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Poster Abstracts

Case Report

Abstract 2

Massive Systemic Arterial Air Embolism during Thoracotomy

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Introduction: The incidence rate of systemic air embolism ranges from 0.02% up to 0.21%. Depending on the process of air entry into circulation, it can be classified as venous or arterial. While venous air embolism is widely reported, systemic arterial air embolism (SAAE) is rare and potentially life threatening. SAAE involves air entering the pulmonary venous system or directly into systemic circulation, causing adverse neurologic and cardiac effects. Entraining an air volume as small as 0.5 ml into the pulmonary veins can lead to cardiovascular collapse and death. SAAE has nonspecific clinical manifestations and the difficulty in detecting air in the arterial system can delay diagnosis and produce poor outcomes. This case report will highlight SAAE during a thoracotomy with resection of a pleural tumor to promote detection and timely treatment of this rare complication.

Case Presentation: A 64-year old female was scheduled for a left thoracotomy with resection of a large 20 cm solitary fibrous pleural tumor. Physical exam findings included orthopnea, dyspnea on exertion, and atrial premature contractions. A double lumen endobronchial tube, arterial line, and two 16-gauge peripheral IVs were placed following induction of general anesthesia. The surgical team was able to identify a plane between the mass and left lower lobe and dissect the tumor away from surrounding structures. Only a few remaining attachments on the anterior aspect of the tumor to the left upper lobe remained when the mass was lifted away from the left upper lobe and out of the chest cavity. The patient suddenly developed hypotension and bradycardia that progressed into ventricular fibrillation. After 30 minutes of CPR took place, the patient was declared dead. During the postmortem exam, the head vessels and distal aorta were ligated and the heart and lung were removed as a unit and submerged underwater. The root of the aorta was incised and a significant amount of air came out of the aorta and left ventricle. This explained that the cause of death was intraoperative, massive systemic arterial embolism that occurred when the large tumor was elevated out of the chest cavity, relieving the compressive effects of the tumor.

Discussion: SAAE occurs when air is introduced into pulmonary veins and arterial circulation. Obstruction of blood flow to the cerebral and cardiac vasculature can lead to ischemia, cardiac arrhythmias, stroke, and death. This may occur under multiple mechanisms. Elevating the large pleural tumor out of the chest cavity relieved its compressive effects on major structures and vessels. This created a positive pressure gradient that entrained large air volumes into the pulmonary venous system and left side of the heart, causing sudden cardiovascular collapse. Intraoperative tranesophageal echocardiography can facilitate prompt diagnosis and mitigate risks. It is the most sensitive tool for monitoring air migration into venous and arterial circulation. Management strategies prioritize stabilizing the patient. This includes 100% oxygen, fluid resuscitation, and cardiopulmonary resuscitation using ACLS guidelines in the presence of cardiac arrest. Steep trendelenburg with right lateral decubitus positioning is recommended for SAAE. This suspends the air in the superior aspect of the left ventricle and prevents it from migrating into the systemic circulation. Hyperbaric oxygen chamber therapy is the only effective treatment for SAAE. It delivers 100% oxygen at a high pressure, which improves oxygenation to end organ systems and dissolves air emboli by promoting nitrogen reabsorption into plasma. SAAE is a

potentially life-threatening complication with nonspecific clinical manifestations that is often misdiagnosed. Identifying diagnostic methods and management strategies can facilitate prompt recognition and treatment for SAAE.

Abstract 3

Negative Pressure Pulmonary Edema after Partial Upper Airway Obstruction

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Introduction: Negative pressure pulmonary edema (NPPE) is a rare noncardiogenic pulmonary edema traditionally associated with a forced inhalation against a closed glottis, typically after general anesthesia. The incidence of NPPE reported in the literature ranges from 0.05% to 0.1%, but the actual occurrence is believed to be higher than reported. There are two types of NPPE described in the literature: type 1, which occurs after a forceful inhalation during an acute upper airway obstruction (UAO), and type 2, which occurs after the relief of a chronic UAO. Type 1 is the more prevalent form and was the variety that the patient in this case study experienced. Type 1 NPPE was traditionally thought to occur only with vigorous inhalation against a closed glottis or complete UAO. However, this report presents a case of NPPE that developed following a partial UAO.

