 minutes was given intravenously for preoperative surgical prophylaxis. The eyes were lubricated and taped. The trachea was intubated with a 6.5 mm endotracheal tube (ET) using a video laryngoscope, and secured at 22 cm at the teeth. After correct ET placement was confirmed with positive $ETCO_2$ and the presence of bilateral breath sounds, the cuff was inflated to minimal occlusion pressure at 20 cm H_2O. Pressure control ventilation was initiated, and the respiratory rate was titrated to maintain $ETCO_2$ within normal limits.

General anesthesia was maintained with sevoflurane at end expiration concentration of 0.5-0.7% MAC, and depth of anesthesia was titrated to maintain a bispectral index (BIS) of 40-60. To prevent hypothermia, a fluid warmer and a forced air warmer were used with the temperature set at 43° C. Rocuronium was administered in incremental doses of 10 mg to maintain a train of four (TOF) count of 1/4 as measured by a peripheral nerve stimulator. Blood pressure was supported

with fluids at 100 mL/hr and phenylephrine was administered as needed to maintain the blood pressure at 20% of the baseline. Metoclopramide 10 mg and dexamethasone 8 mg were given at the beginning of the surgery, and ondansetron 4 mg was given 30 minutes before the surgery was finished.

At the end of the case, when the TOF count was 2/4, neuromuscular blockade was antagonized with sugammadex 100 mg. The airway was suctioned followed by uneventful extubation. The patient received lactated ringers 1 L, and the estimated blood loss was minimal. In the post anesthesia care unit, the patient was arousable to verbal commands, vital signs were stable, and no anesthetic complications noted. Moreover, warming blankets were used to prevent hypothermia and chest physiotherapy was used to improve airway clearance. The patient met the discharge criteria within two hours and was discharged from PACU accompanied by the parents.

Discussion

The etiology of CP is usually multifactorial.[3] Some of the contributing factors include perinatal hypoxic-ischemic injury, intrauterine infection, trauma, congenital abnormalities, and multiple pregnancies. The diagnosis of CP is mainly clinical.[1] The neurological symptoms of CP depend on the affected area in the brain.[4] Cerebellar impairment will cause ataxia, while spasticity is mainly due to motor cortex injury. Because of spasticity, these patients frequently suffer from spine deformities, contractures, and chronic pain. Muscle contractures are common, and these patients are at risk of joint dislocations during repositioning. Obtaining vascular access can be challenging. Contractures may also impact neck mobility and intubation/airway decisions.

Because of the cognitive deficits, obtaining a detailed history and physical assessment may be challenging, and require assistance from the patient's family and/or care providers.[1,3] Preoperative assessment should include evaluation for a history of seizures, lung disease, gastrointestinal dysmotility, and swallowing defects. These patients frequently suffer from gastroesophageal reflux disease (GERD), decreased lower esophageal sphincter tone, and impaired cough and gag reflexes, which can lead to aspiration episodes and recurrent pneumonia. G-tube placement may be required for these patients to provide nutritional support and decrease the aspiration risk. With repeated lung insults, these patients are prone to develop reactive airway disease. In addition, chronic respiratory system disease can result in pulmonary hypertension and ventricular hypertrophy, and cardiac failure might be observed in severe cases of lung injury and pulmonary hypertension.[4]

A detailed history of the patient's medications, and the pharmacological interactions and anesthetic implications should be carefully evaluated.[4] Anticonvulsants should be continued in the perioperative period to prevent seizures, as demonstrated in the case presented here. Anticonvulsant medications may have a sedative effect, which should be considered when selecting anesthetic medications. Premedication with sedatives may increase the risk of aspiration in this population and should be avoided whenever possible.[4] The minimum alveolar concentration (MAC) of inhalational agents is decreased in these patients, and a further reduction may be observed in patients who are taking anticonvulsant medications. Therefore, BIS monitoring may be helpful in this patient population.

Bronchodilators and antibiotics should be administered preoperatively if needed to treat the lung infection and optimize the patient's condition. Due to feeding problems, these patients are prone to malnutrition and should be assessed for dehydration, electrolyte imbalance, and anemia. The patient presented here suffered from malnutrition as demonstrated by a BMI of 18 kg/m^2, but his electrolyte and hematologic laboratory values were normal.

Rapid sequence induction should be considered in confirmed cases of GERD. However, inhalation induction with head of bed elevated could be equally safe based on the available data and could be the only option in some patients due to lack of IV access.[3] Because patients with CP frequently have reactive airways, propofol may be the optimal induction agent as it decreases airway smooth muscle tone. The level of potassium increase after succinylcholine administration is not significant and it can be safely used in this patient population.[3] Patients with CP have up-regulation of cholinergic receptors, and non-depolarizing neuromuscular blocking agents are less potent in these patients. Since these agents are highly water soluble, this effect is balanced clinically due to decreased volume of total body water.[3]

Hypothermia is a significant perioperative issue that can result in wound infection, delayed awakening from anesthesia, and prolonged hospitalization.[1,4] Patients with CP are more prone to hypothermia due to the combination of malnutrition and hypothalamic dysfunction. Therefore, it is prudent to use all preventive measures for hypothermia, including fluid warmer, ventilator humidifier, and forced air warmer.

