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Front Cover:
On the front cover residents enrolled in the Fairfield University Nurse Anesthesia Program participate in an airway management lab. Pictured clockwise from the top are Lauren Moccia and Galo Moran-Cadme practicing fiberoptic intubation skills; Fredrick Lam performing a simulated cricothyrotomy with Alvin Stewart and Peta-Gaye Simms observing; Program Director Steven Belmont, DNP, CRNA, APRN, CFII demonstrating mask ventilation to Alexa Herold and Kevin Hein; and Kelly Patrick, Brandon Soley, Danielle Reardon, and Steven Santiago practicing direct laryngoscopy.

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Quality Improvement Project Abstract

Anesthetic Management of a Pediatric Patient with Prader-Willi Syndrome

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Keywords: Prader-Willi syndrome, general anesthesia, MRI, scoliosis

Prader-Willi syndrome (PWS) results from the paternal deletion or maternal disomy of chromosome 15.[1] Individuals with PWS are often in the perioperative domain undergoing general anesthesia and surgical intervention throughout the lifespan. Prader-Willi patients pose a challenge to anesthesia practitioners due to airway, respiratory, cardiac, and gastrointestinal anomalies.[1-3] Anesthesia management includes a thorough individualized preoperative assessment as well as a basic knowledge of the disease and accompanying comorbidities to safely care for this population.[1]

Case Report

A 9-year-old female with PWS presented to the magnetic resonance imaging (MRI) suite to undergo a total spine MRI without intravenous (IV) contrast for juvenile idiopathic scoliosis of the thoracic region. The patient was 46 kg and 128 cm tall, with a BMI of 16.96 kg/m^2. Past medical history consisted of premature birth at 31 weeks, Wolff-Parkinson-White (WPW) syndrome, developmental and language delay, hypotonia, seizures, scoliosis, and mild asthma. The patient had been seen by her pediatric cardiologist in December 2020 where an electrocardiogram (ECG) was completed. This revealed increased left ventricular forces with a WPW pattern. She had an atrial septal defect (ASD) that had spontaneously closed and a current patent foramen ovale (PFO). Her last known seizure episode was less than 6 months ago. Her asthma was well controlled with the last exacerbation being over 1 year ago. Surgeries of note included an adenoidectomy in 2014 and a tonsillectomy in 2015. Her airway assessment revealed a normal mandible, Mallampati score of II, 5 cm mouth opening and Class II upper lip bite test. The patient had no previous anesthetic complications.

The patient arrived at the MRI suite for a preoperative assessment with her grandfather. The patient was conversational and compliant. Because the patient's mother, her primary caregiver, could not physically be present, she communicated via phone during the anesthesia preoperative evaluation. The patient’s last known intake was the previous evening at 19:30.

She walked into the MRI control room with her grandfather where a time out was completed by three anesthesia professionals and two MRI technicians. The team then proceeded to the MRI scanning room where the patient was positioned supine on the MRI bed. General anesthesia was induced via mask inhalation with a mixture of N_2O 7 L/min and O_2 3 L/min, followed by sevoflurane 8% inspired concentration in O_2 8 L/min. Intravenous (IV) access was established with a #22 gauge catheter in the patient's left hand. An IV infusion of lactated Ringers (LR) solution was initiated. Post-induction vital signs were SpO_2 99%, HR 120/min, and BP 129/66 mm Hg. The heart rate on ECG was normal sinus rhythm. The patient maintained a natural airway and O_2 6 L/min was administered via non-rebreather facemask. A bolus of propofol 100 mg IV was administered and general anesthesia was maintained with a propofol infusion at 300

mcg/kg/min. A conversion to total intravenous anesthesia was chosen to lower the incidence of respiratory adverse events and improve recovery time. A dose of hydrocortisone 60 mg IV was administered following the recommendations from the patient's endocrinologist.

The patient was positioned into the MRI machine by the anesthesia professionals and the MRI technicians. The scan was completed in 66 minutes. The patient remained still throughout the entirety of the procedure with vital signs remaining at post-induction readings. A total of LR 500 mL was administered. The propofol infusion was discontinued when the scan finished, and the patient maintained a natural airway with an inspired concentration of O_2 6 L/min to the post anesthesia care unit. She was discharged home in stable condition later that day.

Discussion

First discussed in 1956, Prader-Willi syndrome results from the paternal deletion or maternal disomy of chromosome 15.[1] It affects males and females equally and occurs in about 1:20,000 live births.[1] Life expectancy varies between 30 and 50 years depending on the severity of comorbidities.[4,5]

Scoliosis is seen in about 40% of individuals with PWS, ranging from mild to severe.[4] Most individuals with PWS present with lumbar or thoracolumbar curvature.[4] Research shows that significant restrictive lung patterns are associated with a Cobb's angle greater than 40%.[6] Individuals with PWS may need scoliosis surgery to improve restrictive lung patterns.[7] At about 18 months of age, PW children should begin to be screened for scoliosis.[4] Obtaining baseline spine radiographs can track changes over time.[4] This patient had mild scoliosis with less than 40% curvature and her pulmonologist reported that there was no active concern for restrictive airway disease.

It has been reported that PWS patients have a narrow airway and small glottic opening, hypoplastic mandible, and a Mallampati score of II or greater.[4] All of these require special attention when performing intubation and are situation specific. Having a video laryngoscope or awake fiberoptic device available and/or in the procedure room will aid in difficult airway scenarios.[8] The benefits of maintaining a natural airway and respirations outweighed the risk of placing a supraglottic device or intubating this child. Previous anesthesia records noted asthma, and airway manipulation posed the risk of eliciting bronchospasm and post-intubation laryngeal edema.[9] The patient was given a shoulder roll to help with airway patency during the scan and emergency airway supplies were readily available in the MRI control and scanning room.

Individuals with PSW suffer from obstructive sleep apnea (OSA) and often require continuous positive airway pressure intraoperatively and postoperatively.[4,5,7] These individuals usually require tonsillectomies and/or adenoidectomies at an early age.[4] This patient had both her tonsils and adenoids removed, essentially eliminating her OSA. However, it is important to understand that even after removal, PWS patients can still suffer from OSA and require non-invasive ventilation.[4] This should be assessed on a case-to-case basis.

Patients who are diagnosed with PWS usually have accompanying cardiac anomalies, most commonly atrial and ventricular septal defects.[1,4] This patient had a past medical history of ASD, PFO, and WPW syndrome; however, maintained normal sinus rhythm throughout the procedure. Starting in late childhood, PWS patients can suffer from an insatiable appetite, which is caused by an increased ghrelin production.[4] This leads to an enhanced reward from eating, making obesity common in this population.[4] These individuals can eat until their stomachs distend and essentially rupture.[4] This occurs partially due to their high pain threshold and lack of ability to vomit.[4] This patient had a BMI that was clinically underweight, which is unusual for this population. A report from her endocrinologist stated that although she had started to show an increased awareness in food, she had yet to exhibit symptoms of hyperphagia. Preoperative fasting guidelines may be difficult to adhere to in this population due to the presence of behavioral issues and hyperphagia.[4] Since the patient's family members were reliable historians and she had not eaten since 19:30, the anesthesia providers concluded that a natural airway was safe and provided optimal recovery.

Developmental delays and extreme behavioral issues usually occur in most PWS persons. Such behavioral disorders manifest as temper tantrums and stubbornness.[4] Giving a preoperative anxiolytic such as midazolam has shown to be effective in patients with PWS.[4] In cooperative PWS patients, local anesthesia and monitored anesthesia care can be successfully implemented when appropriate.[2] During this interaction, the patient showed no behavioral concerns and was pleasantly cooperative. Although she had a mild speech impediment, hospital staff were able to understand her and communicate appropriately. In her grandfather’s presence she was able to stay calm and the use of premedication was unnecessary.

The majority of PWS individuals have hypotonia at birth stemming from a decrease in growth hormone (GH) secretion.[3-5] A decrease in GH results in short stature throughout life.[2-5,7] The patient’s endocrinologist was satisfied with her current dose of GH and improving body composition. Additionally, adrenal insufficiency is not uncommon in PWS patients, but there are conflicting results with responses to cortisol testing.[4] Usually, the patient’s endocrinologist will make recommendations for anesthesia professionals regarding the administration of stress-dose steroids for surgery.[4]

Non-operating room anesthetic procedures are high-risk situations since resources are not as readily available. This case presented potential difficulties due to the additional diagnosis of PWS. The airway, cardiac, and gastrointestinal concerns of this population can make it challenging to administer anesthesia. Safety is always the main priority and by completing a thorough preoperative assessment and having accessible emergency airway supplies, the patient had a positive outcome. Recommendations for repeating a similar case in the future would be to continue having three anesthesia professionals in the MRI suite.

References

1. Rusin N, Tobias JD. Anesthetic care during posterior spinal fusion in a patient with Prader-Willi syndrome. *Pediatr Anesth Crit Care J.* 2020;8(2)80-87. doi:10.14587/paccj.2020.13

2. Roman-Torres CVG, Kussaba ST, Bantim YCV, de Oliveira RBAA. Special care dentistry in a patient with Prader-Willi syndrome through the use of atraumatic restorative treatment under general anesthesia. *Case Rep Dent.* 2017;2017:7075328. doi:10.1155/2017/7075328
3. Crinò A, Fintini D, Bocchini S, Grugni G. Obesity management in Prader-Willi syndrome: current perspectives. *Diabetes Metab Syndr Obes.* 2018;11:579-593. doi:10.2147/DMSO.S141352
4. Butler MG, Miller JL, Forster JL. Prader-Willi syndrome - clinical genetics, diagnosis and treatment approaches: an update. *Curr Pediatr Rev*. 2019;15(4):207-244. doi:10.2174/1573396315666190716120925
5. Scheimann AO. Clinical features, diagnosis, and treatment of Prader-Willi syndrome. *UpToDate.* September 1, 2021. Updated January 31, 2022. Accessed August 7, 2022. https://www.uptodate.com/contents/clinical-features-diagnosis-and-treatment-of-prader-willi-syndrome?search=prader%20willi%20syndrome%20anesthesia&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1
6. Horng MH, Kuok CP, Fu MJ, Lin CJ, Sun YN. Cobb angle measurement of spine from x-ray images using convolutional neural network. *Comput Math Methods Med.* 2019;2019:6357171. doi:10.1155/2019/6357171
7. Yoon JY, Park SH, Won YH. Respiratory failure after scoliosis correction surgery in patients with Prader-Willi syndrome: two case reports. *World J Clin Cases.* 2021;9(32):9960-9969. doi:10.12998/wjcc.v9.i32.9960
8. Kim KW, Kim SH, Ahn EJ, Kim HJ, Choi HR, Bang SR. Anesthetic management with a neuromuscular relaxant and sugammadex in a patient with Prader-Willi syndrome: a case report. *SAGE Open Med Case Rep.* 2020;8:1-3. doi:10.1177/2050313X20927616
9. Rajesh MC. Anaesthesia for children with bronchial asthma and respiratory infections. *Indian J Anaesth.* 2015;59(9):584-588. doi:10.4103/0019-5049.165853

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Dexmedetomidine: An Adjuvant to Spinal Anesthesia for Cesarean Section

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Keywords: dexmedetomidine, Precedex, spinal anesthesia, cesarean section

Spinal anesthesia is the preferred anesthetic for women undergoing a cesarean section. The reported rate of cesarean delivery in the United States is over 30%.[1] Generally, the benefits of spinal anesthesia outweigh the risk. However, with extreme sympathetic blockade after intrathecal administration of local anesthetic, women may experience nausea, vomiting, shivering, and hypotension leading to compromised uteroplacental perfusion and fetal distress.[1] As the rate of cesarean sections increases, anesthesia practitioners must monitor the latest literature regarding spinal anesthesia to provide the safest anesthetic for mother and baby.

Case Report

A 37-year-old female was scheduled for a cesarean section. The patient presented at 39 1/7 weeks gestation with a BMI of 31.6 kg/m^2 and allergies to erythromycin, latex, and bananas. She had a known history of asthma, eczema, mononucleosis, covid-19, and advanced maternal age in multigravida. Past surgeries include three cesarean sections, and she had no reported past anesthetic complications.

A preoperative anesthesia exam revealed clear lungs on auscultation with a heart rate of 81 beats/min and blood pressure of systolic 110 mm Hg and diastolic 70 mm Hg. Platelets were within normal limits. The benefits and potential risks of spinal anesthesia were discussed and the patient consented to undergo cesarean section under spinal anesthesia. Preoperatively, a fluid bolus of lactated ringers was administered via a peripheral intravenous catheter (PIV); she received metoclopramide 10 mg and famotidine 20 mg intravenously.

Once the patient arrived in the operating room, standard noninvasive monitors were applied, and O_2 4 L/min was administered via nasal cannula. Spinal anesthesia was performed at the L3-L4 interspace using a 25-gauge pencil-point needle. Placement in the subarachnoid space was confirmed with the free flow of cerebrospinal fluid. Bupivacaine 0.75% 1.6 mL mixed with preservative-free morphine 0.15 mg and dexmedetomidine 5 mcg was injected successfully. The patient tolerated the procedure well and was immediately laid supine with left uterine displacement. The area of sensory blockade was assessed, and the patient had an adequate anesthetic level blockade from T10-S2.

Heart rate, respiratory rate, blood pressure, oxygen saturation, and temperature were monitored intraoperatively using a 5-lead electrocardiogram, noninvasive blood pressure cuff, SpO_2 finger probe, and a skin temperature sticker. Phenylephrine 100 to 200 mcg IV was administered throughout the procedure to treat hypotension (84/40 mm Hg). Nausea was a frequent complaint by the patient during the procedure and was treated with ondansetron 4 mg. The cesarean section lasted 85 minutes. A viable male neonate with Apgar scores of 9 and 9 was delivered during the cesarean section. Postoperatively, the initial assessment showed vitals within normal limits with no signs of neurological deficit for the mother and baby. The patient had no complaints of pain during the procedure.

Discussion

Spinal anesthesia is a regional anesthetic commonly utilized for patients undergoing cesarean section. During spinal anesthesia, there is a transient blockage of sensory and motor of spinal nerves. Advantages of spinal anesthesia include quick onset, cost-effectiveness, and allowing the mother to be awake during the procedure. Disadvantages of spinal anesthesia include the anesthetic effect's short duration and possible adverse effects including hypotension, bradycardia, nausea, vomiting, shivering, or dyspnea.[2,3] Of these potential adverse effects, hypotension is the most concerning as it can lead to morbidity and mortality for both infant and mother.[2] Administering spinal anesthesia with an adjuvant has the potential to offset some disadvantages mentioned. Some adjuvants that have shown to enhance the quality of spinal anesthesia when injected intrathecally include epinephrine, morphine, fentanyl, and sufentanil.[4]

Bupivacaine 0.75% is the most widely used local anesthetic for spinal anesthesia.[4] The local anesthetic's dose determines the duration of action. Studies have shown that decreasing the amount of local anesthetic given intrathecally for spinal anesthesia may minimize the risk of hypotension.[2] Often decreasing the amount of local anesthetic administered is not an option considering the dose determines the duration of the block. To provide a smaller dose of local anesthetic but still optimize the effects, anesthesia practitioners have utilized adjuvants such as those listed above and dexmedetomidine.

Dexmedetomidine is a highly selective alpha 2-receptor agonist that provides analgesic, sedative, and anti-sympathetic effects with no significant impact on respiration.[5] By adding low-dose dexmedetomidine intrathecally, the spinal bupivacaine efficacy is enhanced by 24%.[6] Studies have proven the combination of intrathecal bupivacaine with dexmedetomidine prolongs the duration of the anesthetic effects on average an additional forty minutes and in some cases up to another ninety minutes, even with lower doses of bupivacaine.[2,5,6]

The safety of the mother and fetus while using intrathecal dexmedetomidine has been questioned. A recent study in 2019 measured the amount of dexmedetomidine in the umbilical artery (UA) and umbilical vein (UV), as well as Apgar scores of newborns born via cesarean section to mothers who received spinal anesthesia with low dose dexmedetomidine 5 mcg added. The results showed the concentration of dexmedetomidine was too low to be detected in both the UA and UV by the advanced measuring system, and all infants had Apgar scores greater than eight, suggesting low dose dexmedetomidine given intrathecally will not lead to adverse effects on the fetus.[5] A concern of intravenous dexmedetomidine is hemodynamic instability; therefore, the same concerns exist for intrathecal use of dexmedetomidine. The literature reviewed showed no reports of significant differences in hemodynamics with patients who received low dose dexmedetomidine with bupivacaine intrathecally compared to those who did not have the addition of dexmedetomidine intrathecally.[2,3,5,6] With the use of dexmedetomidine 5 mcg intrathecally, patients' hemodynamics remained more stable during the procedure due to a lower local anesthetic requirement and fewer opioids required.[2] In addition to maintaining stable hemodynamics, intrathecal dexmedetomidine effectively reduces the incidence of shivering during cesarean section.[3] Decreasing shivering is of significance, considering that shivering may lead to increased oxygen consumption and carbon dioxide production, which affects certain maternal physiological functions.[3]

The anesthetic considerations for spinal anesthesia performed for women undergoing cesarean section will continue to be researched and evaluated. With the literature available now, some key advantages exist when utilizing low dose dexmedetomidine as an adjuvant to local anesthetics administered intrathecally. As anesthesia practitioners, patient safety is a primary concern. After reviewing multiple studies, the patient discussed in the case report may have benefited by only administering dexmedetomidine 5 mcg with the bupivacaine 0.75% 1.6 mL intrathecally. Another alternative could have been administering a lower dose of bupivacaine 0.75% or even a lower concentration, such as 0.5%, with the low dose dexmedetomidine.