Case Presentation: A 25-year-old male presented for left knee arthroscopy following multiple patellar dislocations. The patient was an active-duty Army pilot and had no underlying medical conditions. The patient had a normal preoperative physical and airway exam. The patient was induced, received neuromuscular blockade with succinylcholine, and intubated without any complications. The surgery was uneventful, and the patient was extubated deep after suctioning and insertion of an oropharyngeal airway. Appropriate tidal volumes and end-tidal CO2 were confirmed before placement of a simple mask with 6 L/min of oxygen. After being transferred to the gurney, the patient exhibited forceful snoring indicating a possible obstruction, although ventilation was still present. This partial obstruction was relieved by hyperextending the head. The patient was then taken to the post-anesthesia care unit, where his oxygen saturation was critically low at 60%. The patient was immediately given positive pressure ventilation and supplemental oxygenation with minimal improvement. After inserting a nasopharyngeal airway, the patient coughed up large amounts of bloody frothy sputum. The patient's oxygen saturation improved with the administration of supplemental oxygen and positive pressure via continuous positive airway pressure and diuretics. The patient made a full recovery and was discharged home after four hours.

Discussion: NPPE due to partial airway obstruction is not commonly reported in medical literature, but anesthesia providers must be aware of it as a possible complication of general anesthesia. Young, healthy, and muscular males are at the highest risk of developing NPPE due to their strength and ability to generate a significantly larger intrathoracic negative pressure differential against an obstructed airway. Other risk factors include obstructive sleep apnea, obesity, short neck, acromegaly, and upper airway surgery. The most common cause of NPPE in adults is post-extubation laryngospasm following surgery. Symptoms of NPPE may appear within minutes of the obstructive event but have been reported to manifest up to 30 hours later. Prevention and prompt identification of UAO are key to decreasing the incidence of NPPE. Timely diagnosis and treatment of NPPE are crucial in preventing further respiratory compromise and patient mortality. Respiratory support through supplemental oxygen and PPV is the mainstay of primary treatment, while bronchodilators and diuretics have mixed evidence of alleviating symptoms of pulmonary edema. This case report illustrates that NPPE can be more complex than commonly perceived, and seemingly minor UAOs can lead to severe clinical complications. Prevention of UAO and prompt identification of NPPE can decrease the incidence of serious clinical ramifications associated with its presence.

Abstract 4

Risk Assessment and Management of Bone Cement Implantation Syndrome

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Introduction: This case report describes an intraoperative patient death due to bone cement implantation syndrome (BCIS) and the anesthetic interventions utilized. The literature review reveals limited anesthetic interventions once BCIS occurs. Preoperative risk assessment strategies are explored to identify patients at high risk for developing BCIS intraoperatively. Identification of these patients can allow optimization of the patient's condition or prompt discussions with the surgeon to alter surgical technique. BCIS most commonly occurs in cemented hip hemiarthroplasty with an intraoperative mortality ranging from 0.2% to 4.3% depending on the type of hip fracture. BCIS typically develops once the cement or prosthetic stem is introduced or during prosthetic hip reduction. The pathophysiology is not well defined, but may be mediated by embolism, anaphylaxis, complement activation, or histamine release. Symptoms include hypoxia, sudden loss of arterial pressure, pulmonary hypertension, and potentially cardiac arrest.

Case Presentation: An 80-year-old female presented to the Emergency Department (ED) after falling at home. Orthopedic surgery diagnosed a femoral neck fracture and scheduled the patient for right cemented hip hemiarthroplasty. Relevant medical history included CHF, COPD with home oxygen use, DM type II, and mild mitral regurgitation. An elevated BNP of 436 prompted a preoperative TTE which revealed an EF of 55% to 60% with an elevated pulmonary artery peak pressure of 53 mmHg. The patient consented to general anesthesia with a postoperative peripheral nerve block. A PENG block had been administered in the ED the day prior. Intraoperatively, standard monitors were applied, anesthesia was induced, and the trachea was intubated without incident. A second IV with an albumin infusion was started. Fifty minutes after induction, bone cement was used in the surgical field. The SpO2 and ETCO2 values and heart rate began to drop drastically. A call for immediate anesthesia assistance was placed and a dose of epinephrine was given. A carotid pulse was unable to be palpated. The patient was repositioned to supine. CPR was initiated and continued for 36 minutes until time of death was called.

Discussion: Many of the anesthetic interventions described in the literature were used in this case. Ultimately, grade 3 BCIS developed, and the patient was not resuscitated. Current literature on BCIS primarily defines the syndrome, its risk factors, and offers limited interventions to prevent or treat BCIS intraoperatively. These interventions include adequate fluid resuscitation with colloid both preoperatively and intraoperatively, use of 100% FiO2, use of vasopressors to maintain right ventricular function, and use of intravenous dexamethasone and pheniramine. The literature currently focuses on patients who received spinal anesthesia for cemented hip hemiarthroplasty. Therefore, the current interventions may not be generalizable to patients undergoing general anesthesia for this procedure. Several articles stress the importance of a preoperative risk assessment and discussion with the surgeon to further optimize the patient's condition or modify surgical techniques. The literature defines significant risk factors for developing BCIS as COPD, pulmonary hypertension, right ventricular dysfunction, metastatic bone disease, trauma, and a previously non-instrumented femoral canal. The patient population that experiences hip fractures may have several of these risk factors. This case report describes a patient who had many of the key risk factors for BCIS but did not respond to the defined interventions. Further research into the pathophysiology and management of BCIS will optimize anesthetic management and decrease mortality in a frail population. Recommendations for practice

include a preoperative risk assessment, a discussion with the surgeon, adequate fluid resuscitation, and administration of 8 mg dexamethasone IV.