Intraoperative hypotension (defined as >20% decrease in blood pressure compared with the preoperative value) is frequently observed on these patients and should be considered when planning the anesthesia for these patients.[3] The mechanism for hypotension is believed to be related to the increased sensitivity to general anesthetics and reduced central adrenergic response to adrenergic agonists, and it requires meticulous medications dosage adjustment. [5]

The anesthetic plan of this patient followed evidenced-based care based on available literature. Rapid sequence induction was used to decrease the risk of aspiration, and a multi-modal approach was used to address PONV and further reduce the risk of aspiration. Measures were implemented to safely position the patient and prevent hypothermia. A BIS monitor was utilized to manage depth of anesthesia, and hemodynamic support was provided with fluids and vasopressors during the case.

References

1. Bajwa SJS, Haldar R. Anesthesia for cerebral palsy - Need for meticulous perioperative planning. *Med J DY Patil Univ*. 2017;10:602-4.
2. Arneson D. Prevalence of cerebral palsy: Autism and Developmental Disabilities Monitoring Network, three sites, United States, 2004. *Disabil Health J*. 2009;2(1):45-48. doi:10.1016/j.dhjo.2008.08.001
3. Prosser DP, Sharma N. Cerebral palsy and anaesthesia. *Contin Educ Anaesth Crit Care Pain.* 2010;*10(3):*72-76.
4. Hegade G, Shaikh S. Role of anesthesiologist in the management of a child with cerebral palsy. *Anesth Essays Res*. 2017;11(3):544. doi:10.4103/0259-1162.194569

5. Wass CT, Warner ME, Worrell GA, et al. Effect of general anesthesia in patients with cerebral palsy at the turn of the new millennium: A population-based study evaluating perioperative outcome and brief overview of anesthetic implications of this coexisting disease. *J Child Neurol*. 2012;27(7):859-866. doi:10.1177/0883073811428378

Mentor: Regalado A. Valerio Jr., DNP, CRNA, CHSE

Anesthesia Considerations for Postural Orthostatic Tachycardia Syndrome

Pauline Rioux, BSN
University of Southern California

Keywords: Postural Orthostatic Tachycardia Syndrome (POTS), postural tachycardia, orthostatic intolerance, autonomic dysfunction

Postural orthostatic tachycardia syndrome (POTS), also known as orthostatic intolerance syndrome, is a disorder characterized by autonomic system failure.[1] Patients with POTS exhibit maladaptive sympathetic response to idiopathic events, such as a change in position, resulting in tachycardia, without orthostatic hypotension.[2] Cerebral hypoperfusion resulting from postural tachycardia causes symptoms such as palpitations, lightheadedness, tremulousness, fatigue and syncope.[3] Anesthetic management is primarily aimed at preventing precipitating events and mitigating autonomic responses with the use of volume expansion, α-1 selective adrenergic agent to maintain blood pressure, and β-adrenergic antagonists to decrease heart rate.[2]

Case Report

A 26-year-old woman (weight 46 kg, height 160 cm) with no known allergies and a prior medical history significant for POTS, syncope, chest pain, post-operative nausea and vomiting (PONV) and congenital rotational deformity of bilateral lower extremities presented for a right fibular osteotomy with harvest and injection of bone marrow under general anesthesia. Home medications included aspirin 325 mg daily, midodrine 2.5 mg three times daily, cyclobenzaprine 10 mg daily, tramadol 50 mg as needed, and oxycodone 5 mg as needed.

Pre-operative respiratory and neurologic function were intact and vital signs were as follows: heart rate 73/min with normal sinus rhythm, blood pressure 99/70 mm Hg, respiratory rate 16/min, temperature 37.3ºC, and SpO_2 99% on room air. Airway examination revealed a mouth opening greater than 4cm, Mallampati II score, ability to prognath, full neck range of motion. Diagnostic studies, including electrocardiogram (ECG) and chest x-ray, and laboratory values; were all within normal limits and cardiac clearance was obtained. Preoperative interview and physical assessment of this patient revealed low frequency of POTS associated symptoms, no recent syncopal episodes, normal fluid and salt intake. Patient denied dizziness, lightheadedness and/or palpitations.

A crystalloid 250 mL fluid bolus was administered preoperatively to maintain normovolemia and prevent tachycardia. Preoperative medications included acetaminophen 1000 mg, celecoxib 200

mg and gabapentin 300 mg for postoperative pain management per enhanced recovery after surgery (ERAS) protocol, as well as aprepitant 40mg and scopolamine transdermal patch for PONV prevention. Midazolam 2 mg IV was given for anxiolysis premedication.