References

1. Noffsinger SR. Evidence-based prevention strategies for the management of spinal anesthesia-induced hypotension in healthy parturients undergoing elective cesarean delivery. *AANA J*. 2022;90(4):311-316.
2. Khan MN, Zubair H, Rasul N, Parveen S, Fatima A, Adalt S. Comparison of hemodynamic changes after use of intrathecal 0.75% hyperbaric bupivacaine versus 0.5% hyperbaric bupivacaine with dexmedetomidine in patients undergoing cesarean section. *Pak J Med Health Sci*. 2022;16(6):346-348. doi:10.53350/pjmhs22166346
3. Wang Y-Q, Zhang X-J, Wang Y. Effect of intrathecal dexmedetomidine on cesarean section during spinal anesthesia: A meta-analysis of randomized trials. *Drug Des Devel Ther*. 2019;13:2933-2939. doi:10.2147/dddt.s207812
4. Cousins MJ, Bridenbaugh PO. Spinal (subarachnoid) blockade. In: Cousins MJ, Carr DB, Horlocker TT, Bridenbaugh PO, eds. *Cousins and Bridenbaugh's Neural Blockade in Clinical Anesthesia and Pain Medicine*. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2012:213-240.
5. Li X-xiao, Li Y-mei, Lv X-li, Wang X-he, Liu S. The efficacy and safety of intrathecal dexmedetomidine for parturients undergoing cesarean section: A double-blind randomized controlled trial. *BMC Anesthesiol*. 2020;20(190). doi:10.21203/rs.3.rs-28230/v1
6. Liu L, Qian J, Shen B, Xiao F, Shen H. Intrathecal dexmedetomidine can decrease the 95% effective dose of bupivacaine in spinal anesthesia for cesarean section. *Medicine*. 2019;98(9). doi:10.1097/md.0000000000014666

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Management of a Patient with Beckwith-Wiedemann Syndrome

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Keywords: Beckwith-Wiedemann Syndrome, anesthesia, airway

Beckwith-Wiedemann Syndrome is a congenital overgrowth disorder first described in 1963 and 1964 by Drs. J. Bruce Beckwith and Hans-Rudolf Wiedemann.[1-5] It was initially characterized by macroglossia, omphalocele, and lateralized overgrowth.[1-7] Macroglossia can be associated with an increased risk for upper airway obstruction and difficult mask ventilation or intubation.[3-7] The following report details the case of a 16-year-old female patient with a history of Beckwith-Wiedemann Syndrome undergoing a free tissue transfer to repair a palatal fistula.

Case Report

A 16-year-old, 47 kg, 165 cm female presented for free tissue transfer to repair a palatal fistula. The patient had a past medical history of Beckwith-Wiedemann Syndrome, macroglossia, cleft palate, anterior hard palate fistula, malocclusion of the teeth, and gastroesophageal reflux disease. The patient's past surgical history included a pharyngeal flap for velopharyngeal

insufficiency, attempted palatoplasty repair of anterior palate fistula with incomplete closure, and midline glossectomy. The patient's electrocardiogram was normal, without history of cardiac anomaly, and had a metabolic equivalent testing score > 4. The day of surgery physical assessment revealed clear lung sounds, normal heart tones, poor dentition, and a Mallampati class 1 airway. Premedication included intravenous midazolam 2 mg.

The patient was brought to the operating room, where standard noninvasive monitors were applied. Oxygen via circuit mask was administered at 15 L/min until the patient reached an expired O_2 concentration of 90%. General anesthesia was induced with intravenous fentanyl 50 mcg and propofol 100 mg. After successful mask ventilation, intravenous succinylcholine 60 mg was administered. The patient's trachea was intubated with a 7.0 mm single lumen cuffed endotracheal tube via direct laryngoscopy with a Macintosh 3 blade. Endotracheal tube placement was verified with the presence of bilateral breath sounds and capnography and the tube was secured at a depth of 21 cm. Mechanical ventilation was initiated on a mode of SIMV, tidal volumes of 400 mL, a rate of 15/min, and PEEP of 5 cm of H_2O.

General anesthesia was maintained via inspired sevoflurane concentrations of 1.9 - 2.4% in a mixture of O_2 1 L/min and air 1 L/min. The free tissue transfer to repair a palatal fistula was performed uneventfully. The patient's trachea was extubated in the operating room after verifying lung dynamics, spontaneous respirations, and confirming pharmacological antagonization of neuromuscular blockade with > 90% response on train-of-four monitoring.

While transferring the patient from the operating room table to the bed, the surgeon noted a loss in the Doppler flap signal. After a discussion with the surgeon, it was determined to transfer the patient back to the operating room table, induce general anesthesia again, and re-intubate the patient's trachea to examine the flap. General anesthesia was induced with intravenous hydromorphone 0.2 mg, propofol 50 mg, and succinylcholine 100 mg. The patient's trachea was re-intubated with a 7.0 mm single lumen cuffed endotracheal tube via video laryngoscopy with a GlideScope (Verathon) 3 blade. Endotracheal tube placement was verified with the presence of bilateral breath sounds and capnography, the tube was secured at a depth of 21 cm, and mechanical ventilation was initiated at the same settings. After the neck was prepped and draped sterilely, the neck incision was opened. The surgeon was able to confirm good return of blood flow to the flap on pinprick and a robust doppler signal on the flap pedicle. The incision was then closed. Per the surgeon's request due to concern for airway swelling, it was determined to keep the patient's trachea intubated and mechanical ventilation was continued postoperatively. The patient was transferred to the pediatric intensive care unit in stable condition. Overnight, the patient was started on an intravenous fentanyl continuous infusion for sedation and mechanical ventilation compliance. The patient's trachea was extubated the next day without complication.

Discussion

Anesthesia considerations for a patient with Beckwith-Wiedemann Syndrome include an increased incidence of macroglossia and the potential for a difficult airway. The syndrome was first described in 1963 by Dr. J. Bruce Beckwith in three related necropsy cases, then Dr. Hans-Rudolf Wiedemann added two more cases in living children in 1964.[1-5] It is considered the most common epigenetic overgrowth disorder, affecting over 1:10,000 people and is caused by

epigenetic or genetic defects on chromosome 11p15.[2] Cardinal features of Beckwith-Wiedemann Syndrome include macroglossia, lateralized overgrowth, and hyperinsulinism.[2] Lateralized overgrowth is defined as asymmetric overgrowth of one or more regions of the body, particularly in the limbs and associated with increased muscle bulk.[2]

Since Beckwith-Wiedemann Syndrome can cause macroglossia, anesthesia providers carefully plan for potential airway-related complications.[3,5,7] Macroglossia is prevalent in 50-95% of patients with Beckwith-Wiedemann Syndrome.[2,3,5,6] Upper airway obstruction and difficult mask ventilation or intubation occurs in up to 6% of cases.[6] The most mentioned anesthesia consideration for patients with Beckwith-Wiedemann Syndrome is a thorough perioperative assessment, including an airway assessment.[3-5] Most authors suggest having a detailed plan and backup plan for difficult intubation, as well as varied airway equipment available in the room, including emergency airway equipment.[3-5] Other anesthesia considerations include an awake intubation and an awake or delayed extubation.[3,5,7]

Sequera-Ramos et al. retrospectively reviewed electronic medical records of 210 patients with Beckwith-Wiedemann Syndrome who received an anesthetic between January 2012 and July 2019, for a total of 310 anesthetics.[6] Almost 75% of patients were considered an American Society of Anesthesiologists Physical Status class III and 53.2% had macroglossia documented on their physical examination.[6] The most common procedure types included general surgery and plastics/craniofacial surgery.[6]

Results showed that the prevalence of a difficult airway was 5.3%, difficult facemask ventilation of 2.9% and difficult intubation of 5.2%.[6] In comparison, the prevalence of difficult laryngoscopy in the general pediatric population was reported at 2%.[6] The intubation first-attempt success rate was 83.8%, with 82.7% of patients being documented as having a Cormack-Lehane grade 1 view.[6] In cases with a difficult airway, one of the patients experiencing difficult facemask ventilation was successfully rescued with a supraglottic airway device that was kept as the primary airway device for the duration of the procedure.[6]

In summary, the literature supports that patients with macroglossia experienced a higher prevalence of difficult facemask ventilation, difficult intubation, multiple intubation attempts, and hypoxemia (defined as SpO_2 < 90% for > 30 seconds).[6] Therefore, macroglossia may be a contributing factor to a difficult airway.[6] Factors associated with a difficult airway in patients with Beckwith-Wiedemann Syndrome include macroglossia, age < 1-year, lower weight (on day of surgery and not corrected for gestational age), plastic/craniofacial surgery, history of obstructive sleep apnea, and endocrine abnormalities.[6]

Beckwith-Wiedemann Syndrome can also cause neonatal hypoglycemia due to hyperinsulinism and islet cell hyperplasia.[4] Hypoglycemia can be present in up to half of infants with Beckwith-Wiedemann Syndrome and can be classified as transient, lasting less than one week, or prolonged, lasting greater than one week.[1-3] Anesthesia considerations include monitoring perioperative glucose levels and treating hypoglycemia as necessary.[3,4,7]

Cardiac anomalies can also be present in patients with Beckwith-Wiedemann Syndrome, including tetralogy of Fallot, atrial septal defect, ventricular septal defect, patent ductus

arteriosus, hypoplastic left ventricle, and idiopathic cardiomegaly.[7] A thorough preoperative assessment is imperative. A cardiac workup may be indicated, depending on the extent and severity of the patient's anomaly.

Despite patients with Beckwith-Wiedemann Syndrome being reported to have higher incidences of a difficult airway compared to the general pediatric population, intubation first-attempt success rate was 83.8%.[6] The first-attempt technique for intubation using direct laryngoscopy was 71.2%.[6] Patients with Beckwith-Wiedemann Syndrome can successfully be managed through a comprehensive preoperative evaluation including a thorough airway assessment and detailed documentation, reviewing prior anesthetics, planning, vigilant perioperative monitoring, careful postoperative care, and awareness of possible outcomes.[3,4,7]

References

1. Pandita A, Gupta S, Gupta G, Panghal A. Beckwith-Weidemann Syndrome with IC2 (KvDMR1) hypomethylation defect: A novel mutation. *BMJ Case Rep*. 2018;2018:bcr2017222419. doi:10.1136/bcr-2017-222419
2. Duffy KA, Cielo CM, Cohen JL, et al. Characterization of the Beckwith-Wiedemann spectrum: Diagnosis and management. *Am J Med Genet C Semin Med Genet*. 2019;181(4):693-708. doi:10.1002/ajmg.c.31740
3. de la Varga O, Galve AI, Romera A. Perioperative anesthetic management of reductive glossoplasty in a patient with Beckwith-Wiedemann Syndrome. Manejo anestésico perioperatorio de glosoplastia reductora en paciente con síndrome de Beckwith-Wiedemann. *Rev Esp Anestesiol Reanim* (Engl Ed). 2021;68(3):156-160. doi:10.1016/j.redar.2020.02.009
4. Lagoo JY, Shah VM. Anaesthetic considerations in an infant with Beckwith-Weidemann Syndrome and hepatoblastoma for partial hepatectomy [published correction appears in Indian J Anaesth. 2015 Mar;59(3):205]. *Indian J Anaesth*. 2015;59(2):121-123. doi:10.4103/0019-5049.151377
5. Tsukamoto M, Hitosugi T, Yokoyama T. Perioperative airway management of a patient with Beckwith-Wiedemann Syndrome. *J Dent Anesth Pain Med*. 2016;16(4):313-316. doi:10.17245/jdapm.2016.16.4.313
6. Sequera-Ramos L, Duffy KA, Fiadjoe JE, et al. The prevalence of difficult airway in children with Beckwith-Wiedemann Syndrome: A retrospective cohort study. *Anesth Analg*. 2021;133(6):1559-1567. doi:10.1213/ANE.0000000000005536
7. Batra M, Valecha UK. Anesthetic management of tongue reduction in a case of Beckwith-Wiedemann Syndrome. *J Anaesthesiol Clin Pharmacol*. 2014;30(4):562-564. doi:10.4103/0970-9185.142863

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Management of a Patient Undergoing Bronchoscopy with a Mediastinal Mass

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Keywords: bronchoscopy, mediastinal mass, case report, anesthesia management, pediatrics, airway compression, cardiopulmonary collapse, hemodynamic compromise

Introduction

A mediastinal mass is a life-threatening comorbidity that requires serious consideration when developing an anesthetic plan. It poses a significant risk to patient safety because it could lead to airway compression and cardiopulmonary collapse. A systematic approach and multidisciplinary collaboration are essential to reduce perioperative complications.Due to the proximity of mediastinal structures in relation to the mass, perioperative challenges such as hemodynamic instability and central airway collapse are patient-dependent.[1-3] Intraoperative challenges are directly correlated with the size of the mass and the anatomic space it invades.[1]

Case Report

A 16-year-old female presented to an outside facility with recurrent chest pain and daily febrile episodes, where she received a multidisciplinary evaluation. This patient was initially diagnosed with costochondritis and pneumonia after a preliminary computed tomography (CT) scan showed an infectious pulmonary nodule. She was prescribed a course of corticosteroids and doxycycline and was later discharged from the hospital. Symptoms continued to worsen despite ongoing treatment. The patient then developed a non-productive cough, shortness of breath, persistent headaches, and intermittent lightheadedness, which prompted an emergency department visit. An echocardiogram showed normal myocardial function, unremarkable myocardial size, and a small pericardial effusion. A diagnosis of myocarditis was made based on the echocardiogram findings. After discharge, symptoms did not improve with treatment over the next month, so she was admitted to a children's specialty hospital. A new CT scan showed a mediastinal mass, and a pulmonary nodule previously noted on preliminary imaging. She was then transferred to an academic medical center for a flexible bronchoscopy with endobronchial ultrasound-guided biopsy.

The anesthesia team collaborated with the pulmonologist regarding the method of induction and maintenance to ensure optimal surgical conditions and patient safety. Baseline vitals included blood pressure 109/57 mm Hg, heart rate 99/min, 22 /min, SpO_2 98%, and temperature 36.8° C. A general anesthestic was required for the diagnostic procedure. An intubating supraglottic airway (SGA) was selected for airway management in case emergent endotracheal intubation was required. A rigid bronchoscope was readily available in case of respiratory collapse; it allows for direct airway visualization and can be advanced beyond an obstruction to facilitate ventilation.[3] The goals were to maintain spontaneous ventilation throughout the procedure and to minimize the use of positive-pressure ventilation.

General anesthesia was induced with a combination of sevoflurane inhalation and incremental intravenous propofol boluses. A low-dose continuous propofol infusion was chosen to ensure a steady-state anesthetic during the procedure. Inhaled sevoflurane was used to reduce the amount of propofol required, in an attempt to preserve spontaneous ventilation. Blood pressure was intermittently labile, requiring phenylephrine boluses. Respirations fluctuated during the case, ranging from 30 to 60/min. Spontaneous ventilation was maintained throughout the bronchoscopy. After the procedure was completed, the SGA was removed when protective reflexes were regained, and the patient was able to follow commands. There was no evidence of cardiopulmonary compromise after the removal of the SGA. The patient was transported to the post-anesthesia care unit with O_2 6 L/min via simple mask. The patient was hemodynamically stable upon arrival to the post-anesthesia care unit with no evidence of perioperative complications.

Discussion

A comprehensive understanding of the risks associated with a mediastinal mass requires a thorough understanding of the anatomy and physiology of mediastinal structures. It is estimated that perioperative complications occur in approximately 9% to 20% of cases, despite being adequately prepared and following clinical guidelines.[2] The location of a mass can predict the degree of difficulty that an anesthetist may encounter.[1-2]

The mediastinum is made up of three anatomical compartments: anterior, middle, and posterior. Perioperative complications occur more frequently with anterior mediastinal masses.[1-3] This can be attributed to the proximity of other anatomical structures, including the tracheobronchial tree, cardiac chambers, thoracic aorta, superior vena cava, and pulmonary arteries.[1-2] A retrospective study examined the rate of perioperative complications in patients with mediastinal masses; results showed that 15% of these patients experienced complications ranging from mild hemodynamic instability to complete cardiopulmonary collapse during the operative period.[2] Approximately 85% of the patients who experienced complications had an anterior mediastinal mass.[2]

Cardiopulmonary instability is common, usually due to compression of heart chambers and major pulmonary vessels.[1-7] Hypoxemia can occur due to decreased pulmonary artery blood flow leading to a ventilation/perfusion mismatch and potentially right-sided heart failure.[2-3,6] Pulmonary vein compression can significantly inhibit blood return to the left ventricle leading to reduced cardiac output and pulmonary edema.[3] Airway patency is threatened by general anesthesia due to bronchial and tracheal relaxation effects. These detrimental effects are amplified by neuromuscular blockade due to loss of muscle tone, leading to decreased airway diameter.[3,5-7] Positive-pressure ventilation increases intrathoracic pressure, leading to increased extrinsic airway compression, which can cause complete airway collapse.[2,5,6] Anesthesia personnel aimed to prevent increases in intrathoracic pressure by maintaining spontaneous ventilation with a SGA for the duration of the diagnostic procedure. Neuromuscular blockers were negated from the anesthetic plan to optimize airway muscle tone.