Abstract 6

Submental Intubation for Panfacial Fractures

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Introduction: The purpose of this case study is to describe the technique of submental intubation in the presence of panfacial fractures, and to review outcomes of hemorrhage compared to tracheostomy. Maxillofacial trauma poses a difficult situation for the anesthesia practitioner when it comes to airway management. Oral intubation may impede the ability to perform maxillomandibular fixation, and nasal intubation may be contraindicated if there is a skull base fracture that could lead to the endotracheal tube (ETT) entering the cranium. Traditionally tracheostomy has been the airway technique used for patients with panfacial fractures where nasal intubation is contraindicated. However, in 1986 Hernandez Altemir developed a new technique called submental intubation (SMI). SMI is a less invasive and effective alternative to tracheostomy if the patient does not require long-term ventilation postoperatively.

Case Presentation: A 23-year-old male presented to the operating room following a motor vehicle collision. Injuries included fractures of the zygomatic arch, temporal process, maxillary wall, frontal sinus wall, ethmoid sinus wall, and nasal bones. He also had a pneumocephalus due to a fracture in the cribiform plate of the ethmoid bone. The surgery to be performed included an open reduction internal fixation (ORIF) of the fractures and maxillomandibular fixation. The anesthetic plan was a general endotracheal anesthetic with conversion of the oral ETT to SMI in order to optimize the surgical field view. Nasotracheal intubation was contraindicated due to the cribiform plate fracture. The alternative to SMI is a tracheostomy; however, the patient did not require long-term airway support. Induction of anesthesia was administered via peripheral IV, and neuromuscular blockade was established with rocuronium. Once the patient was anesthetized, a Cook airway exchange catheter was used to exchange the standard ETT for a reinforced ETT. Then SMI was performed using the Altemir method, and the ETT was sutured in place. Prior to ICU transfer, the submental ETT was converted back to an oral ETT. Postoperatively the patient remained intubated for one day and was then extubated. Three weeks following the procedure, the submental incision scar appearance was negligible as noted in the outpatient clinic.

Discussion: It is beneficial for the anesthesia practitioner to understand the potential risks of choosing a submental airway in comparison to a tracheostomy. The most common complication of a tracheostomy is hemorrhage due to trauma of the cervical vessels or the thyroid gland. A literature review was conducted to review the outcome of hemorrhage from SMI compared to tracheostomy. The literature demonstrates SMI is a viable and safe alternative to tracheostomy amongst patients with panfacial fractures not requiring long-term ventilation. While only two of the studies, Kita et al. and Emara et al., compared tracheostomy to SMI for hemorrhage rates, none of the other studies had patients with SMI experience hemorrhage perioperatively. SMI following the Altemir method avoids large blood vessels which can prevent hemorrhage. The blunt dissection from the submental incision to the mouth passes through subcutaneous tissue, cervical fascia, and the mylohyoid muscle. The two most common complications from SMI included skin infections and issues with the ETT, including dislodgement and pilot balloon damage. The Kita et al. study discussed another interesting variable: apneic time during SMI. While the ETT is being passed from the mouth through the incision, the patient is unable to be ventilated. In order to decrease apneic time, Kita et al. utilized a silicone tube to dilate the passage and

make it easier for the ETT to pass through. Overall, SMI was successful in 100% of the patients, with minimal complications perioperatively and no cases of hemorrhage.

Evidence Based Practice

Abstract 7

A Comparison on the Efficacy of Erector Spinae Block Versus Paravertebral or Thoracic Epidural in Patient Undergoing Cardiac Surgery

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Background/Discussion/Question: Cardiac surgery is associated with significant postoperative pain, traditionally managed with opioids and epidural techniques. The erector spinae (ESP) block, providing analgesia to the anterior, lateral, and posterior chest wall, is described as a simplistic, safe alternative to thoracic epidural anesthesia and analgesia (TEA) or a paravertebral block (PVB) for cardiac patients . The literature suggests that its minimal risk of vascular puncture, hypotension, or local anesthetic toxicity and superior postoperative pain scores enhance patient recovery after cardiac surgery. This doctoral project aimed to answer the PICO question: In adult cardiac surgical patients, is the use of the ESP block effective in decreasing postoperative pain and complications compared to the PVB or TEA block?