Patient was positioned supine in optimal sniffing position and was administered preoxygenation with O_2 10 L/min for 3 min. After applying standard monitors, anesthesia was induced with lidocaine 60 mg, fentanyl 50 mcg, and propofol 100 mg. Rocuronium 46 mg was administered for neuromuscular blockade to facilitate tracheal intubation. The trachea was visualized via direct laryngoscopy and intubated with a size 7 mm endotracheal tube. Mechanical ventilation was initiated with pressure controlled volume guaranteed (PCV-VG) ventilation, tidal volume (TV) 6-8 mL/kg and respiratory rate (RR) 12/min. Immediately post induction, a popliteal nerve block was performed with a 133 mg bupivacaine liposome single-dose infiltration in the right popliteal fossa for postoperative pain management. A second IV 18 gauge catheter was inserted in the left hand for additional venous access. Anesthesia was maintained with 2% sevoflurane at 1 MAC. Dexamethasone 10 mg and ondansetron 4 mg were administered for PONV prevention.

One episode of hypotension was noted as systolic blood pressure decreased below 90 mm Hg with a concurrent increase in heart rate from 60 to 82/min. Adequate systolic blood pressure was restored to 90 mm Hg after a one-time 50 mcg IV dose of phenylephrine was administered. The remainder of intraoperative course was unremarkable with no abnormality in cardiac rhythm, oxygenation and $EtCO_2$ remained within 35-45 mm Hg, and temperature was maintained above 36^{o}C.

The total duration of surgical procedure was 3 hours. At the end of surgery, airway was suctioned, an oral airway was placed in the oropharynx, and sugammadex 92 mg was administered for full neuromuscular blockade reversal as evidenced by 4/4 train of four (TOF) count and sustained tetany. Tracheal extubation was performed once the patient met extubation criteria: hemodynamic stability, patent airway, spontaneous breathing, adequate oxygenation and tidal volumes > 5 mL/kg, and response to verbal commands. Oxygenation was supported with O_2 6 L/min via simple face mask during transport to recovery. The patient was monitored in the post anesthesia care unit and showed no signs of tachycardia, hypotension, PONV or other immediate post-operative complications before transferring to inpatient unit for overnight observation.

Discussion

The etiology of POTS remains unknown, however some studies suggest an autoimmune component due to the presence of ganglionic A3 acetylcholine receptor antibodies.[3] It is estimated that as many as 500,000 patients aged 15-50 years are affected in the United States, of whom 80 percent are female. Patients with POTS undergoing surgery may be at an increased risk of hemodynamic instability, arrhythmias and subsequent cardiovascular collapse precipitated by hypovolemia and/or anesthetic agents.

Preoperative considerations must include a full cardiac assessment and diagnostic testing as warranted.[4] Patients on α-1 adrenergic agents, such as midodrine, should continue taking these medications on the morning of surgery and surgery should be scheduled as first case to minimize extension of nothing per os (NPO) period. Anxiolysis with a benzodiazepine agent decreases the

incidence of tachycardia during the preoperative period.[5] In POTS, the normal compensatory vasoconstrictive reflex response to hypotension caused by hypovolemia is impaired and patients may not tolerate minimal alterations in intravascular volume status.[5] Administration of an intravenous (IV) normal saline fluid bolus in the preoperative period in the hypovolemic patient helps mitigate hemodynamic fluctuations associated with hypovolemia, induction of anesthesia and volatile anesthetics.[6]

Adequate intraoperative and postoperative pain management is essential in preventing POTS symptoms precipitated by increased sympathetic response to pain. Institution-specific ERAS protocols may vary in recommendations, however all guidelines include anesthetic management strategies to minimize pain and enhance early rehabilitation. Preoperative administration of non-opioid analgesics such as nonsteroidal anti-inflammatory drugs (NSAIDs), acetaminophen and gabapentin, which in conjunction with additional multi-modal pain management methods including neuraxial and regional nerve blocks, enhance both intraoperative and postoperative pain management and decrease the use of opioids.[7] Opioid-sparing modalities reduce opioid-associated side effects such as respiratory depression, delayed emergence, nausea, vomiting, hypotension, and postoperative decreased gastric motility.[7]

Perioperative cardiac status must be monitored closely and heart rate should be maintained below 85 bpm with the use of β-adrenergic antagonists, such as labetalol or propranolol, or calcium channel blockers.[4] Invasive hemodynamic monitoring by arterial and central venous pressure may be indicated given the potential for cardiovascular decompensation.[6] Hypotensive episodes should be treated with an α-adrenergic agonist agent such as phenylephrine. Sympathomimetic agents, such as ephedrine or epinephrine should be avoided.[2] Anesthetic agents that may induce tachycardia, including ketamine, desflurane and pancuronium, and those with anticholinergic properties such as glycopyrrolate, must be avoided.[6] Additionally, significant arterial and venous vasodilation associated with administration of propofol, isoflurane or desflurane; may result in an increased sympathetic response and increase incidence and severity of tachycardia.[6]

Total intravenous anesthesia (TIVA) may be preferred over inhaled anesthetics which are associated with myocardial depression resulting in tachycardia. Dexmedetomidine continuous infusion or single dose may also be considered as an anesthetic and analgesic adjunct and to lower heart rate in symptomatic POTS patients. Etomidate has minimal effects on vasculature and may be preferred for IV induction, particularly for patients with preoperative tachycardia and hemodynamic instability.[5]