Current evidence-based practice guidelines suggest emphasizing preoperative planning through a comprehensive physical assessment.[2-4,6,7] If the patient is symptomatic, the risk of perioperative

complications is higher.[4] Preoperative symptoms of orthopnea and stridor indicate airway compromise and are predictive of perioperative respiratory complications.[3] Upper extremity swelling and syncopal episodes could signify impending cardiovascular compromise during the operative period secondary to blood vessel compression.[3] It is recommended to utilize local anesthesia, regional anesthesia, or sedation to maintain airway tone when appropriate.[1,3] Dexmedetomidine and ketamine are adjuncts utilized in the anesthetic regimen because they do not depress the ventilatory drive.[1,3,7] If general anesthesia cannot be avoided, spontaneous ventilation is superior to positive-pressure ventilation because spontaneous ventilation maintains the transpleural pressure gradient.[3,6] Due to an extensive patient history of symptomatic episodes, the anesthesia team collaborated with the pulmonologist to assemble the best course of action. The presenting symptoms signaled the possibility of impending respiratory complications after induction of anesthesia.

If major vessels are located near the mass, it is advised to initiate invasive hemodynamic monitoring before induction of anesthesia.[4] Femoral intravenous access should be obtained if there is a concern for superior vena cava compression.[4,6] Mediastinal masses located at or below the carina can lead to mechanical obstruction by the mass despite securing the airway with an endotracheal tube.[2] This obstruction leads to hypoxia and hypercarbia due to inadequate ventilation to the distal alveoli.[2] After a thorough review of CT imaging, it was deemed appropriate to induce anesthesia without the placement of an arterial line.

Multiple disciplines, such as a thoracic surgical team, perfusionists, and pulmonologists, should be consulted if major perioperative complications arise.[4,6,7] Contrary to proposed recommendations, Hartigan et al.[5] conducted staged anesthetic inductions with positive-pressure ventilation and neuromuscular blocking agents in individuals with known mediastinal masses, and results showed an absence of cardiopulmonary collapse. These results may not apply to clinical practice due to the small sample size, but they offer new evidence to stimulate discussion about current practice and future research.[5]

There were no perioperative complications that arose during the bronchoscopy. However, additional anesthesia interventions could have been implemented to ensure patient safety during the procedure. An arterial line would have been a beneficial prophylactic measure because it would have signaled impending cardiopulmonary instability quicker than a non-invasive blood pressure cuff. Careful attention to positioning should have been observed to a higher degree because the induction of general anesthesia in a semi-upright position optimizes functional residual capacity.[1,6,7] More planning regarding cardiovascular collapse management should have been discussed with the entire team.

The approach to conducting the bronchoscopy was well-planned and demonstrated positive results. The absence of perioperative complications reinforces that current clinical recommendations are likely beneficial to patient safety. Adequate planning and vigilant monitoring are essential to conducting a successful anesthetic on a patient with a mediastinal mass. Each patient should be evaluated, and an individualized plan should be developed to enhance patient safety.

References

1. Fabbro M, Patel PA, Ramakrishna H, Valentine E, Ochroch EA, Agoustides JG. Case 5-2014 challenging perioperative management of a massive anterior mediastinal mass in a symptomatic adult. *J Cardiothorac Vasc Anesth.*2014;28(3):819-825. doi:10.1053/j.jvca.2013.12.029
2. Pearson JK, Tan GM. Pediatric anterior mediastinal mass. *Semin Cardiothorac Vasc Anesth.* 2015;19(3):248-254. doi:10.1177/1089253215578931
3. McLeod M, Dobbie M. Anterior mediastinal masses in children. *BJA Educ.* 2019;19(1):21-26. doi:10.1016/j.bjae.2018.10.001
4. Radvansky B, Hunt ML, Augoustides JG, et al. Perioperative approaches to the anterior mediastinal mass - principles and pearls from a ten-year experience at an experienced referral center. *J Cardiothorac Vasc Anesth.* 2021;35(8):2503-2512. doi:10.1053/j.jvca.2021.02.014
5. Hartigan PM, Karamnov S, Gill RR, et al. Mediastinal masses, anesthetic interventions, and airway compression in adults: A prospective observational study. *Anesthesiology*. 2021;136(1):104-114. doi:10.1097/aln.0000000000004011
6. Dubey PK, Tripathi N. Anesthetic considerations in a patient with large anterior mediastinal mass. *J Cardiothorac Vasc Anesth.* 2019;33(4):1073-1075. doi:10.1053/j.jvca.2018.03.023
7. Halepota HF, Tan JS, Reddy SK, et al. Association of anesthetic and surgical risk factors with outcomes of initial diagnostic biopsies in a current cohort of children with anterior mediastinal masses. *World J Pediatr Surg.* 2021;4(4). doi:10.1136/wjps-2021-000303

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General Anesthesia Considerations for Twin-Twin Transfusion Syndrome

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Keywords: Twin to twin transfusion syndrome, intrauterine surgery, laser ablation, fetal surgery

Twin to twin transfusion syndrome (TTTS) is a placental vessel abnormality found between twins who share a placenta (monochorionic). Abnormal vessel anastomoses create unequal vascular flow between twins resulting in one twin receiving excess blood flow ("recipient"), and the other twin ("donor") receiving insufficient flow in return. This placental abnormality can affect up to 15% of monochorionic twin pregnancies and can lead to amniotic fluid imbalance such as oligo- or polyhydramnios, and cardiac dysfunction.[1] This case outlines a general anesthetic method used for a woman with monochorionic diamniotic (two amniotic sacs) twins for minimally invasive approach using fetoscopic laser photocoagulation of communicating placental vessels.

Case Report

The patient was a 35-year-old, 72 kg, 153 cm, G1P0 presenting at 16-weeks 4/7 days gestation. On physical exam, the patient had a Mallampati score of I and a thyromental distance > 6

centimeters. Pulmonary and cardiac exam were within normal limits. The patient denied nausea, vomiting, or reflux on the day of surgery.

The patient arrived to the perioperative holding area and an intravenous (IV) catheter was established by the preoperative nursing staff. Intravenous fluid administration was held per the surgeon's request to limit perioperative IV fluid to a maximum of 400-600 mL. Citric acid-sodium citrate solution 30 mL was administered orally to the patient within 30 minutes preoperatively. The patient was brought to the operating room and a sign-in occurred per hospital protocol prior to the commencement of anesthesia. Two units of packed red blood cells were immediately available in a cooler and verified by the anesthesia provider and the circulating RN. Standard noninvasive monitors were applied to the patient and an IV infusion of lactated ringers (LR) was initiated prior to induction. A roll was placed under the patient's right flank for left uterine displacement.

A rapid sequence intubation (RSI) technique was used including a three-minute preoxygenation with O_2 10 L/min via anesthesia circuit and face mask, propofol 200 mg, succinylcholine 100 mg, and rocuronium 20 mg IV. A Cormack and Lehane grade 1 view of the vocal cords was seen during direct laryngoscopy. The trachea was intubated with a 6.5 mm endotracheal tube (ETT) without issue. Mechanical ventilation was administered via the ETT and the patient was placed on volume control (VC) ventilation and maintained on an inspired sevoflurane concentration of 2-2.5%. Tachycardia was recorded during tracheal intubation and lasted for 5 minutes post-intubation.

An orogastric tube was placed to low wall suction and 400 mL of clear gastric fluid was removed from the stomach. Cefazolin 2g was administered for surgical infection prophylaxis, as well as dexamethasone 4 mg for postoperative nausea and vomiting (PONV) prevention. Neuromuscular blockade was maintained throughout the procedure with rocuronium and based on train of four count (TOFC) with a goal of 1-2 twitches throughout the procedure. Phenylephrine 200 mg was administered in divided doses before beginning an IV infusion of phenylephrine, titrated between 20-30 mcg/min to keep mean arterial pressure (MAP) above 70 mm Hg.

Three donor-recipient anastomoses were identified and ablated by the surgeon. No amnioreduction was necessary. After placental vessel ligation, Fetal heart tones (FHT) were assessed via ultrasound by the surgeon and were within normal limits. The procedure lasted for a total of one hour after IV induction. Local infiltration of bupivacaine 0.5% was administered by the surgical team around a 2-cm incision. Ondansetron 4 mg IV was given at the end of the procedure for PONV prophylaxis. Neuromuscular blockade was antagonized with atropine 0.5 mg and neostigmine 2 mg IV. A subsequent dose of atropine was given for bradycardia in the 50's for a total dose of 0.8 mg.

The patient was transitioned to pressure support ventilation and the ETT was subsequently removed from the trachea after the patient showed adequate return of airway reflexes and neuromuscular recovery. Oxygen 6 L/min was delivered via face mask after extubation. The patient reported nausea after extubation and vomited a small amount of clear liquid. A total of LR 400 mL was administered throughout the procedure. The patient denied pain post operatively. Nifedipine, a calcium channel blocker, was ordered per protocol by the surgeon

postoperatively for its tocolytic properties to prophylactically prevent preterm labor and administered by the Post-anesthesia Care Unit (PACU) RN. FHT were assessed preoperatively, intraoperatively, and postoperatively in the OR by the fetal surgery team.

Discussion

Anesthesia for fetal surgery involves consideration of both the mother and the fetus. The anesthetic plan must therefore consider both entities regarding maternal safety, teratogenicity, maternal-placental oxygenation, and even fetal anesthesia.[3] Fetoscopic laser photocoagulation of communicating placental vessels is a minimally invasive fetal surgery performed between 16-26 weeks gestation and can result in survival rates of 88-90% for one fetus and 60-70% for both.[1,7]

Without treatment, TTTS can result in the intrauterine demise of one or both fetuses or preterm and/or pre-viable birth.[1] Anesthetic options for this procedure include local anesthesia, local anesthesia with IV sedation, neuraxial techniques, or general anesthesia (GA).[1,6] Placental transfer of volatile anesthetics during GA can promote fetal anesthesia and decreased movement, optimizing surgical conditions, but it may not be necessary.[2] Maternal physiologic comorbidities must be balanced against surgeon and patient preference for the anesthetic technique chosen during the procedure.

Maternal cardiovascular changes during pregnancy include an increased circulating blood volume and cardiac output coupled with decreased systemic vascular resistance (SVR).[3] These physiologic changes can contribute to the pregnant patient becoming hypotensive under general anesthesia requiring intervention by the anesthesia professional. General anesthesia may be associated with increased blood pressure and heart rate fluctuations compared to local anesthesia techniques for this procedure.[3] Additionally, pregnancy-induced hypoalbuminemia can decrease oncotic pressure and place the patient at risk for pulmonary edema and postoperative maternal respiratory distress in the setting of excess IV fluid administration in patients undergoing treatment for TTTS.[2] Current recommendations include judicious IV fluid administration and preference for vasopressors for treatment of hypotension.[2] This case included a fluid-restricted plan to prevent excess fluid administration in the setting of hypotension and instead maintain perfusion with the phenylephrine IV.

Respiratory changes during pregnancy include increased oxygen consumption, decreased functional residual capacity, and a decreased time to desaturation.[5] Adequate preoxygenation should be provided prior to induction, especially following a rapid-sequence intubation (RSI) method without ventilation assistance.[4] Video laryngoscopes should be readily available and may be the first-choice intubation tool depending on patient airway assessment.[4] Because this patient was 16 weeks and had a reassuring airway exam, direct laryngoscopy was performed with a video laryngoscope available as a backup.

Pulmonary aspiration of gastric contents is one of the greatest causes of maternal morbidity associated with general anesthesia. After 16 weeks gestation, pregnant patients are considered to be a “full stomach” despite an adequate fasting period.[5] Because this procedure is elective, fasting guidelines should be followed along with the administration of a clear antacid within 30

minutes of anesthesia, such as Bicitra. These guidelines are recommended to prevent aspiration pneumonitis in the obstetric population.[4]

During the case the patient experienced nausea postoperatively, probably due to a variety of factors including volatile anesthetic usage, neuromuscular blockade reversal choice, and personal history of nausea during pregnancy. Neostigmine and atropine were chosen for neuromuscular blockade reversal related to the ability of atropine to cross the placental barrier and limit fetal bradycardia associated with neostigmine administration. There may have been a possible imbalance between the agents, however, as evidenced by bradycardia after administration indicating an unopposed muscarinic effect of neostigmine promoting nausea. Although not given during this case, metoclopramide may have been a suitable option to administer early for its effect in increased gastric emptying and preventing the nausea experienced by this patient in the PACU.

General anesthesia in the pregnant patient is not without risk and may contribute to hemodynamic instability, airway compromise, pulmonary aspiration, excess fluid administration, and PONV.[2,3] If GA is the best method for maternal and fetal safety then a careful plan should be designed to mitigate these risks that takes into consideration the physiologic changes that occur during pregnancy. Performing this case under neuraxial or local anesthesia are alternative techniques[7] that could be used to keep the pregnant patient awake and spontaneously breathing without airway intervention, and avoid the need for GA and its potential adverse effects.

References

1. Miller JL. Twin to twin transfusion syndrome. *Transl Pediatr.* 2021;10(5):1518–1529. doi: 10.21037/tp-20-264
2. Duron VD, Watson-Smith D, Benzuly SE, et al. Maternal and fetal safety of fluid-restrictive general anesthesia for endoscopic fetal surgery in monochorionic twin gestations. *J Clin Anesth.* 2014;26:184-90. doi: 10.1016/j.jclinane.2013.10.010
3. Rossi C, Kaufman MA, Bornick PW, Quintero RA. General vs local anesthesia for the percutaneous laser treatment of twin-twin transfusion syndrome. *Am J Obstet Gynecol.* 2008;199(2):137. doi: 10.1016/j.ajog.2007.12.008
4. Frölich MA. Obstetric Anesthesia. In: Butterworth IV JF, Mackey DC, Wasnick JD. eds. *Morgan & Mikhail's Clinical Anesthesiology, 7e*. McGraw Hill; 2022. Accessed July 25, 2023. https://accessanesthesiology-mhmedical-com.ezproxy.neu.edu/content.aspx?bookid=3194&sectionid=266522956
5. Bedson R, Riccoboni A, Physiology of pregnancy: clinical anaesthetic implications, *Contin Educ Anaesth Crit Care Pain,* 2014;14(2):69–72. doi: 10.1093/bjaceaccp/mkt036
6. Glennon CL, Shemer SA, Palma-Dias R, et al. The History of Treatment of Twin-to-Twin Transfusion Syndrome. *Twin Res Hum Genet.* 2016;19:168-74
7. Sago H, Ishii K, Sugibayashi R, et al. Fetoscopic laser photocoagulation for twin–twin transfusion syndrome. *J Obstet Gynaecol Res*. 2018;44(5):831–839.

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Ultrasound-Assisted Neuraxial Anesthesia in the Obese Parturient

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Key Words: ultrasound, neuraxial anesthesia, obesity, obstetrics

The traditional approach to neuraxial anesthesia is a landmark technique involving palpitation of the intervertebral space at the level of Tuffier's line. This virtual line serves as an anatomical landmark for the L4-L5 interspinous space, the optimal location for neuraxial anesthesia placement. However, the traditional landmark technique poses challenges in patients with difficult to palpate surface anatomy, such as the obese parturient.[1] Technological advancements in handheld ultrasounds offers valuable assistance in performing neuraxial anesthesia in challenging patient populations.[2] The purpose of this case report is to discuss the scanning techniques and benefits of ultrasound-assisted neuraxial anesthesia placement.

Case Presentation

A 41-year-old female (138.2 kg, 170 cm, BMI 47.8 kg/m^2) presented for a repeat cesarean section with insertion of an intrauterine device under spinal anesthesia. Her past medical history was significant for class III obesity, diabetes mellitus type 2, hypertension, asthma, iron deficiency anemia, depression, anxiety, and gastroesophageal reflux disease. Past surgical history included two prior cesarean sections and a laparoscopic cholecystectomy. A history of difficult spinal placement was noted in previous anesthetic records.

A comprehensive metabolic panel, complete blood count, and coagulation panel were obtained preoperatively, all within normal limits. Cardiac testing and clearance were not obtained. Physical examination revealed full range of neck motion, a normal thyromental distance, normal temporomandibular joint mobility, an oral mouth opening greater than 6 cm, and a Mallampati airway classification score of III. Surgical and anesthesia consent was reviewed, and the patient was transferred to the operating room with an intravenous catheter in place. The patient received cefazolin 3 g for antibiotic prophylaxis.

Prior to surgical start, the patient was placed in standard sitting position for the administration of a spinal anesthetic. Standard noninvasive monitors were placed with a nasal cannula for supplemental O_2 3 L/min. Landmark palpation followed by a preprocedural ultrasound scan was performed to identify the L4-L5 intervertebral space and approximate the depth of the intrathecal space. The patient's skin was marked to easily identify the needle insertion site, and the procedural area was prepped with chlorohexidine in a sterile fashion. The patient's back was draped and 1% lidocaine 20 mg was used to produce a superficial skin block prior to placement of an introducer. A 25 g pencil-point spinal needle (Whitacre) was advanced through the introducer until a slight loss of resistance with a dural "pop" was felt. The stylet was withdrawn, and appropriate placement of the spinal needle was confirmed with the presence of cerebrospinal fluid.

Spinal anesthesia was performed in one attempt without requiring needle redirection. The patient received 0.75% bupivacaine hydrochloride 13.5 mg, preservative free morphine sulfate 100 mcg, and fentanyl 10 mcg in the administration of the spinal anesthetic. Aspiration of cerebrospinal fluid was performed prior to injecting the local anesthetic, halfway through the injection, and at the end to reconfirm appropriate spinal placement. All needles were withdrawn from the spinal column and intrathecal space, and the patient was assisted into the supine, left uterine displacement position. Hemodynamics were assessed and a phenylephrine intravenous infusion was started at 0.3 mcg/kg/min. The phenylephrine infusion was titrated to maintain hemodynamic stability and placental perfusion. Sensory blockade was assessed utilizing an alcohol pad and pinprick, confirming the appropriate T4 level of blockade required for cesarean delivery. The cesarean section was performed without complications to the mother and neonate. Following the procedure, the patient received a transversus abdominis plane block for postoperative pain management, and the mother and neonate were transferred to the postoperative care unit for recovery.