Methods/Evidence Search: Several databases were utilized to support the search query, including CINAHL, MEDLINE, EBSCO, Open Access Journals, Google Scholar, ScienceDirect, Nursing & Allied Health Database, and Embase. Inclusion criteria included male and female adults undergoing cardiac surgery, ESP block, ESP block versus PVB or TEA, cardiac surgery via midline sternotomy and thoracotomy, English language, randomized controlled trials, publications dating 2016 to the present, case studies, systematic reviews, and meta-analysis. The 10 most pertinent publications of ESP block in adult cardiac surgery were reviewed and selected from the search.

Synthesis of Literature/Results/Discussion: The literature indicates the ESP block is both a safe and effective analgesic modality for the cardiac surgical patient. It provides similar or more effective pain management after cardiac surgery than both the TEA and the PVB while avoiding adverse effects. Singh et al. and Krishna et al., both level-one randomized controlled trials, described the ESP block as providing superior analgesia in the cardiac surgical patient when compared to commonly utilized methods of pain relief. Ragavendran et al. described the ESP block as having comparable analgesic pain scores to the TEA. However, the risks of the TEA were highlighted as points of contingency when compared to the safety profile of ESP block in cardiac patients. In Kukreja et al., the ESP was used as a rescue analgesic for failed TEA after thoracotomy and concluded it was a safe alternative to TEA and PVB. The ten articles reflect several favorable features for the ESP block in cardiac surgical patients. Collectively the data indicate the ESP block is effective in avoiding complications of hypotension, permanent spinal cord injury, urinary retention, epidural spread, vascular puncture, local anesthetic toxicity, pneumothorax, and hematoma, often observed in epidural and other regional blocks.

Conclusion/Recommendations for Practice: Inadequate postoperative pain management is linked to increased morbidity and mortality. The impact of enhanced recovery after surgery and fast-tracking protocols necessitates implementing effective multimodal techniques. The ESP block offers a cost-effective alternative for the cardiac surgery patient compared to the thoracic epidural and paravertebral block. The ESP block was found to have comparable pain control or better pain control with fewer adverse effects. Implementation of the ESP block as a multimodal analgesic strategy in the cardiac surgical patient can enhance recovery after cardiac surgery. Its favorable safety profile is a cost-effective

alternative to the TEA and PVB blocks.

Abstract 8

Achieving Optimal Sedation: The Use of Inhalational Agents on ICU Patients with Acute Respiratory Distress Syndrome

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Background/Discussion/Question: The COVID-19 pandemic posed an immense challenge to public health, heightening intensive care unit (ICU) admissions way beyond what most healthcare systems are able to manage. While most of these patients developed acute respiratory distress syndrome (ARDS), due to the eventual shortage of intravenous (IV) sedative agents they received suboptimal sedation. Considerably, inhalational agents (IAs) have been known to provide immunomodulatory, anti-inflammatory, and bronchodilator effects, making them a viable alternative for sedation in the ICU. This project addressed the following question: Among ICU patients with ARDS, does the use of IA compared to IV sedation improve patient outcomes and reduce hospital length of stay?

Methods/Evidence Search: An electronic search was conducted using the databases PubMed, MEDLINE, and Embase. The initial search limit included the English language and articles published between 2016 to 2022. The keywords used to search all databases were intensive care unit, acute respiratory distress syndrome, inhaled volatile anesthetics, hypnotics, and intravenous sedation. The search initially resulted in 85 articles. Duplicate articles, titles with abstracts deemed irrelevant, those with an incorrect patient population, and opinion pieces were eliminated from review. From the three databases, 18 articles were retrieved and a full-text screen was employed to assess eligibility. This left eight articles that fully met the inclusion criteria and were then included in this project. The following articles were included: four systematic reviews and/or meta-analyses, two randomized controlled trials, and two retrospective studies.

Synthesis of Literature/Results/Discussion: Current ICU guidelines in the United States focus on IV sedation despite evidence from current studies abroad supporting the use of IAs on mechanically ventilated patients. The literature reviewed revealed that the use of isoflurane and sevoflurane compared to IV sedation with propofol or midazolam resulted in improved pulmonary function in terms of the PaO2/FiO2 ratio; shortened awakening time; and reduced extubation time. It also allowed for decreased use of narcotic-based sedation. Additionally, none of the studies reported serious adverse effects from the IAs such as malignant hyperthermia, hepatotoxicity, or nephrotoxicity. One retrospective study also explored the use of isoflurane with continuous lateral rotational therapy in ARDS, which demonstrated that IA use allowed subjects to spontaneously breathe while being deeply sedated and lowered their peak pressures, all the while remaining hemodynamically stable. Among the eight articles reviewed, only one article revealed that oxygenation did not significantly differ from baseline to the end of study between sevoflurane and propofol. Seven out of the eight studies reviewed the type of sedation used and its effects on morbidity and mortality; one study reported significantly decreased ICU/hospital stay and mortality rates and six studies reported comparable results.