Intraoperatively, differential diagnosis of tachycardia should be investigated such as light anesthesia, nociception, hypovolemia, patient positioning, pharmacologic agents, hyperthermia, pulmonary embolism and anaphylaxis.[2] Neuraxial blockade should be considered, when appropriate, to reduce the need for anesthetics and opioid agents. Regional nerve blocks can be utilized in multimodal pain management and are recommended in ERAS protocols for adequate pain relief with minimal effect on hemodynamic status.[7] If postoperative pain is anticipated, neuraxial or regional block with a catheter may be indicated. However, local anesthetics with epinephrine should be avoided to prevent associated tachycardia.[2]

Particular attention should be paid to patient positioning and effects on hemodynamic status during changes in position. Steep reverse Trendelenburg positioning will exacerbate POTS symptoms by increasing venous pooling and inability to increase peripheral vascular resistance.[8] Volume expansion and prevention of hypovolemia can mitigate the sympathetic response to postural changes. PONV may also increase the risk of post-operative tachycardia and can be prevented with prophylactic glucocorticoids and anti-emetics.[4] A continuous propofol IV infusion should be considered for patients with high risk of PONV, however caution should be used in patients with hemodynamic instability due to propofol associated hypotension.

Anesthetic care of patients with POTS requires a thorough preoperative cardiovascular function assessment and optimization, vigilant perioperative hemodynamic management and monitoring. Considerations should be aimed at prevention of etiologies that may precipitate POTS symptoms such as maintaining normovolemia, normothermia, avoiding sympathomimetic agents, preventing PONV and providing adequate multimodal pain management.

References

1. Grigoriou E, Boris JR, Dormans JP. Postural orthostatic tachycardia syndrome (POTS): association with Ehlers-Danlos syndrome and orthopaedic considerations. *Clin Orthop Relat Res.* 2015;(473):722-728.
2. Ruzier M, Daziuba M, Hofmann JP, Grubb BP. Surgical and dental considerations in patients with postural tachycardia syndrome. *Auton Neurosci.* 2018;(215):119-120.
3. Dahan S, Tomljenovic L, Shoenfeld Y. Postural orthostatic tachycardia syndrome (POTS) – a novel member of the autoimmune family. *Lupus.* 2016;(25):339-342.
4. Zadourian A, Doherty TA, Swiatkiewicz I, Taub PR. Postural orthostatic tachycardia syndrome: prevalence, pathophysiology and management. *Drugs.*2018;(78):983-994.
5. Jelly CA., Viktorsdottir, O. Specific considerations with cardiac disease. In Bittner E, Chitiliam H, Levine W, Vassallo S. *Clinical anesthesia procedures of the Massachusetts General Hospital*. 9th edition. Philadelphia, PA: Wolters Kluwer; 2016:17-32.
6. Kernan S, Tobias JD. Perioperative care of an adolescent with postural orthostatic tachycardia syndrome. *Saudi J Anaesth*. 2010;4(1):23-27.
7. Oseka L, Pecka S. Anesthetic management in early recovery after surgery protocols for total knee and total hip arthroplasty.*J Am Assoc Nurse Anesth. 2*018;86(1):32-39.
8. Rabbitts JA, Groenewald CB, Jacob AK, Curry TB. Postural orthostatic tachycardia syndrome and general anesthesia: a series of 13 cases. *J Clin Anesth.* 2010;(23):384-392.

Mentor: James M. Houlden, MSN, CRNA

Erector Spinae Plane Block for Patients undergoing Surgical Mastectomy

Millie Franklin, DNP, BSN
Samford University

Keywords: regional anesthesia, erector spinae plane block, mastectomies, postoperative pain

The modified radical mastectomy is a commonly performed surgical procedure for breast cancer. Due to complex nerve innervation involving the breast, postoperative analgesia in these patients remains a challenge. Managing postoperative pain with regional anesthesia (RA) in the form of an interfascial plane block may be an efficacious supplement to a comprehensive plan.[1] The erector spinae plane (ESP) block has emerged as an innovative regional technique for providing postoperative pain control in a variety of surgical procedures including mastectomies.

Case Report

A 40-year-old female with right sided breast cancer presented for a bilateral radical mastectomy with axillary node dissection. Past medical history included recent chemotherapy. The patient denied any known drug allergies, previous anesthetic complications, or bleeding disorders. Preoperative laboratory results pertinent to the case included: hemoglobin 13.8 g/dL, hematocrit 41.4%, platelets 390 K/uL, international normalization ratio 1.1, and prothrombin time 12.5 seconds. The anesthetic plan was for general anesthesia combined with an ultrasound-guided ESP block.