Discussion

Central neuraxial anesthesia is the preferred anesthetic technique for managing laboring pain and cesarean delivery.[3,4] The administration of local anesthetics within the subarachnoid and epidural spaces has traditionally been accomplished utilizing a surface landmark technique. The needle insertion site is identified through palpitation of the iliac crests and spinal processes, and with tactile feedback, local anesthetics may be administered through the L3-L4 or L4-L5 intervertebral space.[1] Patients with difficult to palpate surface anatomy pose challenges in identifying the appropriate needle puncture site. Particularly in the obstetric population, the anatomic and physiologic changes of exaggerated lordosis, edema, and weight gain contribute to greater difficulty discerning surface landmarks.[5] The use of ultrasonography overcomes these challenges and facilitates anesthesia practitioner's successful placement of neuraxial anesthetic blockade.[2]

Handheld ultrasounds are low-frequency, 2-5 MHz curvilinear array probes that facilitates midline identification and visualization of spinal column anatomy.[1] A real-time automated interpretation of lumbar ultrasound images provides many benefits, including a higher first pass needle success rate, less time spent identifying the needle puncture site, a reduction in redirection attempts, and reduced occurrences of paresthesias.[6] This technology assists anesthesia professionals in identifying the desired interspace, gives an appropriate angle of needle trajectory, and assists in the selection of a proper needle length by estimating the depths of the epidural and intrathecal spaces.[2]

Pre-puncture ultrasound scan and real-time ultrasonography are two forms of ultrasound guided neuraxial anesthesia that are performed. Real-time ultrasonography is evolving technology that is limited to anesthesia practitioners with advanced dexterity. Scanning the spinal column while simultaneously performing a single-handed needle insertion is a complex and challenging skill. Ultrasound probe placement often interferes with the needle entry point and results in difficultly visualizing needle movement within the targeted tissue plane.[7]

The more popular approach, a preprocedural scan, allows for an assessment of spinal column anatomy and measurement of depths to the epidural and intrathecal spaces prior to needle puncture. The clinician marks the skin based on the ultrasound scan and then introduces the spinal or epidural needle free-handedly without the use of real-time ultrasonography. The practitioner must use the loss of resistance technique and feel for the "dural pop" to ensure proper neuraxial placement. While a preprocedural scan relies on clinical expertise and tactile feedback, it provides the added benefit of being able to identify and properly adjust for anatomical variances.[7]

There are two ultrasound probe positions that provide valuable information regarding the anatomy of the spine for neuraxial anesthesia placement. The longitudinal paramedian scanning technique is performed parallel to the long axis of the spine with the ultrasound probe in a vertical position over the sacral area. As the probe is advanced in the cephalad direction, anesthesia professionals can determine the desired interspace for needle insertion. The ultrasound probe is then held horizontally over the desired interspace for a more detailed assessment of the spinal column. This transverse midline approach allows for identification of spinal column midline, a measurement of the depth from skin to the epidural or subarachnoid space, and determination of the needle trajectory angle.[2]

Performing a preprocedural ultrasound scan utilizing the longitudinal paramedian and transverse midline techniques has improved first-pass needle success rates in patients with difficult to palpate surface landmarks, such as the obese parturient population.[6] By locating the targeted intervertebral space, identifying anatomical midline, and measuring the depth from skin to the epidural and subarachnoid spaces, the incidence of paresthesias and post-dural puncture headaches have been dramatically reduced.[1,3,4,6,7] Furthermore, identification of an optimal needle insertion angle permits for a less needle redirections, skin punctures, and time spent locating the appropriate placement for local anesthetic administration.[4,6]

While a preprocedural ultrasound scan offers many benefits to the administration of neuraxial anesthesia, there are limitations. A learning curve exists for becoming proficient with ultrasound-assisted neuraxial anesthesia placement. Anesthesia practitioners must become familiar with scanning techniques, the gross anatomy of the spinal column, and the sonoanatomy of the spine. Learning studies suggest it takes 30-40 successful procedural attempts to become competent with utilizing ultrasonography for neuraxial anesthesia placement.[8] With appropriate training anesthesia professionals can overcome these barriers, making the use of ultrasonography a valuable adjunct for the placement of neuraxial anesthesia.

The body habitus of this patient made her a suitable candidate for performing a preprocedural ultrasound scan prior to neuraxial anesthesia. A spinal anesthetic was successfully performed in a single needle pass without requiring redirection, congruent with the stated benefits of ultrasonography. While this case mirrored literature recommendations for the use of ultrasound in neuraxial anesthesia, further education and training is needed to make ultrasonography a mainstream technique for patients with challenging spinal anatomy.

References

1. Rana S, Gupta B, Verma A, Awasthi H. Ultrasound-assisted subarachnoid block in obese parturient: Need of the hour. *Saudi J Anaesth.* 2020 Apr-Jun;14(2):228-230. doi: 10.4103/sja.SJA_619_19.
2. Talati C, Arzola C, Carvalho JC. The use of ultrasonography in obstetric anesthesia. *Anesthesiol Clin.* 2017 Mar;35(1):35-58. doi: 10.1016/j.anclin.2016.09.005.
3. Daly JL, Ortiz VE. Anesthetic considerations in the care of the parturient with obesity. *Curr Anesthesiol Rep.* 2019;9(1):76-84. doi:10.1007/s40140-019-00312-5
4. Jiang L, Zhang F, Wei N, Lv J, Chen W, Dai Z. Could preprocedural ultrasound increase the first-pass success rate of neuraxial anesthesia in obstetrics? A systematic review and meta-analysis of randomized controlled trials. *J Anesth*. 2020 Jun;34(3):434-444. doi: 10.1007/s00540-020-02750-6.
5. Lee A, Loughrey JPR. The role of ultrasonography in obstetric anesthesia. *Best Pract Res Clin Anaesthesiol*. 2017 Mar;31(1):81-90. doi: 10.1016/j.bpa.2016.12.001. (old 10)
6. Ni X, Li MZ, Zhou SQ, et al. Accuro ultrasound-based system with computer-aided image interpretation compared to traditional palpation technique for neuraxial anesthesia placement in obese parturients undergoing cesarean delivery: a randomized controlled trial. *J Anesth.* 2021;35(4):475-482. doi: 10.1007/s00540-021-02922-y.
7. Gaur A, Dedhia J, Bouazza-Marouf K. Ultrasound and central neuraxial blocks. *Saudi J Anaesth*. 2018 Apr-Jun;12(2):175-177. doi: 10.4103/sja.SJA_768_17.
8. Ghosh SM, Madjdpour C, Chin KJ. Ultrasound-guided lumbar central neuraxial block. *BJA Educ*. 2016;16(7):213-220. doi:10.1093/bjaed/mkv048

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Anesthetic Management of a Pediatric Patient with Cri du chat Syndrome

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Keywords: Cri du chat syndrome (CdCS), pediatric, difficult airway, larynx

Management of the airway and endotracheal intubation in patients with Cri du chat syndrome (CdCS) may be challenging due to the abnormalities of the upper airway. The name of the syndrome refers to its most characteristic clinical feature, a high-pitched crying similar to the mewing of a cat and is a genetic disorder caused by a total or partial deletion on the short arm of chromosome 5.[1] To minimize potential complications, patients diagnosed with CdCS require the preparation of emergency airway equipment and individualized intraoperative interventions to optimize patient outcomes. The following case study describes the anesthetic considerations of a patient diagnosed with CdCS.

Case Report

A 12-year-old, 140 cm, 50 kg patient presented for an annual intraoral cleaning with a known diagnosis of CdCS. The patient's medical history included dental caries, gastroesophageal reflux disease, and developmental delay. The patient's surgical history consisted of numerous intraoral cleanings throughout childhood under general anesthesia. The patient had no known drug allergies.

The patient's preoperative airway assessment was limited and difficult to perform due to the patient's baseline mental status. The patient was accompanied by their legal caregiver, and the consent was signed by the parents. Prior anesthesia records were reviewed to prepare for the potential management of a difficult airway. Based on past records, various techniques were utilized to secure the patient's airway, which included direct laryngoscopy, video laryngoscopy, and fiberoptic bronchoscopy. Other airway findings included severe micrognathia, macroglossia, and dysphagia.

After transporting the patient to the operating room, standard noninvasive monitors were applied before administering intramuscular ketamine 250 mg and midazolam 5 mg into the right upper deltoid. Preoxygenation with O_2 10 L/min via facemask took place after the patient was placed in the sniffing position to optimize airway management as a peripheral intravenous line was placed. To facilitate intubation, fentanyl 50 mcg and propofol 100 mg were administrated intravenously (IV) to achieve the effect of apnea. Airway obstruction occurred instantaneously as the patient went apneic, in which positive pressure ventilation was performed using an oropharyngeal airway. After verifying the ability to ventilate, rocuronium 30 mg IV was administered to aid with vocal cord relaxation.

Following induction, direct laryngoscopy was not attempted due to an expected difficult airway and a video laryngoscope with a size 2 MAC blade was utilized instead. Despite the assistance of a video laryngoscope, a Cormack-Lehane Grade 4 view persisted with multiple attempts at visualization. After one failed intubation attempt, the patient's head was flexed and extended further, and a video laryngoscope size 3 MAC blade cover was applied. In between attempts, the patient was manually ventilated using a 90 mm oropharyngeal airway. A second attempt was made resulting in the inability to visualize the vocal cords resulting in desaturation to 87%. Bag mask ventilation was immediately resumed, and additional experienced anesthesia staff were called to the room for a third attempt with a fiberoptic bronchoscope. With the utilization of an Ovassapian airway, a 6.0 mm fiberoptic bronchoscope allowed direct visualization of the vocal cords in which the trachea was intubated with a 7.0 mm endotracheal tube and secured after confirming bilateral breath sounds and capnometry. The patient was maintained with sevoflurane 2% inspired concentration in a mixture of O_2 0.5 L/min and air 1.5 L/min, short-acting opioids, and no re-administration of neuromuscular blockers.

Prior to the end of the 1-hour duration case, TOF was assessed resulting in 2 twitches and neuromuscular blockade was antagonized with the administration of neostigmine 2.5 mg and glycopyrrolate 0.5 mg. The volatile anesthetic was discontinued, and the plan was to emerge the patient to their baseline mental status with the head of bed slightly elevated. Due to the patient being unable to follow commands and participate in a neurological assessment, emergence was

prolonged to ensure that anesthetics had been metabolized prior to extubation. After regular tidal volumes of >5 mL/kg, regular respiratory rate, and sustained tetanus, the patient was extubated. After extubation, the patient was transferred to the post-anesthesia care unit (PACU) on O_2 6 L/min delivered via facemask for surgical recovery and close monitoring over the course of hours before being discharged home.

Discussion

When preparing an anesthetic plan for a child diagnosed with CdCS, a thorough preoperative assessment that includes reviewing prior anesthetic records, if available, is crucial for the anesthesia practitioner to evaluate. The importance of a comprehensive preoperative evaluation cannot be overemphasized because CdCS presents as phenotypic manifestations that are variable and can affect multiple organ systems.

The anesthesia practitioner should begin by completing a subjective assessment of neurological function. Children with CdCS present with many behavior problems, such as attention deficit hyperactivity disorder, impulsiveness, aggressiveness, and autism spectrum disorders.[2] The developmental and behavioral profile of a child with CdCS observed in the pre-operative setting can influence the anesthetic plan. Intramuscular sedative agents, which do not require patient cooperation, can facilitate an efficient transfer to the OR and induction of general anesthesia.[3]

Based on the patient's limited subjective pre-operative airway assessment and known airway difficulties in this patient population, having appropriate equipment to manage a difficult airway is crucial. Upper airway structures abnormalities create potential difficulty with airway management and endotracheal intubation. Laryngeal (hypoplasia, narrowing, vocal cord asymmetry) and epiglottic (small, atonic, flaccid) abnormalities, in addition to neurologic abnormalities seem to contribute to the characteristic cry.[4] The availability of supraglottic airway mechanisms equipment necessary when confronted by the dreaded situation of failure to ventilate or intubate.

In addition to the deformities of the upper airway, further anesthetic difficulties may be related to the presence of an accentuated response to muscle relaxants, as many CdCS patients are diagnosed hypotonic.[5] To increase the success of tracheal intubation, this patient was administered rocuronium on induction with no re-administration in the intraoperative period. Patients with pre-existing motor weakness and hypotonia may be sensitive to the effects of non-depolarizing NMBAs and the depolarizing agent, succinylcholine, may be contraindicated.[6]

Children with CdCS have a higher incidence of congenital heart disorders. Cardiac anomalies associated with septal defects, such as patent ductus arteriosus (PDA), ventricular septal defects (VSD) and arterial septal defects (ASD), have been estimated to affect 15% to 20% of patients diagnosed with CdCS.[7] Given the high association of congenital heart disorders with CdCS, a pre-operative cardiology consult, echocardiogram study, and electrocardiogram are suggested in this patient population.

Other common health problems associated with CdCS include craniofacial malformations, low birth weight, swallowing difficulties during infancy, hearing and visual difficulties and

scoliosis.[8] The varying comorbidities associated with CdCS necessitate a thorough multi-disciplinary approach prior to undergoing an anesthetic in addition to attentive post-operative monitoring. It is recommended that patients who receive general anesthesia with a known diagnosis of CdCS should be observed for a longer period during postanesthetic recovery until they are fully awake.

CdCS has been reported as one of the most complex yet poorly understood diagnoses in the pediatric population. Airway management maybe challenging for an anesthesia practitioner despite access to prior anesthetic records. The risk of congenital heart disease defects, in addition to other organ involvement, warrants a thorough preoperative physical examination with potential referrals prior to the administration of a volatile anesthetic. To manage an expected difficult airway, the anesthesia practitioner must remain prepared, vigilant, and knowledgeable when planning the anesthetic management of a pediatric patient presenting with CdCS.

References:

1. Rodríguez-Caballero A, Torres-Lagares D, Rodríguez-Pérez A, Serrera-Figallo MA, Hernández-Guisado JM, Machuca-Portillo G. Cri du chat syndrome: A critical review. *Med Oral Patol Oral Cir Bucal.* 2010;15(3):e473-e478. doi:10.4317/medoral.15.e473
2. Honjo RS, Mello CB, Pimenta LSE, et al. Cri du Chat syndrome: Characteristics of 73 Brazilian patients. *J Intellect Disabil Res*. 2018;62(6):467-473. doi:10.1111/jir.12476
3. Guthrie DB, Boorin MR, Sisti AR, et al. Retrospective comparison of intramuscular admixtures of ketamine and dexmedetomidine versus ketamine and midazolam for preoperative sedation. *Anesth Prog*. 2021;68(1):3-9. doi:10.2344/anpr-67-04-02
4. dos Santos KM, de Rezende DC, Borges ZD. Anesthetic management of a patient with Cri Du Chat syndrome. Case report. *Rev Bras Anestesiol.* 2010;60(6):630-351. doi:10.1016/S0034-7094(10)70078-7
5. Guala A, Spunton M, Mainardi PC, Emmig U, Acucella G, Danesino C. Anesthesia in Cri du Chat syndrome: Information on 51 Italian patients. *Am J Med Genet A*. 2015;167A(5):1168-1170. doi:10.1002/ajmg.a.36992
6. Davis C, Grischkan J, Tobias JD. Perioperative Care of a Child With Cri Du Chat Syndrome. *J Med Cases*. 2020;11(9):279-282. doi:10.14740/jmc3494
7. Hills C, Moller JH, Finkelstein M, Lohr J, Schimmenti L. Cri du chat syndrome and congenital heart disease: a review of previously reported cases and presentation of an additional 21 cases from the Pediatric Cardiac Care Consortium. *Pediatrics*. 2006;117(5):e924-e927. doi:10.1542/peds.2005-1012
8. Ajitkumar A, Jamil RT, Mathai JK. *Cri Du Chat Syndrome.* In: StatPearls. StatPearls Publishing; 2022. https://www.ncbi.nlm.nih.gov/books/NBK482460/. Accessed February 23, 2023.

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Submental Intubation: Airway Management for Complex Maxillofacial Surgery

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Keywords: Submental intubation, submental, maxillofacial surgery, LeFort I, septorhinoplasty

Airway management in patients undergoing complex maxillofacial surgery may present with unique challenges. A thorough preoperative assessment and discussion of the injuries as well as surgical approach are crucial in developing a safe airway plan. When traditional oral or nasal tracheal intubation approaches interfere with maxillomandibular open reduction, submental intubation may be a safe and reliable alternative. Submental intubation is a short-term airway alternative resulting in less risks compared to tracheostomy placement. It also provides undisrupted access to oral and nasal fracture reconstruction while allowing for dental occlusion.

Case Report

A 20-year-old 74 kg male presented to the operating room for an elective midface, Le Fort I with bilateral sagittal split osteotomy and septorhinoplasty. A preoperative assessment was performed, and was notable for no known drug allergies and a past medical history of right unilateral cleft lip. Given the association of other congenital anomalies associated with cleft lip,[1] additional evaluation was undertaken including electrocardiogram, echocardiogram, chest radiograph, and head computed tomography scan. The EKG showed normal sinus rhythm, echocardiogram showed normal ejection fraction of 65% and head CT and CXR findings showed no acute abnormalities. Pre-anesthetic lab values were within normal limits including starting hemoglobin of 12.7 gm/dL and hematocrit of 34 gm/dL.