Conclusion/Recommendations for Practice: IAs used for general anesthesia have advantageous pharmacokinetics due to potent sedative effects, rapid elimination, and minimal accumulation. Many studies have proven their efficacy and benefits for use in short- and long-term sedation, specifically for mechanically ventilated patients with ARDS, while also noting their life-saving role in refractory diseases such as asthma and epilepsy. However, due to the high cost of anesthesia delivery systems, technological limitations, lack of FDA approval, and unfamiliarity among intensivists and nursing staff in critical care settings in United States, the use of IAs in the ICU is limited. Evidence suggests that IAs improve

oxygenation, decrease IV sedative and opioid use, and potentially provide organ protection. Based on this review, the therapeutic utility of IAs in improving the recovery of critically ill, mechanically ventilated patients outside of the operating room is worth exploring, which consequently opens the possibility of nurse anesthetists having permanent daily roles in the ICU.

Abstract 9

Among Adult Patients Suffering From Anosmia in the Setting of "Long COVID," is the Stellate Ganglion Block an Effective Treatment for Olfactory Dysfunction when Compared to Intranasal and Systemic Corticosteroids?

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Background/Discussion/Question: Anosmia, or the loss of the sense of smell, is a common, persistent symptom of COVID-19 even after full clinical recovery. Olfactory dysfunction in COVID-19 occurs in roughly half of those infected, with up to 7% of patients still reporting disturbances more than 12 months after diagnosis. Anosmia is often associated with loss of taste, and the persistence of these symptoms leave many patients feeling depressed, hopeless, and frustrated. It is hypothesized that these symptoms may be caused by the autonomic nervous system's maladaptive response to pro-inflammatory cytokines, leading to sympathetic nervous system hyperactivity. A proposed solution to this is blockade of the stellate ganglion. The purpose of this review was to investigate the potential benefit of treating patients with anosmia with a stellate ganglion block compared to IV corticosteroids.

Methods/Evidence Search: A systemic review of the literature was performed utilizing the databases PubMed, MEDLINE, and Web of Science through Columbia University Irving Medical Center Library. Keywords included: stellate ganglion, anosmia, and COVID-19. Full-text English language articles published between 2020 and 2022 were included. After duplicates were removed, the initial search yielded 56 articles which were then screened by title and abstract. Inclusion criteria were patients who had recovered from COVID-19 after treatment with IV corticosteroids or stellate ganglion block. Thirty-six articles were retrieved and assessed for eligibility. Exclusion criteria were incorrect treatment variables or lack of any treatment variables, and one article did not discuss the results of the study. Nine full-text articles were reviewed and included in the final analysis. Of the articles included in this review, three are case reports, three are randomized controlled trials, and two are literature reviews.

Synthesis of Literature/Results/Discussion: Of the nine included studies, four studies investigated the efficacy of steroids and four looked at the efficacy of the stellate ganglion block in treating COVID-19 related anosmia. Of the four studies that looked at the stellate ganglion block, all were case studies and all reported that the stellate ganglion block is a safe and effective treatment for COVID-19 related anosmia. All patients in the stellate ganglion block case studies reported full resolution of anosmia within 24 to 48 hours after stellate ganglion block treatment. One of these studies reported that patients also felt resolution of other "long COVID" symptoms, including associated "brain fog." The other four studies investigated the efficacy of the current standard treatment for COVID-19 related anosmia: corticosteroids. Two randomized controlled trials looked at the efficacy of nasal corticosteroids and found that they did not produce statistically significant improvement in symptoms. The other two studies discussed the use of oral corticosteroids. One of them was a randomized controlled trial that found oral corticosteroids may be a safe and effective treatment; however, further research is necessary. The other was a literature review which concluded that data is too limited on corticosteroids to regard it as a definitive treatment.

Conclusion/Recommendations for Practice: Based on this literature review, the stellate ganglion block may be a viable treatment option for COVID-19 related chronic anosmia, although more research is needed in this area. The use of the stellate ganglion block for COVID-19 related anosmia may be relatively new; however, the stellate ganglion block itself has been used as a treatment for other chronic illnesses for many years. While corticosteroids are the current standard of care for anosmia, research is

limited and the success of these treatments is not well documented. A double-blinded, randomized controlled trial is currently being conducted on the efficacy of the stellate ganglion block for COVID-19 related anosmia, which will ideally be replicated by other researchers in the future. This new application for the stellate ganglion block may provide CRNAs in the pain management sector with an opportunity to improve quality of life for many affected patients through their skills in regional anesthesia. This should be further explored.