The patient was taken to the preoperative block area and standard non-invasive monitors were applied. Baseline vital signs included a blood pressure of 146/82 mm Hg, heart rate of 86/min, respiratory rate of 14/min, and SpO_2 of 100% on room air. The patient was premedicated with midazolam 2 mg and fentanyl 50 mcg intravenously (IV) and positioned in the sitting position. A high-frequency linear ultrasound probe was placed in a parasagittal plane 3 cm lateral to the 5th thoracic vertebrae on the right side. The transducer was manipulated to visualize the major landmarks of the transverse process, trapezius, rhomboid major, and erector spinae muscles. After a skin injection of 4 ml of 1% lidocaine, a 20-gauge 4-inch block needle was inserted in a craniocaudal fashion. The needle tip was identified with an in-plane ultrasound view, and then observed continuously while advancing until it approached the bony transverse process. The needle tip was advanced to the fascial plane of the erector spinae muscle, and after negative aspiration, a local anesthetic injection of 3 mL of 0.25% bupivacaine was delivered with visualization of the separation of the erector spinae muscle from the transverse process. Additional local anesthetic was administered in incremental volumes of 5 mL with aspiration prior to each injection to a total of 30 mL. A subsequent block using the same technique was performed on the contralateral side for a total of 60 mL and 150 mg of 0.25% bupivacaine.

The patient was then transported to the operating room and standard non-invasive monitors were applied. After preoxygenation, IV induction of anesthesia was completed using a defasciculating dose of rocuronium 5mg, fentanyl 50 mcg, lidocaine 40 mg, propofol 200 mg, followed by succinylcholine 160 mg. Endotracheal intubation was performed successfully, and general anesthesia was maintained with sevoflurane 2.2 % expired concentration and fentanyl totaling

150 mcg. Acetaminophen 1g and ketorolac 30 mg were administered IV for multimodal analgesia. The patient required two doses of esmolol in 10 mg increments for tachycardia and hypertension after right sided closure and upon initial surgical incision to the left breast.

The patient remained otherwise hemodynamically stable throughout the duration of the surgical procedure. The patient was extubated successfully with spontaneous ventilation and transported to the post anesthesia care unit. After overnight admission for observation she was revisited the following day. Conversations with the patient and nursing team revealed that the patient's pain was controlled with alternating schedules of ketorolac and hydrocodone/acetaminophen which otherwise did not require parenteral narcotics nor breakthrough medications.

Discussion

An emphasis on RA continues due to its analgesic properties while modulating the body's response to surgical stress.[2] These techniques have successfully been administered to patients having mastectomies in order to reduce opioid use, improve pain scores, and optimize recovery. Hill and colleagues explain that there is evidence to show that RA offers an additional benefit to surgical recovery by reducing pulmonary complications.[2]

The thoracic paravertebral block (PVB) has long been considered the "gold-standard" in cases of modified radical mastectomy, however, the greater risk of complications in addition to moderately high failure rates with this technique limit its practicality.[4] Alternatives to this thoracic wall block include the pectoral nerve (PECS) block, serratus anterior block, and the ESP block. Each of these fascial plane blocks are discussed amongst the literature with high regard for their use as alternatives to both thoracic epidural and paravertebral blocks, providing anterolateral thoracic coverage.[5] While traditional blocks inhibit a specific nerve or bundle, fascial plane blocks rely on the indirect spread of LA.[5] A key benefit of plane blocks is the ability to use in anticoagulated patients where traditional techniques may not be feasible.[5]

The ESP block is a newer technique which has a particular advantage of anterior, lateral, and posterior coverage.[5] The site of injection to perform this block is distant from the pleura, spinal cord, and major blood vessels, thus few contraindications exist.[6] Chin et al noted that the ESP blockade compared with the serratus anterior and PECS block addressed the ventral rami as well as dorsal rami, resulting in better posterolateral thoracic coverage.[5] As the ESP block can provide analgesia for the full thorax, mastectomy patients can greatly benefit from this type of regional block.

Regarding efficacy, Sharma and colleagues explained that in mastectomy patients ESP blocks compared to no block significantly reduced morphine consumption and postoperative pain scores.[1] Additionally, a systematic review by ElHawang et al explained that ESP blocks provided superior pain control and reduced opioid consumption compared to tumescent anesthesia or no block at all.[3] In the same study, patients that received ESP blocks reported less PONV and demonstrated higher patient satisfaction scores compared to other pain modalities.[3] A comparison between the ESP block and the PECS B block was performed by Khorasanizadeh and colleagues which showed that pain scores were significantly higher in the PECS B group compared to the ESP group, while frequency of opioid use and visual analog scores (VAS) were

lower.[7] A randomized controlled trial by Gürkan et al compared the ESP block and PVB to a control group with no block and found that both regional techniques reduced morphine consumption by 62% at 24 hours.[8] While both PVB and ESP block offered greater pain control than IV morphine alone, the benefits conferred by choosing the ESP block are that it remains a safer alternative due to a greater distance from major organ systems and blood vessels while retaining the efficacy needed for satisfactory analgesia.

Although these blocks offer substantial benefits, efficacy is dependent upon the skill of the practitioner. A comparative study performed by Moustafa and colleagues noted that senior anesthesia residents had a better success rate and required less time and less guidance to perform the ESP compared to the PVB.[4] The ease of performing the ESP block compared to advanced techniques such as PVB, make it an appealing option that offers equivalent postoperative analgesia, especially with time constraints or amongst novice practioners.[4] A key distinction for the ESP block is the improved safety by lowering risk for iatrogenic injury. Increasing needle distance from the pleura by use of ESP instead of the PVB provides a distinct advantage for all practitioner levels. Additionally, the improved safety with ESP parallels a decrease in failed block rate when compared with PVB.[4]

This case study and review of literature support the validity of an ESP technique in breast surgery patients. We expected and found minimal narcotic maintenance, satisfaction with pain control, and the absence of PONV with this technique as consistent with the literature. The variations noted in the patient's intra-operative hemodynamics could be attributed to alterations with the intensity of the surgical stimulus on the contralateral side, or pain sensed outside blockade boarders. Additional considerations that could be implemented include placement of a catheter, delivery of a larger volume or higher concentration of local anesthetic (LA), or use of longer acting agents with additives.