The airway assessment identified a Mallampati score of II, thyromental distance of 5 cm, mouth opening of 7 cm and full neck range of motion. Narrow nasal cavities were noted and appeared smaller in diameter in comparison to a 6.0 mm nasotracheal tube, indicating an equal or larger diameter tube would be difficult to pass through nasal cavity, while a smaller diameter tube would not be appropriate for patient in providing adequate ventilation throughout duration of case. The patient was also evaluated for signs of sleep apnea, asthma, or airway obstruction. According to a study that evaluated health status among adults born with cleft lip/palate, 53.6% of participants reported snoring and 44.8% reported extreme daily fatigue.[2] In addition, the reported rate of asthma was significantly higher in comparison to the general population.[2] Although these rates may indicate a higher risk of a respiratory event intraoperatively, the patient reported only occasional snoring with no signs of sleep apnea and denied asthma or breathing difficulties during exercise or seasonal changes.

Given the patient's small nasal cavities and need for nasal intubation with later conversion to oral intubation during the case, the decision was made to proceed with submental intubation to ensure safe and effective airway management. All necessary equipment was made available in the room including a size 7 mm reinforced endotracheal tube, size 6 mm standard ett, hemostat, scalpel, accordion extender, and video laryngoscope.

The patient was premedicated with 2mg of intravenous midazolam. Standard monitors were applied, preoxygenation was initiated and general anesthesia was then induced with fentanyl 100 mcg, lidocaine 70 mg, propofol 250 mg, and rocuronium 50 mg. Adequate ventilation was established followed by initial placement of a reinforced tube via direct laryngoscopy without any difficulty. Correct placement was confirmed, and the tube was secured. Following endotracheal tube placement, a submental incision was made by the surgeon and the submental space was dissected using kelly clamps to create an open passageway until the floor of mouth was reached. Once the kelly clamps were visualized through the floor of the mouth by the anesthesia provider, the reinforced tube was disconnected from circuit, the connector piece was detached, and the tube was manipulated into an upside down "u-shape" toward the tip of the kelly clamp. The surgeon then grasped the wall of the reinforced tube with the kelly clamps and pulled the tube through the submental space from interior to exterior. This technique is known as a one-tube technique. The connector piece was then reattached, and the circuit was reconnected. Mechanical ventilation was initiated and appropriate settings were programmed for the patient similar to standard intubation methods. General anesthesia was maintained with sevoflurane 2-2.4%. An arterial line was placed, and adjuncts of dexmedetomidine, ketamine, and opioids were given prior to incision and during periods of sympathetic response to stimulation.

Following repair of the facial fractures, sutures securing reinforced tube were removed, the reinforced tube was briefly disconnected from circuit, connector piece detached, and the tube was retracted back through the submental space from exterior to interior. The connector piece was reattached and the circuit reconnected. During closure of submental incision, neuromuscular blockade was antagonized with sugammadex 200 mg and the anesthetic gas was turned off. The patient resumed spontaneous ventilation and once adequate tidal volumes and respiratory rate were observed, the tracheal tube was removed with no adverse events. The patient was taken to recovery on supplemental oxygen via a simple face mask and post-operative vital signs were within normal limits. The patient was admitted to intermediate care for observation and later discharged home without any complications.

Discussion

Submental intubation was originally indicated for complex craniomaxillofacial trauma requiring maxillomandibular fixation.[2] The previous method of airway securement in these cases was tracheostomy placement, however, 6-8% were associated with early complications and 60% were associated with long-term complications.[3,5] Submental intubation allows better surgical visualization of all facial, pharyngeal and skull base structures without obstruction from an endotracheal or nasotracheal tube.[3] Within the last few decades, the use of submental intubation expanded and has been used in patients with difficult airway anatomy in whom nasal intubation has failed, combined Lefort I and Lefort III procedures, facial cancer involving lips and nose, and combined orthognathic and rhinoplasty surgery.[3] Combined orthognathic and rhinoplasty surgery as discussed in the case report, would require conversion from a nasal endotracheal tube to an oral endotracheal tube, making submental intubation a useful alternative with low risks. In a thirty-year study that examined 1,021 submental intubations, the most common acute complication was infection (3.5%) while scarring (1.2%) and salivary fistula (1.1%) made up the most common chronic complications. [6] Contraindications to consider include the need for

prolonged intubation postoperatively, presence of infection or malignant tissue in the submental space, and coagulopathies.[3]

Several techniques can be used to perform a submental intubation and may include a one-tube technique or a two-tube technique depending on the equipment available. The one-tube technique is most common but may not be possible without reinforced tubes or tubes with non-detachable connecters. Reinforced tubes are more advantageous than standard endotracheal tubes due to the embedded metal wire coiling, which prevents kinking during tube manipulation.[3] It is important to note however, that reinforced tubes have a non-detachable connector piece.[3] Removal of the connector piece is an essential step to ensure easy passage through the submental incision. The non-detachable connector piece can be removed by cutting the tube with a scalpel below the level of connection, then replacing it with a universal connector piece from a standard endotracheal tube one size smaller than the reinforced tube.[3] This modification allows for easy disconnection and ensures an adequate fit when reconnected for ventilation.

The initial step in performing a submental intubation with a one-tube technique, begins with standard oral intubation with a reinforced tube, followed by a midline submental incision made by the surgeon. A hemostat is then used to dilate and dissect through the inferior submental incision into the floor of the mouth creating a large enough passage for the endotracheal tube to pass. The pilot balloon is first passed through the submental space using the hemostat from interior to exterior. Next, the anesthesia practitioner disconnects the circuit, detaches the connector piece from the reinforced tube, and manipulates the tube into a "U-shape" for the surgeon to grasp with the hemostat clamps. The tube is then pulled through the submental incision from interior to exterior and the connector piece and then the circuit is reattached. Correct placement is reconfirmed, and the tube is secured with sutures.[3]

In operating rooms where neither a reinforced tube nor a detachable connector piece is present, a modified submental intubation method may be needed. In 1996, an alternative method for submental intubation was identified by authors Green and Moore.[4] In this practice, a two-tube method was used by first intubating with a non-detachable connector tube. Following initial intubation, a submental incision was made, and a second non-detachable connector tube was placed through the surgical incision from exterior to interior. Once the second tube was secured in the submental space, it was then exchanged with the initial tube. Direct laryngoscopy and Magill forceps were used for tube manipulation. In 2016, a modified Green and Moore method was developed. The modified two-tube technique involved a submandibular incision versus a submental incision, and use of a fiberoptic video laryngoscope versus direct laryngoscopy.[4] These changes aimed to reduce trauma, quickly identify landmarks, and reduce the appearance of scarring.[4] Longer procedure time using a fiberoptic video laryngoscope outweighed the risk of inadvertent extubation seen in the one-tube and classic Green and Moore methods.[4] Regardless of the method used, the average time to perform a submental intubation is equal to 10 minutes when performed by experienced providers, making it an attractive alternative to tracheostomy placement.[5]

Patients with altered airway anatomy present unique challenges for anesthesia providers. Submental intubation is a growing technique to consider when approaching airway management

for complex maxillofacial surgeries. Knowledge of the anatomy, necessary equipment, and sequence of steps involving submental intubation may be beneficial when faced with these complex procedures. A short procedure time and low risk of complications may prove that submental intubation can be a useful alternative approach to airway management for decades to come.

References

1. Ardouin K, Davis S, Stock NM. Physical health in adults born with cleft lip and/or palate: A whole of life survey in the United Kingdom. *Cleft Palate-Craniofac J.* 2020;58(2):153-162. doi:10.1177/1055665620944758
2. Altemir FH. The submental route for endotracheal intubation. A new technique. *J Maxillofac Surg*. 1986;14:64–65.
3. Jacob DAD, Tuncer FB, Kashan DL, Gurunluoglu R. Clinical anatomy of submental intubation. *Ann Plast Surg*. 2019;84(2):232-237. doi:10.1097/sap.0000000000001948
4. Samieirad S, Khalife H, Noroozi M, Tohidi E, Hashemipour MA. How to overcome the challenges of non-detachable connector tubes in submental intubation for panfacial fractures. *Arch Iran Med*. 2017; 20(8): 481 – 486.
5. Williams K-AD, Tariq M, Acharekar MV, et al. Submental intubation in maxillofacial procedures: A more desired approach than nasotracheal intubation and tracheostomy. *Cureus*. 2022. doi:10.7759/cureus.27475
6. Lim D, Ma BC, Parumo R, Shanmuhasuntharam P. Thirty years of submental intubation: A review. *Int J Oral Maxillofac Surg.* 2018;47(9):1161-1165. doi:10.1016/j.ijom.2018.04.015

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Massive Subcutaneous Emphysema during Paraesophageal Hernia Repair

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Keywords: subcutaneous emphysema, laparoscopic, fundoplication, paraesophageal hernia, hiatal hernia, geriatric

The term *paraesophageal hernia* describes hiatal hernias with at least one-third of the stomach herniated into the mediastinum accounting for 5-10% of hiatal hernias.[1] A laparoscopic transabdominal approach is favored as it is associated with fewer postoperative complications compared to open, 28% and 60% respectively.[1] While the laparoscopic approach has shorter operative time; less blood loss, shorter length of hospital stays, and decreased postoperative pain medication use, other complications include perforation, subcutaneous emphysema, and pneumothorax related to insufflation of CO_2.[1]

Case Report

An 80-year-old, 79 kg male presented for a scheduled laparoscopic fundoplication with esophageal lengthening for the treatment of a large paraesophageal hernia. The patient's pertinent medical history included coronary artery disease with myocardial infarction in 2003, paroxysmal atrial fibrillation, stable asymptomatic thoracic aortic aneurysm, and hypertension; all controlled with appropriate medications. The patient's surgical history included multiple general anesthetics with no history of anesthetic complications. Preoperative cardiology consultation was obtained. A recent echocardiogram showed mild right ventricle enlargement with normal function, ejection fraction of 50-55%, mild mitral and tricuspid regurgitation, and sinus bradycardia. A complete blood count, coagulation panel, and basic metabolic panel were unremarkable.

The patient was transported to the operating room and premedicated with midazolam 2 mg intravenously (IV). Standard non-invasive anesthesia monitors were applied to the patient. After the patient was appropriately preoxygenated, a rapid sequence induction with cricoid pressure was performed and the trachea was intubated with a size 7.5 mm endotracheal tube (ETT) via direct laryngoscopy using a Macintosh size 3.5 blade and secured at 23 cm at the teeth. Mechanical ventilation was initiated with a volume-controlled setting and $EtCO_2$ was maintained at 35 to 45 mm Hg. An 18 Fr orogastric tube was inserted and the stomach was decompressed. A right radial arterial line was placed using ultrasonography after an Allen's test was performed. After the patient was positioned in the lithotomy and steep reverse Trendelenburg position, abdominal insufflation began.

Two hours later, the $EtCO_2$ steadily increased to 48 mm Hg despite increases in minute ventilation. On physical examination, the ETT was correctly positioned, and subcutaneous emphysema was present with crepitus on palpation of the chest. Lung sounds were clear bilaterally. A collaborative decision between the certified registered nurse anesthetist and surgeon was made to continue the surgery. One hour later, an increase in $EtCO_2$ to 50 mm Hg required increasing minute ventilation. Peak inspiratory pressures were 32 cm H_2O. Edema and palpable crepitus were noted at the patient's jaw. The surgeon was updated on the patient's status. An hour and a half later, edema and palpable crepitus were noted around the patient's eyes bilaterally. The patient's $EtCO_2$ peaked at 54 mm Hg. An arterial blood gas (ABG) revealed a pH of 7.18, $PaCO_2$ 64.8 mm Hg, PaO_2 163 mm Hg, and HCO_3 24.4 mEq/L. The patient was mildly hypotensive but was managed with a phenylephrine infusion at 50 mcg/min. The surgeon was notified, and the surgery continued as the surgeon reported it was near completion.

Once insufflation was discontinued, the patient's $EtCO_2$ and peak inspiratory pressure decreased to normal values. After surgery, a portable chest radiograph was taken and revealed the ETT was appropriately placed, no pneumothorax was present, and extensive subcutaneous emphysema was noted in the patient's chest and neck.

The decided plan was to extubate the patient and admit to the step-down unit after phase one recovery for overnight observation. After train-of-four was assessed and resulted in 4/4 twitches, neuromuscular blockade was antagonized with sugammadex 200 mg IV, the patient's airway was suctioned, and the ETT was removed after the return of spontaneous ventilation, and an

unremarkable leak test. In the post anesthesia care unit (PACU), the patient was able to open his eyes, and reported no visual deficit and a tolerable pain level. The patient's facial edema improved, and hemodynamics were normal to the patient's baseline vital signs without medication augmentation. He continued to improve and was discharged from the hospital on postoperative day one.

Discussion

Subcutaneous emphysema is the inadvertent introduction of CO_2 into the subcutaneous tissue leading to gas pockets. Trapped gas can follow along fascial planes and affect distant anatomy.[2] Subcutaneous emphysema can be classified as "mild" with crepitus at trocar insertion sites, "moderate" with crepitus extending to the abdomen and thighs, and "massive" with crepitus and swelling extending to the chest, neck, face, and extremities.[3] The incidence of patients who develop subcutaneous emphysema after laparoscopic surgery is common. A 1991 study examined CT scans of 27 patients 24-hours after routine laparoscopic cholecystectomies and found over half (15) had subcutaneous emphysema. Notably, no patients were symptomatic.[4] CO_2 is the best gas for laparoscopic insufflation as it is colorless, nonflammable, readily soluble in the blood, and expelled easily.[6] Subcutaneous emphysema with increases in patients' $EtCO_2$ during laparoscopic fundoplications occurs in 64% of patients.[5]

Many factors lead to the development of subcutaneous emphysema. These include insufflation pressures greater than 15 mm Hg, multiple attempts at abdominal entry, Veress needle or cannula not placed fully within the peritoneal cavity, loose cannula seal, use of more than five cannulas, a surgeon using laparoscope as a lever leading to compromised tissue integrity by repetitive movements, procedures lasting more than three and a half hours, and $EtCO_2$ greater than 50 mm Hg.[1,2,5,6] Only in the 1996 article by Wahba et al., was patient positioning listed as a specific risk factor for the development of subcutaneous emphysema. Position may be a strong factor as patients are often placed in steep reverse Trendelenburg during laparoscopic fundoplications, whereas gynecological surgeries utilize the Trendelenburg position and only have an occurrence of palpable subcutaneous emphysema in 0.43-2.3% of patients.[6]

This patient's risk factors included seven port sites utilized for surgical access, surgical time of six hours, and his $EtCO_2$ was above 50 mm Hg. It is possible the surgeon was repetitively using the laparoscope as a lever to optimize the surgical view.

When hypercapnia is observed intraoperatively, it is important to quickly assess the patient and rule out pneumothorax (evidenced by increased airway pressures, increased $EtCO_2$, decreased oxygen saturation, acute onset of hypotension, and tachycardia or bradycardia), hypermetabolic conditions like malignant hyperthermia, faulty breathing circuits, or exhausted CO_2 absorbers.[1] First steps in management include increasing minute ventilation to maintain an acceptable $EtCO_2$. Managing the ventilation may be challenging if the peak inspiratory pressure continues to rise, as it did with this patient. In this case, minute ventilation was increased by increased respiratory rate and tidal volume while allowing increased peak inspiratory peak pressures. It may be necessary to communicate with the surgical team to decrease the insufflation pressure or even suspend insufflation to better control the patient's $EtCO_2$ before continuing.[1,5,6] One should avoid the use of nitrous oxide as it can diffuse into air-filled spaces, worsening the spread of

subcutaneous emphysema.[6] Evaluation of the upper airway prior to extubation ensures airway edema will not compress the airway after ETT removal. The anesthesia practitioners did this by observing airflow passing around the ETT when the cuff was deflated as well as viewing decreased exhaled volume on the ventilator. It is important to closely observe these patients for at least four hours postoperatively because subcutaneous emphysema can cause upper airway obstruction by compression. Generally, the subcutaneous emphysema will resolve within a day or two. One must educate the patient – and PACU staff – about subcutaneous emphysema and reassure them it will resolve spontaneously.[5]

Factors reducing the likelihood of subcutaneous emphysema development are awareness of its potential, attention to detail regarding abdominal entry, reduced number of abdominal access attempts, ensure snug trocar skin conditions, use of lowest possible insufflation pressures, and efficient performance of the procedure.[6] A 2019 study demonstrated age greater than 80 years old is not by itself a risk factor for intraoperative complication rates when compared with younger patients undergoing elective paraesophageal hernia repair.[7] Once a paraesophageal hernia is identified, it is recommended for older patients to undergo repair because it can improve their quality of life. Elective procedures allow time to optimize older patient's co-morbidities and is associated with less risks than emergent paraesophageal hernia repair due to uncontrolled dysphagia, vomiting, regurgitation, and retrosternal pain.[7]

While subcutaneous emphysema can occur without symptoms, it is critical to remain vigilant in monitoring and assessing the patient undergoing laparoscopic surgery as subcutaneous emphysema is associated with pneumothorax, hypercarbia, and acidosis as these associations can be life threatening. The anesthesia practitioners electively placed an arterial line in this patient because of the risk of surgical blood loss and hemodynamic instability. In this case, it was advantageous to have the arterial line to draw an ABG, guiding ventilation management. Because several mitigating factors of the development of subcutaneous emphysema are within the control of the surgical team, it is crucial to have clear communication regarding the patient's status.