Abstract 10

An Evidence-based Toolkit for Simulation Education in Regional Anesthesia

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Background/Discussion/Question: The benefit of regional anesthesia has been well documented and the use of ultrasonography to place nerve blocks has resulted in a dramatic increase in use, yet no consensus exists for the best way to teach this skill set. Many programs still employ antiquated teaching methods, and locating information about modern instructional strategies can be difficult for educators. What effective teaching methods are available in simulation education for regional anesthesia (RA)? To answer this question, we compiled a toolkit that provides educators with a comprehensive guide to best-evidence resources for teaching RA utilizing simulation-based education. The toolkit includes training tools, hardware, and software such as virtual/augmented reality, simulation, models, cadavers, needle guidance systems, and a comprehensive plan to best assess learning following simulation education.
Methods/Evidence Search: A literature search was conducted using CINAHL, PubMed, Google Scholar, and Cochrane databases. Keywords searched included virtual reality, augmented reality, technology-enhanced education, computerized simulation, regional anesthesia training, and regional anesthesia skills. Information was also included from a literature search conducted by MTSA doctoral students Erasmo Coutino and Gail Crawford. They reviewed cadaver use in simulation of ultrasound guided regional anesthesia (UGRA) and assessment tools for use in UGRA simulation, respectively.
Synthesis of Literature/Results/Discussion: Virtual reality/augmented reality (VR/AR) was effective in teaching the anatomical basis of RA. Ten of 11 articles showed benefits in knowledge retention with VR/AR, and in six of the articles VR/AR was shown to be non-inferior to traditional methods such as the atlas study, with improved learner engagement and satisfaction. Data were equivocal on whether VR/AR helps with skill acquisition, but two studies indicated it could reduce time to perform a skill and assist with knowledge retention. VR/AR technology continues to evolve but lacks mechanisms for providing needling experience and haptic feedback which are critical for block success. Cadavers are efficacious for learning both gross anatomy and sonoanatomy as well as providing needling and haptic feedback. Thiel cadavers provide more malleability and durability than fresh-frozen specimens; however, they are more expensive than fresh-frozen but easier to store. Both technical and non-technical aspects of block performance should be assessed. A combination of checklists and a global rating scale are the ideal method for assessing competency. For technical aspects of block performance, the regional anesthesia procedural skills (RAPS) checklist with pass/fail scoring was reported as having good validity and reliability. For non-technical aspects of block performance (such as professionalism, communications), the NAIK checklist with the Likert scale was reported as having good validity and reliability for use in RA.
Conclusion/Recommendations for Practice: Multiple strategies should be used to maximize skill acquisition for anesthesia students. In preparation for simulation training with live models, VR/AR is effective for introduction to gross anatomy and web-based learning is useful for sonoanatomy. Food-grade animal models and phantoms are as effective as more expensive options for learning needling techniques. Cadavers are best suited for holistic simulation following basic skill acquisition. Thiel cadavers are superior for RA. A combination of checklists should be used to assess competency. The RAPS checklist with pass/fail and the Naik checklist with the Likert scale have been the assessment tools most often cited in the literature. Use of Just-In-Time regional anesthesia procedure guide resources may improve performance. Evidence does not support a single “best” simulation method but does suggest a

combination of methods is optimal for skill/knowledge acquisition in RA. Continued research and technological innovation have the potential to improve simulation-based RA education.

Abstract 11

Assessment and Anesthetic Management of Patients with Vaping History: An Evidence-based Educational Module

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Background/Discussion/Question: Since its debut in the U.S. market, electronic vapor delivery systems (EVDS) have become a significant social trend. Compelling evidence points to a meteoric rise in e-cigarette usage throughout the U.S., particularly among young people. Presently, 3.6 million teenagers and 10.8 million adults use electronic cigarettes (ECs), with the proliferation of utilization increasing from 0.6% in 2011 to 11.3% in 2017 and from 2.4% to 6% in adolescents and adults, respectively. In patients with a vaping history, does a modified preoperative assessment enhance the anesthetic management? The primary goal of this DNP project was to improve knowledge among anesthesia providers of the deleterious effects of EC use and develop a focused pre-operative assessment for adequate surgical-risk stratification and enhanced anesthetic management of patients with a history of vaping.