In summary, appropriating a balanced anesthetic tailored to each patient and their procedure is paramount; therefore, the decision to incorporate any regional block should be considered on a case by case basis. Considerations for application of the ESP block into practice include further research to find the ideal volume and LA, to identify the maximum concentration to prevent toxicity, and to establish which regional block demonstrates superiority in patients undergoing mastectomy. Going forward, the ESP block proffers efficacy and safety as an anesthetic tool for pain management with breast surgery patients.

References

1. Sharma S, Arora S, Jafra A, Singh G. Efficacy of erector spinae plane block for postoperative analgesia in total mastectomy and axillary clearance: A randomized controlled trial. *Saudi J of Anaesth.* 2020;14(2):186-191.
2. Hill K, Macfarlane A. Does regional anesthesia improve outcome? *Anaesth Intensive Care.* 2018;19(11):619-623.
3. ElHawary H, Abdelhamid K, Meng F, Janis JE. Erector spinae plane block decreases pain and opioid consumption in breast surgery: Systematic review. *Plast Reconstr Surg- Globe Open.* 2019;7(11):e2525. doi: 10.1097/GOX.0000000000002525

4. Moustafa MA, Alabd AS, Ahmed AM, Deghidy EA. Erector spinae versus paravertebral plane block in modified radical mastectomy: Randomised comparative study of the technique success rate among novice anesthesiologists. *Indian J Anaesth.* 2020;64(1):49-54.
5. Chin KJ, Pawa A, Forero M, Adhickory S. Ultrasound-guided fascial plane blocks of the thorax: Pectoral I and II, serratus anterior plane, and erector spinae plane blocks. *Adv Anesth.* 2019;37:187-205.
6. Kendall MC, Alves L, Traill LL, DeOliveira GJ. The effect of ultrasound- guided erector spinae plane block on postsurgical pain: A meta-analysis of randomized controlled trials. *BMC Anesthesiol.* 2020;20:99. doi: https://doi.org/10.1186/s12871-020-01016-8
7. Khorasanizadeh S, Arabzadeh B, Teymourian H, Mohseni GI. Pectoral nerve block and erector spinae plane block and post breast surgery complications. *Int J Cancer Manag.* 2020;13(3):e100893. doi: 10.5812/ijcm.100893.
8. Gürkan Y, Aksu C, Kus A, Yörükouglu UH. Erector spinae plane block and thoracic paravertebral block for breast surgery compared to IV morphine: A randomized controlled trial. *J Clin Anesth.* 2020;59:84-88.

Mentor: David B. Sanford, DNP, MSN, CRNA, EMT-P

Atrioventricular Node Ablation: Anesthetic Care of the Obese Patient

Jeffrey Hua, DNAP, BSN
University of Southern California

Keywords: atrioventricular node ablation, biventricular pacemaker, deep sedation, obesity, chronic obstructive pulmonary disease, obstructive sleep apnea, remifentanil, dexmedetomidine

Atrioventricular node (AVN) ablation for atrial fibrillation (AF) is commonly performed in the cardiac catheterization laboratory often requiring patient immobility for accurate anatomical mapping and ablation.[1] Anesthetic management for AVN ablation can be accomplished via multiple modalities such as total intravenous anesthesia and jet ventilation, or deep sedation and analgesia.[1] Deep sedation is typically accompanied by deleterious sequelae such as hypotension, apnea, and respiratory depression.[1,2] This presents a significant challenge for the anesthesia professional as maintaining hemodynamic and respiratory stability requires judicious management in this high-risk patient population.[1] The following is a case study presenting the anesthetic management of an obese patient with multiple cardiac and respiratory comorbidities.

Case Report

A 63-year-old, 116 kg, 183 cm male presented with a diagnosis of refractory AF and cardiomyopathy. He was scheduled for AVN ablation, and cardiac resynchronization therapy with combined implantable cardioverter defibrillator (ICD) and biventricular pacemaker upgrade. The patient's cardiac history included hypertension, dilated nonischemic cardiomyopathy, congestive heart failure (CHF) New York Heart Association class 4, left ventricular ejection fraction of 30%, right ventricular dilation with pulmonary arterial pressure of 47 mmHg, chronic AF, and prior episodes of ventricular fibrillation with ICD defibrillation. The

patient's pulmonary history included obstructive sleep apnea (OSA) and chronic obstructive pulmonary disease (COPD), requiring home O_2 4-5 L/min via nasal cannula. The patient's other past medical history included diabetes mellitus type 2, obesity with a body mass index (BMI) 34.7 kg/m^2, and gastroesophageal reflux disease. The patient's surgical history included a prior ICD placement under deep sedation without anesthesia complications. Current medications included metformin, esomeprazole, gabapentin, losartan, furosemide, spironolactone, metoprolol, digoxin, rivaroxaban, albuterol, budesonide/formoterol, tiotropium bromide, and montelukast.