References

1. Imai TA & Soukiasian HJ. Management of complications in paraesophageal hernia repair. *Thorac Surg Clin*. 2019;29:351-358. doi: 10.1016/j.thorsurg.2019.07.009
2. Robriguez G & Joseph SE. Anesthesia for Laparoscopic and Robotic Surgeries. In: Barash PG, Cullen BF, Stoelting RK, et al. eds. *Clinical Anesthesia.* 8th ed. Philadelphia, PA: Wolters Kluwer; 2017:1261-1277.
3. Capone J, De Ranieri A, Knezevic NN, Lukić IK, Candido K, Gluncic V. Massive upper body and cervicofacial subcutaneous emphysema following robotic myomectomy. *Case Reports in Anesthesiology*. 2019;2019:1-3. doi:10.1155/2019/5861705
4. Allister JD, D'Altorio RA & Snyder A. CT findings after uncomplicated percutaneous laparoscopic cholecystectomy. *J Comput Assist Tomogr*. 1991;15(5):770-772.
5. Wahba RWM, Tessler MJ & Kleiman SJ. Acute ventilatory complications during laparoscopic upper abdominal surgery. *Can J Anaesth*. 1996;43(1):77-83.
6. Ott D. Subcutaneous emphysema – Beyond the pneumoperitoneum. *JSLS.* 2014;18:1-7. doi:10.4293/108680813X13693422520882.

7. Staerkle RF, Rosenblum I, Kockerling F, et al. Outcome of laparoscopic paraesophageal hearnia repair in octogenarians: A registry-based, propensity score-matched comparison of 360 patients. *Surgical Endoscopy*. 2019;33:3291-3299. doi:10.1007/s00464-018-06619-4

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Tracheal Deviation After Anterior Cervical Surgery

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Keywords: anterior cervical discectomy and fusion, ACDF, tracheal deviation, hematoma

Anterior cervical discectomy and fusion (ACDF) is commonly performed in patients presenting with cervical pain and symptoms that do not respond appropriately to conservative management. There are various complications associated with this procedure, including dysphagia, hematoma, worsening myelopathy, recurrent laryngeal nerve palsy, respiratory insufficiency, esophageal perforation, and instrument failure.[1-3] Multiple studies found that postoperative wound hematomas occurred in 1.3%-5.6% of ACDF cases, which can lead to tracheal deviation.[2,3]

Case Report

A 52-year-old male presented to the hospital for a scheduled elective right C6-7 ACDF with plating. In addition to cervical stenosis, the patient's past medical history was significant for elevated cholesterol, gastroesophageal reflux disease, and tobacco use. Current medications included hydrocodone-acetaminophen 10-325 mg and pantoprazole 40 mg taken by mouth. Laboratory blood test results were unremarkable on the day of procedure.

The patient was brought into the operating room and all standard non-invasive monitors were applied, followed by induction of anesthesia. The patient was given fentanyl 100 mcg, lidocaine 100 mg, propofol 200 mg, ketamine 50 mg, rocuronium 15 mg, and succinylcholine 100 mg through the intravenous (IV) catheter. A GlideScope (Verathon Inc.) video laryngoscope was used for successful intubation of the trachea with an 8.0 mm endotracheal tube, secured at 23 cm at the lips. The endotracheal tube was confirmed to be in the trachea, secured, and mechanical ventilation was initiated. The ventilator was set to a tidal volume of 600 mL and a respiratory rate of 12/min. Total-intravenous anesthesia was simultaneously initiated with continuous infusions of propofol at 150 mcg/kg/min and dexmedetomidine at 0.5 mcg/kg/hr, both titrated to maintain hemodynamic stability. Intra-operative neurophysiological monitors were then applied by the neurophysiologist. Sufentanil was titrated intravenously in incremental doses of 25 mcg for pain management throughout the procedure, for a total amount of 100 mcg.

At the conclusion of the case, ondansetron 4 mg IV was administered to the patient. The patient's neurophysiological status was unchanged throughout the procedure. The propofol and dexmedetomidine infusions were titrated off. Pressure support ventilation was initiated and eventually the patient was transitioned to spontaneous ventilation. Neuromuscular blockade was

confirmed to be resolved by way of train-of-four monitoring. After the patient followed commands and lifted his head off the bed, the trachea was extubated without incident. The patient was transported to the post-anesthesia care unit on 4L/min nasal cannula in stable condition, with a heart rate of 92/min, blood pressure of 110/73 mm Hg, and SpO_2 of 98%.

On post-operative day 2, the Jackson-Pratt (JP) drain had minimal output (10-15 mL) and was removed from the surgical site by the surgeon. Immediately after drain removal, there was a large flow of bright red blood observed from the surgical site. The surgeon used 4x4 gauze sponges to hold pressure for fifteen minutes and the bleeding stopped. Approximately an hour after, a rapidly expanding neck hematoma had developed with edema and left airway deviation, confirmed with computed tomography scan imaging. At the time, the patient was not experiencing any respiratory difficulties, but was becoming increasingly agitated. The patient was emergently taken back to the operating room for re-intubation of the trachea and neck exploration. Upon the conclusion of this case, another JP drain was inserted, and it was decided to leave the endotracheal tube in place for one day post-operatively to allow for observation and monitoring of the patient in the intensive care unit. The endotracheal tube was removed 24 hours post-operatively without incident. The patient had no further complications post-operatively and was discharged on original post-operative day 8.

Discussion

An ACDF is a relatively safe, frequently performed procedure. However, there are serious risks associated with it that can occur in the immediate post-operative period, or within several days to months after the surgery.[3] Complications in the post-operative period that can affect oxygenation status include angioedema, retropharyngeal edema, and surgical site hematoma. Although uncommon, 2% of patients undergoing single-level surgery may require reintubation due to these complications.[2]

Anesthetic implications for ACDF include having a strong knowledge of emergency airway management, as well as an understanding of how cervical spine disease can affect airway management. Due to the potential for cervical spine instability, neck manipulation during induction of anesthesia and intubation of the trachea should be kept to a minimum. A video-laryngoscope, such as the GlideScope (Verathon Inc.), should be considered for use during the intubation process to ensure the neck is kept in a neutral position.[1] Direct laryngoscopy with either a Macintosh or Miller blade is less effective and less safe because it requires overextension of the neck to properly align the oral, pharyngeal, and laryngeal axes.[4] A video-laryngoscope allows for minimal manipulation of the neck, which is why it was utilized during this procedure.[1]

In the case of post-operative surgical site hematoma, airway obstruction can quickly occur, requiring the anesthesia provider to have an effective airway management plan. Surgical site hematomas typically occur between 6–24 hours post-operatively but are most commonly seen within 12 hours of surgery completion.[2] Therefore, it is crucial to know how to perform an emergent intubation, cricothyrotomy or tracheostomy without delay. To ensure effective treatment of a patient with airway obstruction following ACDF surgery requires knowledge of the neck anatomy, as well as specific procedural skills.[2]

In this circumstance, the decision was made to re-intubate the trachea in the operating room, rather than in the patient's hospital room. The operating room was deemed to be a safer and more controlled environment. Because the patient was not yet having life-threatening oxygenation issues, there was enough time to safely transport the patient back to the operating room. Patients who develop airway compromise after ACDF surgery may present in a variety of ways. They may progress from being asymptomatic to having partial or complete airway obstruction within a few minutes or gradually over several days.[2,5] Early signs of developing hematoma include complaints of difficulty breathing, swallowing, and talking.[2]

It is important to note that despite these symptoms, the oxygen saturation reading will often remain in a normal range.[2] Therefore, interventions may be delayed. The carbon dioxide measurement from an arterial blood gas result will provide a better objective assessment of the patient's respiratory status.[2] In this case, the patient was having increasing agitation despite the pulse oximeter reading normal values. Restlessness and agitation are signs of increased carbon dioxide levels and hypoxemia may or may not be present. In later stages of increased carbon dioxide levels, the patient may have accessory muscle use, inspiratory stridor, or cyanosis.[2]

Risk factors contributing to hematoma formation include coagulopathies, excessive surgical blood loss, untreated postoperative hypertension, and prolonged excessive coughing during extubation of the trachea.[2] The anesthesia provider must be aware of these risks in order to prevent them. Although relatively safe, ACDF procedures do have multiple associated risks. As previously stated, it is also important for the anesthesia provider to be familiar with emergency airway management, should these risks and any associated airway obstruction occur.

As demonstrated by this case report, surgical site hematoma, leading to tracheal deviation, is a risk that can occur after an ACDF procedure. Therefore, the anesthesia provider must be prepared with an effective emergency airway management plan should airway obstruction occur. Because patients who develop airway compromise after ACDF surgery may present in various ways, the anesthesia provider should be aware of the symptoms of developing hematoma, not only in the immediate post-operative period, but also in the days following the procedure. Additionally, the anesthesia provider should consider the management of other issues that may arise, such as hypoxemia.

References

1. Al Eissa S, Konbaz F, Aldeghaither S, et al. Anterior cervical discectomy and fusion complications and thirty-day mortality and morbidity. *Cureus*. 2020;12(4):e7643. doi:10.7759/cureus.7643
2. Debkowska MP, Butterworth JF, Moore JE, Kang S, Appelbaum EN, Zuelzer WA. Acute post-operative airway complications following anterior cervical spine surgery and the role for cricothyrotomy. *J Spine Surg*. 2019;5(1):142-154. doi:10.21037/jss.2019.03.01
3. Epstein NE. A review of complication rates for anterior cervical diskectomy and fusion (ACDF). *Surg Neurol Int*. 2019;10:100. doi:10.25259/SNI-191-2019
4. Fan H, Cao H, Sun Y, et al. Endotracheal intubation in elective cervical surgery: A randomized, controlled, assessor-blinded study. *Medicine*. 2017;96(43):e7817. doi:10.1097/MD.0000000000007817

5. Yee TJ, Swong K, Park P. Complications of anterior cervical spine surgery: A systematic review of the literature. *J Spine Surg*. 2020;6(1):302-322. doi:10.21037/jss.2020.01.14

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Enhanced Recovery after Surgery for Open Partial Hepatectomy

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Keywords: enhanced recovery after surgery, hepatectomy, erector spinae block, opioid epidemic, multimodal analgesia.

In response to the national opioid epidemic, many healthcare practitioners seek alternatives to conventional opioid analgesics during surgical stays. One alternative being examined and implemented in many surgical procedures is multimodal drug therapy. Such therapy minimizes surgical pain and provide adequate surgical analgesia while also decreasing the occurrence of opioid use. These alternatives, known as Enhanced Recovery After Surgery (ERAS), have resulted in a 61% reduction in opioid requirements, demonstrating that opioid-free analgesia is possible.[1] This case reports a successful hepatectomy procedure without the use of opioids for pain by anesthesia practitioners.

Case Report

A 50-year-old female previously diagnosed with ascending colon adenocarcinoma with liver metastasis presented for ERAS open partial hepatectomy after computed tomography (CT) revealed numerous lesions on her liver. Past medical history includes hypertension, obesity, body mass index of 43 kg/m^2, and penicillin allergy. Surgical history included hysterectomy, laparoscopic cholecystectomy, and right hemicolectomy. Surgical consent was obtained by the surgeon and anesthesia consent was obtained following a thorough discussion about each aspect of the anesthetic plan. The patient consented to general and regional anesthesia with additional consent for an arterial blood pressure monitoring catheter.

Preoperatively, all vital signs were assessed and found to be surgically optimized. Blood laboratory tests also showed optimal surgical baseline results including coagulopathy results for regional anesthesia. The patient received gabapentin 600 mg, celecoxib 200 mg, scopolamine 1 mg patch and ingested a carbohydrate drink 4 hours prior to surgical start time. In the operating room, intravenous propofol 50 mg was administered to minimize movement during the regional blockade and provide anxiolysis once the patient was helped into a sitting position on the operating room table. Standard noninvasive monitors were attached, and oxygen 8L/min was administered via face mask to the patient. The patients skin was prepared for a bilateral erector spinae plane (ESP) regional block with chlorhexidine gluconate cleaning solution. Sterile gloves were donned and 2.5 mL of lidocaine 1% was injected into the epidermis and dermis to provide cutaneous analgesia prior to insertion of a 22g, 3.5 inch echogenic nerve block needle. 30 mL of Bupivacaine 0.25% with epinephrine 1:200,000 with buprenorphine 150 mcg and

dexamethasone 2 mg were injected on each side separating the erector spinae muscle from the transverse process. The patient was then helped into a supine position and anesthesia was induced intravenously with 100 mg of lidocaine 2%, ketamine 30 mg, propofol 200 mg, esmolol 40 mg, and rocuronium 50 mg. Endotracheal intubation was accomplished with direct laryngoscopy.

After intubation, the following continuous infusions were started: magnesium sulfate 1 g/hr for 4 hours with ketamine 50 mg added, dexmedetomidine infusion at 0.5-0.9 mcg/kg/hr titrated to hemodynamic effect, and sevoflurane at 0.9-1.0% expired concentration. A norepinephrine infusion was necessary at the beginning of the procedure to treat hypotension, but was discontinued shortly after surgical incision and was not resumed for the remainder of the procedure. All intravenous infusions were discontinued one hour prior to end of case. At the end of the procedure, the trachea was extubated with the patient spontaneously ventilating 16/min and inspired tidal volumes of 375 mL. With a numerical scale pain assessment of 0 out of 10 by the patient, no additional medications or interventions were performed by the anesthesia practitioners. Of note, no opioids were administered intraoperatively nor in the immediate postoperative period. The patient was subsequently transported to the intensive care unit.

Discussion

Synthetic opioids have been a part of the anesthesia analgesic history since the first uses of fentanyl in Belgium in 1962.[2] It was only in the last twenty years that researchers began to study their uses and the many side effects that accompany them.[2] Opioids provide safe, effective pain relief when used appropriately. They also adequately attenuate the neuroendocrine and immunological effects of surgical stress; facilitate surgical healing; prevent postoperative morbidity; and, optimize the overall return of baseline activities.[3] The problem of opioid misuse and over prescription has led to the current opioid epidemic in the United States. Opioid abuse affects roughly 4% of the adult population in the U.S., and contributed to more than 33,000 deaths from overdose in 2015.[4] In 2020, it was reported that 9.5 million people over the age of 12 have misused opioids in the last year.[5] Of these, 9.3 million misused prescription pain relievers.[5] With these statistics, many healthcare practitioners are seeking alternatives to traditional opioid analgesics for surgical procedures because approximately 80% of surgical patients report postoperative pain and 75% rank their pain as moderate, severe or extreme due to inadequate intraoperative opioid doses.[4,5] Opioids are typically administered to minimize these pain reports but, in addition to their potential for misuse, ventilatory depression, prolonged anesthestic emergence and other undesirable side effects including longer lengths of hospital stay, nausea, constipation, and ileus, make their use in many surgical procedures controversial. Opioids have even been associated with protumor actions that may have negative effects on cancer survival by inhibiting cellular immunity.[6]

The opioid alternatives for perioperative analgesia are numerous. Each medication selection is associated with risks and benefits. Protocols of these medications have been tested, developed, and implemented throughout the surgical process to enhance surgical recovery. These ERAS protocols focus on a multimodal medication regimen for pain control with a concerted effort to avoid or minimize the use of opioids. ERAS multimodal analgesic techniques that target different pain receptors and pathways are proving to be an effective and sustainable alternative to

traditional opioid interventions while at the same time diminishing some of the less desirable side effects.[5] Intraoperative medications such as dexmedetomidine, dexamethasone, magnesium sulfate, and ketamine are a few opioid alternative intravenous medications. Dexmedetomidine is a highly selective, versatile, and potent alpha-2 agonist with sedative, anxiolytic, sympatholytic, and hypnotic effects making it an ideal opioid alternative.[7] It does not cause respiratory depression, but may cause bradycardia and hypotension intravenously or in regional blockade. Dexamethasone injection added to regional blockade does not carry the risks of hypotension and sedation that is associated with regionally administered dexmedetomidine, but speeds the onset of nerve blockade, provides longer blockade duration, improves analgesia, and reduces postoperative opioid use.[7] Magnesium is an intracellular ion that is an important N-methly-D-asparate (NMDA) receptor antagonist that reduces perioperative opioid consumption and has been shown to effectively address postoperative pain.[8] Ketamine, another NMDA antagonist, lowers the pain threshold and reduces immediate postoperative opioid consumption.[8]

Individualized intraoperative analgesic planning and appropriate medication selection are paramount to a successful surgical recovery. While this requires each component of the care team to be in complete agreement, the crucial component of the individualized plan is patient education, where complete understanding and consent of each intervention is necessary. Patients scheduled for these surgical interventions must be informed of each multimodal analgesic purpose, its risk/benefit, and anticipated outcomes. A consultation with the patient about the pain experienced after a surgical procedure aids in the understanding that no current mode of analgesia will completely and permanently eliminate pain. Realistic numerical pain values should be discussed in a frank manner with the patient's full understanding of the normal postoperative discomforts. The decision to limit or eliminate opioids from the surgical process must also be discussed with a clear understanding of the goals to reduce hospital stay, reduce risk of opioid induced complications, and attempt to correct opioid misuse.

For this particular patient, recovery from opioid induced constipation and potential ileus could increase the risk of surgical complications and the need for additional surgical intervention. At discharge, postoperative day 4, the patient had only received morphine 4mg by mouth for pain on postoperative day 1. For this patient, the multimodal approach to surgical analgesia provided evidence of a safe and effective alternative to traditional opioid analgesics, but unlike opioids, did not carry risks of dependency and longer hospital stays. Given her metastatic state, long term opioid-free analgesia could also help to improve her survival rate by reducing the protumor action of opioids.[6] The latent recovery period will determine if opioid use is appropriate and necessary for analgesia considering that antagonizing the NMDA receptor first may reduce the total amount of opioids required during the latent recovery period. A 7 day postoperative oral magnesium sulfate may also provide analgesia and reduce the overall dose of opioids. The immediate postoperative ERAS protocol of multimodal analgesia proved promising for this patient.