Methods/Evidence Search: A literature search was performed using PubMed, Embase, and CINAHL. The query used MeSH terms, truncated phrases, key phrases, and Boolean logic. Key words included: vaping, electronic cigarettes, e-cigarettes, electronic nicotine delivery systems, smokeless tobacco, anesthesia, surgery, peri-operative, respiratory impacts, pulmonary, and lung. The search results were limited to publications from 2012 to 2022. Limitations applied to the query results included non-English articles and empirical evidence of a nonclinical nature. Inclusion criteria were publications of randomized controlled trials (RCTs), systematic review/meta-analysis of RCTs, and nonrandomized trials that evaluated the usage of ECs and their effects on respiratory, cardiovascular, and immunological function and effects on anesthetic delivery. Articles excluded were those that assessed the impact of conventional tobacco use on different organ systems, focused primarily on combustion cigarettes, or were nonexperimental/observational studies.

Synthesis of Literature/Results/Discussion: There is a direct correlation between EC usage and the development of EC or vaping product usage-related lung injury (EVALI). ECs increase the likelihood of ventilatory complications such as laryngospasm and bronchospasm and have various adverse effects on the respiratory system, including reduced ventilation, enhanced metabolic stress, impeded lung development, and weakened immunity to pathogenic microbes. These patients may present unique challenges for intraoperative ventilation, necessitating the utilization of significant FiO2 and PEEP to provide appropriate gas exchange. ECs have generated volatile organic contaminants (VOC), particularly toluene, in most identified samples of EC aerosols. Quickly absorbed by the lungs at high-enough concentrations, VOC exposure causes lethargy, immobilization, sedation, and even loss of consciousness. As a result of the elevated levels of nicotine in certain ECs, patients are at much greater risk of increased opioid requirements intra- and postoperatively. The research provided some insight into the acute effects of using ECs, but very scant data exist on the chronic health effects that might occur due to vaping. Further research is necessary to explore the chronic adverse effects of using ECs.

Conclusion/Recommendations for Practice: Developing and executing a targeted preoperative screening method that evaluates vaping users and their level of consumption, usage behaviors, device type, and nicotine concentrations would enhance the clinical representation of this population of patients. This information is crucial for creating preoperative care guidelines for such individuals. Anesthetists may find it advantageous to acquire baseline pulmonary function tests, utilize bronchodilators preoperatively and intraoperatively when indicated, and heighten the plane of anesthesia before airway manipulation for

long-term vapers. Additionally, chronic nicotine vaping use increases the risk of hemodynamic instability. Hence, anesthetists should implement stricter heart rate and blood pressure controls and utilize cautious dosing of ephedrine and dexmedetomidine. Because some ECs include a significant quantity of nicotine, surgical patients who vape might necessitate an enhanced postoperative narcotic regimen.

Abstract 13

Comparison of Pediatric OSA to Non-OSA and Opioid Response

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Background/Discussion/Question: Perioperative opioids in the pediatric obstructive sleep apnea (OSA) population have been proposed to be associated with increased opioid sensitivity potentially leading to increased respiratory depression presenting as increased apnea and hypopnea events postoperatively. Is there true opioid sensitivity when pediatric OSA and non-OSA populations are compared? Is there an optimal dose for pediatric OSA patients? The purpose of this evidence-based project was to assess whether children 1-18 years of age with OSA who are administered intraoperative opioids during general anesthesia have increased adverse respiratory events such as hypopnea and apnea during the first 48 hours postoperatively compared to children 1-18 without OSA..

Methods/Evidence Search: CINAHL Complete, MEDLINE Complete, and PubMed were systematically searched for keywords pediatric, obstructive sleep apnea and opioids. Using a date range of 2018 to 2023, filters were placed for English language, peer reviewed, humans, and children 0-18 years, yielding a total of 19 results with evidence reviewing two randomized controlled trials, three retrospective studies, and two prospective studies.

Synthesis of Literature/Results/Discussion: Pediatric patients with OSA demonstrated an increased sensitivity to opioids ($P < 0.05$) compared to those without OSA. Decreased intraoperative spontaneous tidal volumes and minute ventilation, increased apnea and hypopnea events postoperatively, and a longer length of stay were observed in patients with OSA. The studies revealed a relationship between pediatric OSA and postoperative adverse respiratory events. Decreased homogeneity among studies related to dosing, type of opioid given, use of adjuvants, and sample size affected external validity. The greatest risk factors for respiratory events were age under 3 years and preoperative apnea-hypopnea index (AHI) greater than 10 events per hour. All studies supported using a risk stratification guideline based on symptom severity, oxygen saturation, and AHI, yielding a potential 50% reduction in dose. One author recommended a dose calculation based on oxygen saturation and age which resulted in zero adverse respiratory events (50% of [0.0007·age(months)]+[0.0021·saturation nadir(%)]−0.1138 mg/kg). Future studies should improve sample population homogeneity, opioid dosing, type, and adjuvant pharmacological agents that might enhance pain management in the pediatric OSA population. The risk stratification guidelines validity should be explored in more detail, as well as real-time utilization of the calculated opioid-dose formula.