Preoperative vital signs included: non-invasive blood pressure 124/58 mmHg, heart rate (HR) 79/min, respiratory rate 16/min, and SpO_2 98% on 4 L/min. Pre-anesthesia evaluation revealed metabolic equivalents at less than 4, signifying the patient's decreased functional capacity.[2] During this time, the patient confirmed his adherence to the medication regimen prescribed before arriving for his procedure, including the use of all inhalers as regularly scheduled. Additionally, the patient inhaled 4 puffs of albuterol via metered dose inhaler in the preoperative area to optimize bronchodilation.

Before entering the cardiac catheterization laboratory, a 20-gauge intravenous catheter was inserted in the dorsum of the right hand in the preoperative holding area. Prior to induction of anesthesia, standard noninvasive monitors were applied including electrocardiogram, noninvasive blood pressure cuff on the left upper arm, skin temperature on the right axilla, pulse oximetry, and end-tidal carbon dioxide capnography. An additional two 18-gauge IV catheters were inserted in the dorsum of the left hand and right antecubital fossa respectively. Lidocaine 1% was injected subcutaneously to facilitate insertion of a left radial arterial line prior to induction of deep sedation for continuous invasive blood pressure monitoring. Oxygen 10 L/min was continuously administered via nonrebreather mask.

Induction of anesthesia was then initiated with midazolam 1 mg IV, propofol infusion at 20 mcg/kg/min, dexmedetomidine infusion at 0.7 mcg/kg/hr, and remifentanil infusion at 0.05 mcg/kg/min. After induction, spontaneous respiration was maintained. Mild airway obstruction was noted, and relieved after insertion of a 100 mm oropharyngeal airway and a 32 French nasopharyngeal airway.

Maintenance of anesthesia was completed with the previously mentioned anesthetics titrated to effect with propofol infusion continuously at 20 mcg/kg/min, dexmedetomidine infusion ranging from 0.5 mcg/kg/hr to 0.7 mcg/kg/hr, and remifentanil infusion ranging from 0.03 to 0.05 mcg/kg/min. Prior to the AVN ablation, the proceduralist inserted a temporary transvenous pacemaker into the right femoral vein to access the right ventricle in order to ensure sufficient ventricular rate and to maintain atrioventricular synchrony in the period after the AVN ablation, which causes an iatrogenic third-degree heart block.[2] After the AVN ablation procedure was completed, the permanent pacemaker was then inserted. During the procedure, strict diligence was provided to maintain stable vital signs including arterial blood pressure within 20% of baseline with values ranging from 117/48 mmHg to 134/71 mmHg, SpO_2 was maintained at 98% to 100%, respiratory rate of 9/min to 20/min and paced HR of 60/min to 83/min via transvenous pacemaker. The procedure lasted approximately 3 hours with total crystalloid infusion of 300 mL and estimated blood loss of 20 mL.

Emergence of anesthesia was achieved by discontinuing anesthetic infusions, and removal of oropharyngeal and nasopharyngeal airways once deemed appropriate with return of airway reflexes and response to verbal commands. The patient was then transferred to the post anesthesia care unit for continued monitoring.

Discussion

The case presented details the successful anesthetic management of a patient with multiple severe pulmonary and cardiac comorbidities. The patient was sufficiently amnestic while the proceduralist had adequate akinesis while maintaining hemodynamic and respiratory stability. Treatment of refractory AF by AVN ablation is an often lengthy procedure that requires patient immobility at critical times necessitating the need for deep sedation or general anesthesia.[3] Due to the patient possessing several independent risk factors for postoperative pulmonary complications, such as age greater than 60 years old, CHF, COPD, and OSA, it was prudent to optimize the patient's respiratory status throughout the perioperative setting.[2] In the preoperative setting, the patient confirmed adherence to his inhaler medication regimen in order to ensure optimization of their pulmonary function, which is consistent with current guidelines for patients with COPD undergoing anesthesia.[2]

In comparing general anesthesia and deep sedation for ablation procedures, there is no strong consensus for which technique provides fewer postoperative pulmonary complications. This is due to general anesthesia being shown to have shorter procedure times and greater arrythmia free-rate, but higher incidence of esophageal injury and masking of intraprocedural complications including phrenic nerve injury if nondepolarizing muscle relaxants were used.[3] With this in mind, careful consideration was given to providing an anesthetic that would maintain spontaneous ventilation and pulmonary stability while also providing adequate sedation.[2] The choice was made to utilize deep sedation via targeted titration and avoid general anesthesia if possible, due to the increased risk for postoperative pulmonary complications including atelectasis, hypoxia, and pulmonary insufficiency.[2]