References

1. Kawak S, Wasvary JF, Ziegler MA. Opioid requirements in laparoscopic colectomies: Do enhanced recovery after surgery protocols make a difference? *American Surgeon*. 2021;87(7):1048-1053. doi:10.1177/0003134820956312

2. Forget P. Opioid-free anaesthesia. Why and how? A contextual analysis. *Anaesth Crit Care Pain Med*. 2019;38(2):169-172. doi:10.1016/j.accpm.2018.05.002
3. Repine KM, Hendrickse A, Tran TT, Bartels K, Fernandez-Bustamante A. Opioid-free epidural-free anesthesia for open hepatectomy: A case report. *A A Pract*. 2020;14(8):e01238. doi:10.1213/XAA.0000000000001238
4. Skolnick P. The Opioid Epidemic: Crisis and Solutions. *Annu Rev Pharmacol Toxicol.* 2018;58:143-159. doi:10.1146/annurev-pharmtox-010617-052534
5. U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Centers for Behavioral Health Statistics and Quality. Key substance use and mental health in the United States: Results from the 2020 national survey on drug use and health. Washington, D.C.: U.S. Public Health Service, 2021. Accessed August 2, 2022. https://www.samhsa.gov/data/sites/default/files/reports/rpt35325/NSDUHFFRPDFWHTMLFiles2020/2020NSDUHFFR1PDFW102121.pdf
6. Higgins Roche BT. The immune system. In Nagelhout JJ, Elisha S, eds. Nurse Anesthesia. 6th ed. Elsevier; 2017: 959-982.
7. Kaye AD, Chernobylsky DJ, Thakur P, et al. Dexmedetomidine in enhanced recovery after surgery (ERAS) protocols for postoperative pain. *Curr Pain Headache Rep*. 2020;24(5):1-13. doi:10.1007/s11916-020-00853-z
8. Mitra S, Carlyle D, Kodumudi G, Kodumudi V, Vadivelu N. New advances in acute postoperative pain management. *Curr Pain Headache Rep*. 2018;22(5):1. doi:10.1007/s11916-018-0690-8

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Williams Syndrome: Mitigating the Risk of Sudden Cardiac Death

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Keywords: Williams syndrome, sudden cardiac death, supravalvular aortic stenosis, pediatric

Williams syndrome (WS) is a rare congenital disorder resulting from the deletion of 26 to 28 contiguous genes on chromosome 7q11.23, causing multisystem dysfunction.[1] Occurring in up to 1:8,000 live births, deletion of one elastin gene is a key diagnostic indication of WS.[2] The resultant elastin deficiency can lead to arteriopathy and cardiovascular abnormalities.[2] The normal aorta is made of approximately 50% elastin.[3] Presence of abnormal elastin, such as in patients with WS, increases arterial stiffness and reduces distensibility.[3] Risk for sudden cardiac death during the perioperative period is 25 to 100 times greater than the general population.[1,4] With these known risks, perioperative assessment and anesthetic management must be carefully tailored to mitigate adverse events and provide safe care.

Case Report

An 18-year-old, 153 cm, 42.6 kg female with a body mass index of 18.2 kg/m^2 presented for an esophagogastroduodenoscopy (EGD). Her past medical history included esophageal dysphagia,

celiac disease, WS with supravalvular aortic stenosis (SVAS) and mild left ventricular hypertrophy (LVH), iron deficiency anemia, and gastric esophageal reflux disorder (GERD). The patient had no previous surgeries or anesthetics. Current medications included esomeprazole, ethinyl estradiol-norethindrone, and ferrous gluconate. Cardiac computed tomography revealed mild left ventricular hypertrophy consistent with moderate aortic stenosis, moderately hypoplastic sino-tubular junction, origin and proximal course of the left main coronary artery and left anterior descending coronary. An electrocardiogram (EKG) revealed sinus rhythm with non-specific ST-T wave changes. Upon patient assessment, her GERD was well controlled, and she was not experiencing any cardiac symptoms. A systolic ejection murmur was noted. This patient did not have any electrolyte abnormalities present. The anesthetic plan and preparation for this patient included ensuring the patient was scheduled for the first case of the day, adequate hydration pre-operatively, a 5-lead EKG, confirming phenylephrine was available, and having intubation equipment readily available.

A 22-gauge intravenous (IV) catheter was placed in the patient's right antecubital vein pre-operatively. Lactated ringers 500 mL and intravenous midazolam 1 mg were administered prior to entering the operating room. The patient was brought into the operating room and standard non-invasive monitors were applied. The patient was closely monitored for myocardial ischemia with a 5-lead EKG. The patient was placed supine, and a nasal cannula with O_2 3 L/min was applied.

Induction was performed with propofol 80 mg and dexmedetomidine 20 micrograms (mcg). Tape was utilized to cover the patient's eyes, and a bite block was placed in the patient's mouth. A continuous IV infusion of propofol was initiated at 150 mcg/kg/min for maintenance of anesthesia. Phenylephrine boluses of 20-40 mcg were administered during the case to maintain a systolic blood pressure greater than 100 mm Hg. A total of 140 mcg of phenylephrine was administered. The procedure was uneventful, with easy passage of the scope, patient maintenance of appropriate end-tidal carbon dioxide concentration, oxygenation, and respiratory rate without airway adjuncts. Ondansetron 4 mg was administered for anti-emesis, and acetaminophen 500 mg was administered for analgesia. The patient received a total of 600 mL of lactated ringers.

After the 33-minute case, the patient was transported to the post-anesthesia recovery unit, spontaneously breathing with O_2 2 L/min administered via nasal cannula. The patient was monitored in PACU for additional time to assess cardiac function before clearance for discharge. The patient did not experience any perioperative complications and was discharged to home later that day.

Discussion

Williams syndrome is a multisystem disease, impacting facial and oral features, neurocognitive development, the endocrine system, the gastrointestinal system, dentition, the cardiovascular system, and is postulated to accelerate aging.[1] The patient presented with typical clinical features of WS, including characteristic facial features such as a full face with high and rounded cheeks, full lips, broad forehead, pointed chin, and a short and upturned nose.[1] Additionally, the patient

presented with a sociable personality, GERD, SVAS, and mild LVH which are all associated with WS.

Elastin deficiency is a distinctive trait of WS which can lead to many cardiac abnormalities. Structural defects are present in 80% of patients with WS; SVAS is the most common, with a prevalence of up to 70% .[1] Management of aortic valve stenosis includes maintaining normal sinus rhythm, a normal heart rate, preload, afterload, and contractility.[1] An EKG should be obtained to evaluate for ST changes, QT prolongation, or LVH.[1] EKG abnormalities are often noted in WS, with LVH noted in 40% of WS patients, and right ventricular hypertrophy in 60%. Systemic hypertension is also diagnosed in over 50% of patients with WS.[1] Additionally, WS commonly presents with pulmonary artery stenosis, coronary and renal artery stenosis, thoracic aortic stenosis, bicuspid aortic valve, ventricular septal defects, and mitral valve prolapse.[1]

The risk for sudden cardiac death during the perioperative period is 25 to 100 times greater in WS patients than the general population due to myocardial ischemia.[1,4] The risk is noted to be greater in patients with bilateral outflow tract obstruction, especially in combination with coronary arterial stenosis.[5]

Comprehensive preoperative evaluation and anesthetic planning are essential, given the wide spectrum of clinical manifestations in patients with WS. A recent cardiology assessment is essential to determine the patient's current cardiovascular status, including an echocardiogram to assess for SVAS, pulmonary stenosis, and ventricular hypertrophy.[1] The airway should be evaluated for craniofacial abnormalities that could lead to a difficult airway. Electrolyte abnormalities such as hypercalcemia are common in WS and should be ruled out with routine electrolyte screening.[1]

In accordance with current preoperative recommendations for patients with WS, the patient received cardiac clearance from her cardiologist and additional clearance from a cardiac anesthesiologist at the institution where the EGD was performed. An in-patient bed was reserved for extended recovery, and the patient was scheduled for the first case of the day to minimize time without oral intake. Due to her SVAS, periods without fluid intake should be limited to maintain adequate preload and myocardial contractility. To maintain adequate fluid status, lactated ringers 500 mL was also administered pre-operatively. A 5-lead EKG was utilized for more comprehensive monitoring during the perioperative period. Midazolam 1 mg was administered pre-operatively to reduce anxiety-induced tachycardia, which would be detrimental given the presence of SVAS.

In this case, intravenous induction was used instead of an inhalation induction. This was preferred because it allows for the immediate administration of fluids and vasoactive agents to counteract the hypotension typically associated with an anesthetic induction.[1] Phenylephrine, an alpha-1 agonist, is the preferred vasoactive agent in patients with WS due to the avoidance of tachycardia.[1,4] Following this recommendation, phenylephrine boluses were administered to maintain a systolic blood pressure greater than 100 mmHg throughout the duration of the case. Hypotension is implicated in reported cases of sudden cardiac death in patients with WS, and management of SVAS requires maintenance of adequate preload and afterload.[2]

Given the high risk associated with WS and anesthesia, it is imperative to be well-prepared. Although this patient's cardiovascular status was relatively well-maintained, the potential for sudden cardiac death is still prevalent. Ensuring adequate cardiac testing was performed, applying a 5-lead EKG for more robust cardiac monitoring, maintaining an appropriate fluid status, and aggressively treating hypotension were key to a safe and successful case. Despite not encountering any anesthetic complications, this case highlights the importance of understanding the pathophysiology of a complex disease and its practice implications.

References

1. Staudt GE, Eagle SS. Anesthetic considerations for patients with Williams syndrome. *J Cardiothorac Vasc Anesth*. 2021;35(1):176-186. doi:10.1053/j.jvca.2020.01.022
2. Matisoff AJ, Olivieri L, Schwartz JM, et al. Risk assessment and anesthetic management of patients with Williams syndrome: A comprehensive review. *Paediatr Anaesth*. 2015;25:1207–15.
3. Brown ML, Nasr VG, Toohey R, DiNardo JA. Williams syndrome and anesthesia for non-cardiac surgery: High risk can be mitigated with appropriate planning. *Pediatr Cardiol*. 2018;39(6):1123-1128. doi:10.1007/s00246-018-1864-1
4. Burch TM, Mcgowan FX, Kussman BD, et al. Congenital supravalvular aortic stenosis and sudden death associated with anesthesia: What's the mystery? *Anesth Analg*. 2008;107(6):1848–54.
5. Collins RT, Collins MG, Schmitz ML, et al. Peri-procedural risk stratification and management of patients with Williams syndrome. *Congenit Heart Dis.* 2017;12:133–42.

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Effectiveness of Lidocaine Infusions for Postoperative Pain Control

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Keywords: Lidocaine, Postoperative Pain, Anesthesia

Introduction

Due to the undesirable side effects of perioperative opioids,[1] anesthesia practitioners have turned to multimodal approaches to address surgical pain. Lidocaine, an amide local anesthetic with a diverse mechanism of action, has a growing body of research suggesting its effectiveness as a postoperative analgesic. Its primary action is on neuronal cell membrane sodium channels where it blocks sodium influx and propagation of action potentials carrying nociceptive signals. Additional analgesic mechanisms include a reduction in hyperalgesia and modulation of the inflammatory response through actions on sodium and potassium channels, NMDA receptors, and glycine pathways.[2]

Studies have shown mixed results for lidocaine's analgesic effectiveness, possibly due to the unique origin of pain based on the specific operative site, patient characteristics that influence postoperative pain, timing of the administration, and the variable mechanism of action of lidocaine.[3-14] The aim of this evidenced based practice analysis is to review the effectiveness of lidocaine infusions for acute postoperative pain across different surgical specialties.

Methods

Using the PICO framework, the following clinical question was investigated: "In surgical patients who received lidocaine versus control, was there a relationship between surgery type and analgesic effectiveness?" The MeSH terms "pain," "surgery," and "lidocaine" were used to search the PubMed library, yielding 627 results published within the last eight years. Upon review, 12 studies met the inclusion criteria which consisted of comparing the effectiveness of lidocaine infusions versus control for different surgical specialties. A summary of these studies can be found in Table 1. Only meta-analyses and a small number of recent high quality randomized control trials (RCT) were selected to ensure the highest level of evidence. All the studies qualify as level 1 evidence by the Joanna Briggs Institute Levels of Evidence.

Literature Analysis

The results of this analysis will be reported for different surgical populations, including spine surgeries, abdominal surgery, breast surgery, orthopedic surgery, cardiac surgery, and bariatric surgery. These surgical specialties were chosen because they were the focus of the most recent data on lidocaine for postoperative pain.

Spine Surgery

A total of 3 studies addressed lidocaine use during spine surgeries.[3-5] Two systematic reviews of RCTs looked only at spine surgery[3,4], while a Cochrane review of 68 RCTs included many surgical categories, with only 2 studies specific to spine surgery.[5] Licina et al's[4] systematic review showed lowered pain scores at 2, 4-6, and 24 hours while Bi et al's[4] systematic review had lower pain scores at 6, 24, and 48 hours. These reviews also demonstrated a statistically significant decrease in postoperative opioid consumption. The Cochrane review showed uncertain pain control benefits at 4 hours and no clear benefits at longer time points (24 and 48 hours).[5] The two studies that showed improved pain up to 24 and 48 hours and decreased opioid consumption were specific to spine surgery[3,4], while the other was not specific to spine surgery, which may have confounded the results.[5] Additional limitations of these studies include small sample sizes in the individual studies, potential allocation and concealment bias, variation in lidocaine infusion protocols across studies, and pain reduction only seen at specific times after surgery.[3-5] Despite these limitations, there is supporting evidence that lidocaine reduces pain after spinal surgery.

Abdominal

The most robust quantity of evidence was in the abdominal surgical population. Five meta-analyses addressed the abdominal surgical population, both open and laparoscopic. Overall, the findings were mixed. In two studies that assessed laparoscopic abdominal surgery, one found no change in pain scores but a moderate decrease in opioid consumption 24 hours after ambulatory

surgery[6] and the other reported no decrease in opioid consumption after laparoscopic colorectal surgery.[7] These studies lacked blinding and had high heterogeneity, likely due to variation in lidocaine dosing across studies[6,7] and the inclusion of one RCT that was not specific to abdominal surgery.[6] However, two other studies found improved pain scores and opioid-sparing effects. Zhao et al[8] showed statistically significant decreases in opioid consumption and pain scores at 12, 24 and 48 hours postoperatively in patients undergoing laparoscopic cholecystectomy. Zhu et al[9] had similar results with statistically significant lower pain scores recorded at 2, 4, 8, 12, and 24 hours and decreased opioid requirements in elderly patients undergoing a variety of procedures, including gastrointestinal procedures. These studies also had potential bias within the individual RCTs, small sample sizes, and overall high heterogeneity with dosing and administration of lidocaine. There was also inconsistency in the onset and duration of pain control between the studies.

The final meta-analysis included over 40 RCTs involving open and laparoscopic abdominal cases and showed unclear benefit at 4 hours postoperatively and the authors concluded the evidence was too low of quality to make any real inference.[5] This study included other surgical specialties, but subgroup analysis did not show any difference between open abdominal, laparoscopic abdominal, and other surgical types, indicating the results can be generalized to the abdominal surgery population.[5] In review, lidocaine appears to reduce postoperative pain and may reduce opioid consumption in the abdominal surgery population with the understanding that the data is still controversial.

Breast Surgery

Two meta-analyses and one RCT assessed the effectiveness of lidocaine on postoperative analgesia for breast surgeries. In the first study, Chang et al[10] looked exclusively at breast surgeries in a meta-analysis of 4 RCTs and found no decrease in pain scores in the immediate postoperative period; however, there was a decrease in opioid consumption at 72 hours.[10] This study showed some benefit for lidocaine in reducing chronic pain, but the net effect on the perioperative period was negligible.[10] Limitations to this study include small individual RCTs with evidence of concealment bias.[10] The Chang et al results align with a recently published RCT that also showed no change in acute perioperative pain control, but potential benefit at 6 months post-mastectomy.[11] Finally, Weibel et al[5] included three RCTs specific to breast surgery in their meta-analysis but again reported low confidence in the results for potential pain control at 4 hours due to the quality of evidence.[5] To summarize, lidocaine does not appear to have significant benefits in the acute postoperative period, but may reduce the incidence of chronic pain in the breast surgery population.

Orthopedic

All 3 of the meta-analyses that assessed orthopedic procedures also included other surgical specialties in the analysis,[5,6,8] so care must be taken when generalizing the results to orthopedic procedures exclusively. Overall, the results varied widely for this population. Weibel et al[5] did not show any clear pain reduction with lidocaine, and Zhu et al[9] found significant benefit at 2, 4, 8, 12, and 24 hours. Lovett-Carter et al[6] found no benefit to lidocaine with regards to pain scores but some opioid sparing at 24 hours. Limitations of these studies include small sample sizes within the original RCTs and variation in dosing of lidocaine.[5,6,8] However, a recent RCT of patients undergoing total knee arthroplasty and limb fracture repairs did show reduced pain

scores postoperatively at 30 minutes and at 1, 6, 12, and 24 hours and a decrease in additional analgesic needs, which highlights the potential benefit of lidocaine in this population.[12] However, this was a small single-center RCT. From these findings, the research is not conclusive as to the effectiveness of lidocaine for the orthopedic population.

Cardiac

Evidence was sparse for the use of lidocaine as a pain adjunct in the cardiac surgery population. Two studies included cardiac surgery in their meta-analysis, but the analysis was not specific to this specialty.[5,8] Weibel et al[5] had inconclusive results for the effectiveness of lidocaine, and Zhu et al[9] showed decreased opioids and pain scores at 2, 4, 8, 12, and 24 hours. Small sample sizes and heterogeneity for the lidocaine infusion protocol further limited the evidence quality. In another study, Boswell et al[13] analyzed a single RCT on lidocaine use in cardiac surgery and found no benefit with respect to pain scores. As this is a single RCT, these results are limited in their generalizability. In conclusion, there does not appear to be a clear benefit for lidocaine in the cardiac surgery population.