The primary anesthetic agent for this case was the combination of dexmedetomidine and remifentanil infusions. Dexmedetomidine, an alpha 2 agonist, has the benefit of providing both sedation and analgesia, with modest reduction in minute ventilation but maintained ventilatory response to hypercapnia.[3,4,5] Recent literature supports this choice as the combination of dexmedetomidine and remifentanil infusions were shown to have better analgesic outcomes, fewer desaturation periods, and fewer respiratory depressant effects, than when compared to combinations of midazolam-fentanyl, midazolam-remifentanil, or propofol as primary anesthetic agents.[3,4] The risk of using a dexmedetomidine and remifentanil combined anesthetic is a greater risk for hypotension, attributed mainly to dexmedetomidine, which is often seen during the initial loading dose or induction phase.[5]

To avoid hypotension, a left radial arterial line was inserted prior to induction of anesthesia, and slow titration of anesthetic agents was administered with vigilant monitoring of hemodynamic and respiratory status. In lieu of a loading dose of dexmedetomidine, a low bolus dose of midazolam 1 mg IV was administered. This decision is well supported in literature as dexmedetomidine is known to cause hypotension if given rapidly, but this effect is often

mitigated by avoiding bolus dosing and not using rapid infusion.[4,5] Subsequently, maintenance dose infusions of propofol, dexmedetomidine, and remifentanil were initiated and titrated to slowly achieve a steady state, which facilitated hemodynamic stability through the perioperative phase.[4,5]

An unfortunate, but common adverse event seen with deep sedation for this procedure is patient movement, often occurring during painful operative periods such as radiofrequency delivery.[4] To ameliorate the patient's discomfort and ensure akinesis, a remifentanil infusion was utilized titrated between 0.03 to 0.05 mcg/kg/min, which literature has shown is adequate for most cardiac ablation procedures.[4] Remifentanil is an ultra-short acting synthetic opioid with rapid onset and short context sensitive half time, which makes it useful for analgesia in deep sedation, but carries the risk of synergistically increasing respiratory and cardiac depression.[4] Evidence shows that remifentanil infusions at 0.025 to 0.05 mcg/kg/min have been shown to carry equal analgesic efficacy to higher doses of remifentanil, without an increase in respiratory depression.[1,4]

Overall, the anesthetic management of this case was accomplished in alignment with recent literature and with careful consideration for the patient's multiple cardiac and pulmonary comorbidities as well as the anesthesia requirements of the procedure. Hemodynamic and respiratory stability was carefully maintained through careful pharmacological selections and patient monitoring, which lead to a successful and uneventful anesthetic course with rapid recovery.

References

1. Cho JS, Shim J-K, Na S, Park I, Kwak YL. Improved sedation with dexmedetomidine-remifentanil compared with midazolam-remifentanil during catheter ablation of atrial fibrillation: a randomized, controlled trial. *Europace*. 2013;16(7):1000-1006. doi:10.1093/europace/eut365
2. Liem LB. Implantation of cardioverter-defibrillator (ICD) or cardiac resynchronization therapy defibrillator (CRT-D). In: Jaffe RA, Schmiesing CA, eds. *Anesthesiologists Manual of Surgical Procedures*. 5th ed. Philadelphia: Wolters Kluwer; 2014:1498-1500.
3. Gerstein NS, Young A, Schulman PM, Stecker EC, Jessel PM. Sedation in the electrophysiology laboratory: A multidisciplinary review. *J AM Heart Assoc.* 2016;5(6). doi:10.1161/jaha.116.003629
4. Song JW, Soh S, Shim J-K. Monitored anesthesia care for cardiovascular interventions. *Korean Circ J.* 2020;50(1):1. doi:10.4070/kcj.2019.0269
5. Barends CRM, Absalom A, Minnen BV, Vissink A, Visser A. Dexmedetomidine versus midazolam in procedural sedation. A systematic review of efficacy and safety. *PLoS One*. 2017;12(1). doi: 10.1371/journal.pone.0169525

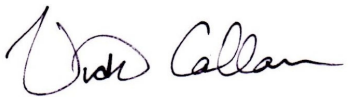
Mentor: Nikola Lazovich, MSN, CRNA

Editorial

Please join me in congratulating CDR Raymond Bonds, DNP, CRNA, CHSE, NC, USN on his recent promotion to Director for Medical Services at Naval Hospital Beaufort. This is in addition to his current role as Director for Surgical Services – with the added responsibilities, Dr. Bonds is stepping down from the editorial board. I am sorry to lose him, and I am grateful to have had the opportunity to work with him, as I have with all of our past board members. Happily, he recommended a replacement – I am pleased to welcome LTC Lauren Suszan, DNP, MSN, CRNA, NC, USN as our newest member of the ISJNA editorial board.

These past two years have been incredibly difficult in so many ways, but we have adapted and risen to the challenge. I would like to wish everyone a very happy, health 2022. Let's be optimistic about how this year is going to progress – be kind, understanding, and patient with one another. Speaking of patience, I have appreciated yours with the delay in release of this Summer issue. It is short, but it is here!

Sincerely,



Vicki Callan, PhD, CRNA, CHSE
Editor

"***The International Student Journal of Nurse Anesthesia*** **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.**"

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 ºC, 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

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___ 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)
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