Bariatric

Two meta-analyses were pertinent to bariatric surgery. The first reviewed 7 RCTs for patients undergoing bariatric surgery and found the only benefit to lidocaine was time to first opioid, but there was no overall total reduction in opioid use.[14] This research was limited due to high heterogeneity between the studies and the RCTs were generally small in size.[14] In the second study, Weibel et al[5] found pain scores to be lower up to 4 hours, but the results also included other surgical specialties and the quality of evidence was low, which makes it difficult to apply these findings to this population.[5] Overall, the effectiveness of lidocaine for bariatric surgery was shown to be minimal.

Table 1. Summary of the analyzed studies

Author	**Sample & Design**	**Interventions**	**Results**	**Limitations**
Zhu et al 2020	Meta analysis of 15 RCTs with 988 patients undergoing various surgeries	Lidocaine infusion vs control, age > 60, infused entire cases with/without bolus and post op infusion at varying doses	Lower pain score at intervals ranging from 2 to 24 hours and decreased opioid consumption	45% risk of higher than mild bias, heterogeneity with regards to lidocaine administration, RCTs were single center with small samples
Licina et al 2022	Meta analysis of 8 RCTs involving spine surgery in pediatrics and adults	Lidocaine vs control in spine surgery, all had boluses with infusions at varying doses and	Lower pain scores at varying intervals up to 24 hours, decreased opioid consumption at	50% risk of bias, heterogeneity seen and RCTs were small studies, variation within dosage

		length	24 and 48 hours	
Hung et al 2022	Meta analysis of 7 RCTs with 496 patients undergoing bariatric surgery	Lidocaine as single adjunct vs control with varying boluses and dosing regimens	Increased time to first opioid, no effect on total opioid consumption	Small RCTs, reported bias risk with concealment and reporting, high heterogeneity was calculated
Kendall et al 2018	RCT of 150 women undergoing mastectomy	1.5 mg/kg bolus with infusion of 2 mg/kg/hr	No change in pain at 24 hours or after 3 months	Single center small RCT, variation in opioid use post op
Sarakatsianou et al 2021	Meta analysis of 8 RCTs with 407 patients having colorectal surgery	Lidocaine infusion vs control with multiple other pain control modalities	No change in postoperative morphine consumption	Lack of information about concealment and randomization, high heterogeneity in studies, diversity in lidocaine protocols
Lovett-Carter et al 2021	Meta analysis of 5 RCTs with 297 patients undergoing varying ambulatory procedures	Lidocaine infusion with a bolus and varying dosage and infusion length	Decreased opioid consumption in PACU and at 24 hours, no change in pain scores	Bias in allocation and blinding, heterogeneity due to varying types of surgery
Nallbani et al 2022	RCT of 81 patients undergoing total knee arthroplasty or limb fracture repair	Lidocaine bolus of 1.5 mg/kg and an infusion of 1.5 mg/kg/hr continued into the postoperative period	Decreased pain scores and additonal analgesic requirements for up to 24 hours	Small, single center study with no standard postoperative opioid dosing
Bi et al 2020	Meta analysis of 4 RCTs with 275 patients undergoing spine surgery	Lidocaine infusion with a bolus and varying dosage and infusion length	Decrease pain intensity at 6, 24, and 48 hours post op. Decreased opioid consumption.	Allocation and selective reporting bias, small study size, high heterogeneity at 48 hours

Zhao et al 2018	Meta analysis of 5 RCTs with 274 patients undergoing laparoscopic cholecystectomy	Lidocaine bolus with 1.5 mg/kg with varying infusion rate and length	Less pain and opioid consumption at 12, 24, and 48 hours	Small sample size with lack of subgroup analysis, risk for lack of concealment, varying lidocaine doses
Weibel et al 2018	Meta analysis of 68 RCTs with 4525 patients undergoing a large variety of procedures	Average bolus was 1.5 mg/kg, most doses were around 2 mg/kg/hr	Low quality evidence for lower pain scores at 1 to 4 hours, no effect greater than 24 hours, unsure effect on opioid consumption	Small size of studies, variations in lidocaine dose, lots of variation in surgical type, not all studies used for each outcome
Chang et al 2017	Meta analysis of 4 RCTs with 167 patients undergoing breast surgery	Received bolus of 1.5 mg/kg with varying infusion rates	No decrease in pain (except chronic) and some reduction in analgesic use at 72 hours	Small study size with only 4 RCTs, potential bias with concealment and sampling reported
Boswell et al 2021	Narrative approach to a systematic review of one RCT with 100 patient undergoing cardiac surgery	Lidocaine infusion given up to 48 post op	No significant association between pain scores and lidocaine infusion	Single study analysis with small sample size

Conclusion

Multimodal analgesia has increased in popularity due to improved outcomes through reduced opioid consumption.[1] These improved outcomes include decreased nausea, ileus, and respiratory depression.[1] Because of this, lidocaine has gained momentum as a multimodal adjunct for surgical pain. This evidenced based practice analysis assessed the effectiveness of lidocaine across different surgical populations. Overall, there was no strong consensus in any surgical population regarding the effectiveness of lidocaine for pain control. The spine surgery group had the most convincing evidence and showed the potential for pain control and decreased opioid consumption for up to 24 to 48 hours.[3-5] Abdominal surgery, which had the largest quantity of evidence, also showed favorable results with pain control and reduction in opioid use which also lasted up to 48 hours.[5-9] Both breast and bariatric surgery showed limited net positive effect. The evidence was moderate in quality for this population, but any positive findings may have been

skewed due to the inclusion of other surgical specialties in the meta analyses.[5,10,11,14] Cardiac and orthopedic procedures both showed some improvement when lidocaine was used as a pain adjunct; however, most of the research in this population was biased by the inclusion of other surgical specialties or based on small studies, making the extrapolation of the data to one population difficult.[5,8,11-13]

All the studies had limitations. The main limitation for this body of evidence is a lack of a standard lidocaine protocol for timing of the administration, which is a significant confounding factor. Generally, most studies used a preincision lidocaine bolus of 1.5-2 mg/kg with an intraoperative infusion of 1.5-2 mg/kg/hr, but the infusions were administered for various lengths of time. Many of the studies were composed of small RCTs with a risk of bias regarding concealment and allocation. The influence of multiple surgical populations in some of the meta-analyses is a significant source of bias as well. However, despite these limitations, the evidence suggests a positive effect for lidocaine use in abdominal and spine surgery, a potential benefit in the orthopedic and cardiac population, albeit with lesser quality evidence, and limited positive effects seen in the bariatric and breast surgery population.
This review was limited to publications completed within the last 8 years, and only included the highest level of evidence (Joanna Briggs Level 1); therefore, other research outside these parameters was not included. Additionally, this review is limited to lidocaine's analgesic effectiveness and other benefits of lidocaine as an adjunct (e.g. decreased ileus, nausea/vomiting) were outside the scope of this project.

To summarize, the results of this analysis recommend the use of lidocaine in the spine and abdominal surgical population with limited confidence in the orthopedic and cardiac population. In the bariatric and breast surgery population, lidocaine's effectiveness for acute perioperative pain was minimal and should be used with these limitations in mind. More high-quality RCTs with subsequent meta-analyses are needed to continue to identify which surgical populations will most benefit from lidocaine infusions for perioperative pain control.

References

1. Simpson JC, Bao X, Agarwala A. Pain management in enhanced recovery after surgery (ERAS) protocols. *Clin Colon Rectal Surg*. 2019;32(2):121-128. Doi:10.1055/s-0038-1676477
2. van der Wal SE, van den Heuvel SA, Radema SA, et al. The in vitro mechanisms and in vivo efficacy of intravenous lidocaine on the neuroinflammatory response in acute and chronic pain. *Eur J Pain*. 2016;20(5):655-674. Doi:10.1002/ejp.794
3. Bi Y, Ye Y, Ma J, Tian Z, Zhang X, Liu B. Effect of perioperative intravenous lidocaine for patients undergoing spine surgery: A meta-analysis and systematic review. *Medicine (Baltimore)*. 2020;99(48):e23332. Doi:10.1097/MD.0000000000023332
4. Licina A, Silvers A. Perioperative intravenous lidocaine infusion for postoperative analgesia in patients undergoing surgery of the spine: systematic review and meta-analysis. *Pain Med*. 2022;23(1):45-56. Doi:10.1093/pm/pnab210
5. Weibel S, Jelting Y, Pace NL, et al. Continuous intravenous perioperative lidocaine infusion for postoperative pain and recovery in adults. *Cochrane Database Syst Rev*. 2018;6(6):CD009642. Published 2018 Jun 4. Doi:10.1002/14651858.CD009642.pub3

6. Lovett-Carter D, Kendall MC, Park J, Ibrahim-Hamdan A, Crepet S, De Oliveira G. The effect of systemic lidocaine on post-operative opioid consumption in ambulatory surgical patients: a meta-analysis of randomized controlled trials. *Perioper Med (Lond)*. 2021;10(1):11. Published 2021 Apr 13. Doi:10.1186/s13741-021-00181-9
7. Sarakatsianou C, Perivoliotis K, Tzovaras G, Samara AA, Baloyiannis I. Efficacy of intravenous use of lidocaine in postoperative pain management after laparoscopic colorectal surgery: a meta-analysis and meta-regression of RCTs. *In Vivo*. 2021;35(6):3413-3421. Doi:10.21873/invivo.12641
8. Zhao JB, Li YL, Wang YM, et al. Intravenous lidocaine infusion for pain control after laparoscopic cholecystectomy: a meta-analysis of randomized controlled trials. *Medicine (Baltimore)*. 2018;97(5):e9771. Doi:10.1097/MD.0000000000009771
9. Zhu Y, Wang F, Yang L, Zhu T. Intravenous lidocaine infusion reduce post-operative pain and length of hospital in elderly patients undergoing surgery: meta-analysis of randomized controlled trials. *Surg Innov*. 2022;29(5):632-645. Doi:10.1177/15533506211045283
10. Chang YC, Liu CL, Liu TP, Yang PS, Chen MJ, Cheng SP. Effect of perioperative intravenous lidocaine infusion on acute and chronic pain after breast surgery: a meta-analysis of randomized controlled trials. *Pain Pract.* 2017;17(3):336-343. Doi:10.1111/papr.12442
11. Kendall MC, McCarthy RJ, Panaro S, et al. The effect of intraoperative systemic lidocaine on postoperative persistent pain using Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials Criteria Assessment following breast cancer surgery: a randomized, double-blind, placebo-controlled trial. *Pain Pract*. 2018;18(3):350-359. doi:10.1111/papr.12611
12. Nallbani R, Komoni E, Sada F, Jusufi IQ, Hasani A. Intravenous lidocaine for postoperative analgesia in 90 patients after total knee arthroplasty and limb fractures. *Med Sci Monit*. 2022;28:e935852. Published 2022 Mar 23. doi:10.12659/MSM.935852
13. Boswell MR, Moman RN, Burtoft M, et al. Lidocaine for postoperative pain after cardiac surgery: a systematic review. *J Cardiothorac Surg*. 2021;16(1):157. Published 2021 May 31. doi:10.1186/s13019-021-01549-0
14. Hung KC, Chang YJ, Chen IW, Chang YP, Chiu SF, Sun CK. Efficacy of intraoperative intravenous lidocaine for postoperative analgesia following bariatric surgery: a meta-analysis of randomized controlled studies. *Surg Obes Relat Dis*. 2022;18(1):135-147. doi:10.1016/j.soard.2021.08.014

Mentor: Julie Soelberg, PhD, CRNA

Ultrasound Mapping for Neuraxial Blocks: A Quality Improvement Project

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Keywords: quality improvement, neuraxial anesthesia, ultrasound landmarks, ultrasound mapping, obstetric

Introduction

Ultrasound (US) mapping for neuraxial placement has been shown to increase first-pass success and decrease complications including post-dural puncture headache and vascular cannulation.[1,2] These findings are especially pronounced in subgroup analyses of patients for whom a neuraxial procedure is predicted to be difficult. Bony-landmark palpation is currently the traditional method used to identify location when performing neuraxial anesthesia procedures for obstetric populations. This quality improvement (QI) project aimed to implement an educational workshop to increase anesthesia practitioners' knowledge, confidence, and utilization of US for neuraxial landmark mapping at a large metropolitan obstetric center in a southern state.

Design and Methods

The frequently cited *Diffusion of Innovation Theory*[3] by Kaminski guided project development, specifically to encourage anesthesia practitioners to adopt a novel technique for improving efficacy of neuraxial anesthetic placement for obstetric patients. The QI team, comprised of three student registered nurse anesthetists, reviewed existing literature, obtained IRB approval, and developed a skills workshop specific to utilization of an ultrasound landmark mapping (ULM) technique. The focus of the workshop was to expose anesthesia practitioners to the procedure and benefits of neuraxial ULM. Certified registered nurse anesthetists and physician anesthesiologists were provided a short educational video followed by a 10-minute individual skills workshop to practice ultrasound landmark mapping.

Anesthesia practitioners were advised that ultrasound-guided techniques could benefit patients who meet specific criteria indicating a neuraxial procedure may be predicted as difficult (history of difficult neuraxial placement, neuro-skeletal abnormalities such as scoliosis, or body mass index > 40). Four outcomes were evaluated: *provider confidence* and *knowledge* of neuraxial landmarks (evaluated before and after the workshop); provider *use of ultrasound* in the two months following the workshop, and *procedure time* (measured from administration of initial local anesthetic to placing patient supine after neuraxial procedure was completed). Data collection occurred for patients with and without ultrasound mapping, utilizing RedCap© instruments and downloaded as an Excel spreadsheet. Data were then analyzed using descriptive statistics.

Outcome

After the educational workshop, anesthesia practitioners' mean self-reported confidence in using US increased from 1.95/10 to an average of 6/10. Anesthesia practitioners who could identify all

five neuraxial landmarks following the workshop improved from a pre-workshop assessment of 37% to 65% post-workshop. No anesthesia practitioners used US for neuraxial procedures prior to the workshop, and 41% of anesthesia practitioners reported using it in the two months following the workshop. A total of 95 neuraxial procedures, inclusive of interventions utilizing US, were performed and documented by nursing staff. Data revealed procedure time was decreased when anesthesia practitioners utilized ULM as compared to traditional palpation techniques alone (median of 5 vs. 8 minutes). For patients who met criteria for ultrasound use (predicted to be difficult), the difference between procedure time was more pronounced (median of 5 vs. 10 minutes). Of the 26 patients whose neuraxial procedures were predicted to be difficult, five received ULM prior to the procedure during this program implementation period.

Conclusion

Neuraxial techniques including spinals and epidurals are common anesthetic techniques provided for the parturient. First-time needle pass success can be difficult in this population. Recent evidence supports ULM can improve efficacy and decrease complication rates of neuraxial anesthesia. Data revealed from this QI project indicates that short, in-person workshops can be implemented to encourage anesthesia practitioners use of ULM technique for neuraxial anesthesia. A limitation of this project was its short two-month duration. Future QI initiatives focused on increasing neuraxial ultrasound utilization could be more successful by lengthening the duration of the implementation phase.

References

1. Sidiropoulou T, Christodoulaki K, Siristatidis C. Pre-procedural lumbar neuraxial ultrasound: A systematic review of randomized controlled trials and meta-analysis. *Healthcare.* 2021;9(4):479. https://doi.org/10.3390/healthcare9040479
2. Young B, Onwochei D, Desai N. Conventional landmark palpation vs. preprocedural ultrasound for neuraxial analgesia and anaesthesia in obstetrics: A systematic review and meta-analysis with trial sequential analyses. *Anaesthesia.* 2020;76(6):818–831. https://doi.org/10.1111/anae.15255
3. Kaminski J. Diffusion of innovation theory: Theory in nursing informatics column. *Can J Nurs Inform*. 2011;6(2). https://cjni.net/journal/?p=1444

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

Editorial

It is with sadness that I acknowledge the passing of Peter Strube, DNAP, MBA, CRNA, FAANA, LTC (ret.). I met Peter many years ago in Missouri when he spoke at one our state professional conferences. We spoke about the ISJNA and he immediately expressed interested in getting involved. He served as a reviewer in 2015 and then joined the editorial board in 2017. I will always remember Dr. Strube's enthusiasm for nurse anesthesia education and helping students succeed. I am grateful for his contributions to our profession - he will be missed.

Sincerely,

Vicki Callan, PhD, CRNA, CHSE, FAANA
Editor

INTERNATIONAL STUDENT JOURNAL OF NURSE ANESTHESIA
GUIDE FOR AUTHORS

MISSION STATEMENT

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

ITEM PREPARATION & SUBMISSION

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

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

REVIEW PROCESS

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

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

PHOTOS

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

ACADEMIC INTEGRITY

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

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

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

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

GENERAL GUIDELINES

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

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

Please note the following:

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

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

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

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

Title

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

Keywords: keyword one, keyword two, etc.

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

Heading (see above)

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

Case Report (400-600 words)

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

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

Discussion (600-800 words)

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

References

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

Mentor: mentor name, credentials

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

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

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

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

Heading

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

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

Heading

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

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

Heading

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

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

AMA MANUAL OF STYLE

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

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

Journal, 6 or fewer authors:

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

Journal, more than 6 authors:

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

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

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

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

Examples:

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

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

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

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

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

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

SUBMISSION CHECK LIST

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

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

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

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

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

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

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