Conclusion/Recommendations for Practice: No optimal opioid dose could be extracted from this evidence-based project due to heterogeneity among studies for pediatric OSA. There is insufficient evidence to fully support a relationship between pediatric OSA and adverse respiratory events; however, data trends toward increased adverse respiratory events in the population with opioid administration. Intraoperative opioid dosing in pediatric OSA should be decreased by 50% as compared to non-OSA pediatric patients, and non-opioid adjuvants should be used where possible (eg, acetaminophen, ketorolac). Anesthesia providers should use the pediatric OSA risk stratification based on symptom severity from preoperative tests such as AHI and oxygen saturation nadir. Anesthesia providers must assume that if a pediatric patient with OSA is moderate-to-high risk, then opioids would enhance respiratory complications (eg, difficult airway and ventilation hypoxia, laryngospasm, bronchospasm, hypopnea, and apnea events).

Abstract 15

Difficult Airway Management Education for Senior Nurse Anesthesia Students

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Background/Discussion/Question: Airway management is a primary responsibility of Certified Registered Nurse Anesthetists (CRNAs). Patients with difficult airways (DAs) present unique, infrequent challenges that are often unanticipated. Mismanagement can lead to hypoxic brain injury, cardiopulmonary arrest, or death. This project's purpose was to prepare Registered Nurse Student Anesthetists (RNSAs) to properly manage anticipated and unanticipated DA scenarios based on updated clinical practice guidelines and other evidence-based practice. Training combined didactic and high-fidelity simulation education to ensure a realistic and standardized experience to optimize learning. The guiding PICOT question was the following: In senior nurse anesthesia students, does a simulation-based learning intervention increase student knowledge, confidence, and procedural skill in the management of difficult airway scenarios?

Methods/Evidence Search: Literature was searched in peer reviewed journals on PubMed, CINAHL, andEBSCO*host*. Keywords included: difficult airway management, cricothyroidotomy, intubating LMA, awake fiberoptic, and airway assessment. Findings were disseminated to students in a simulation-based intervention that included pre- and post-surveys. RNSAs were randomly grouped and tasked with completing four DA simulations on cricothyroidotomy, intubating laryngeal mask airway (LMA), awake fiberoptic, and case cancellation. Afterward, the RNSAs were evaluated by two graders using an objective structured clinical exam (OSCE). The RSNAs then completed individual pre-intervention surveys using Google Forms, followed by a lecture about the graders' evaluations on the DA simulations and a hands-on education session to practice advanced airway management equipment and techniques. Upon conclusion, the RNSAs repeated the four DA simulations and OSCE evaluations followed by completion of post-intervention surveys. Survey results were compared using paired t-tests. OSCE results were compared using descriptive statistics.

Synthesis of Literature/Results/Discussion: Literature informing the intervention was graded as moderate to high quality, falling between levels III-V, and quality A-B according to the Johns Hopkins Nursing Evidence-Based Practice Appraisal Tool. Recommendations made in updated clinical practice guidelines for difficult airway management from the American Society of Anesthesiologists and Difficult Airway Society guided the knowledge structure, while other evidence filled in details about how to perform specific airway maneuvers. Literature supported the use of simulation learning to teach high-risk and rare clinical scenarios, such as DA encounters, and to evaluate skill using an OSCE format. Twenty-five senior RNSAs participated in the intervention. Survey results of student knowledge in airway management showed significant improvement following the intervention ($n = 25$, $P < 0.05$). Surveys also demonstrated that RNSA confidence significantly improved ($n = 25$, $P > 0.05$). Simulation OSCE groups ($n = 6$) showed improvement in completion of scenarios, correct performance of airway maneuvers, and a reduction in scenario time. Results following the intervention corroborate other research that measured improvement in clinical airway skills demonstrated by a reduction in time to successfully and correctly complete simulations. Future research could explore translation of simulation learning into clinical practice.

Conclusion/Recommendations for Practice: Use of a simulation-based learning approach to teach senior RNSAs how to manage difficult airway scenarios and advanced airway skills is effective at improving student knowledge, confidence, and skill. Students realized statistically significant gains in knowledge

and confidence of DA scenarios. Groups saw an overall improvement by reducing time to complete scenarios, successfully completing scenarios, and performing more maneuvers correctly. These improvements have the potential to aid students in management of real-life airway crises. The project focused on four specific airway scenarios and may benefit from additional scenarios to encompass a larger spectrum of clinical possibilities. The education occurred once and students may benefit from reinforcement of learnings through additional education as future CRNAs, especially given the rarity of encountering these situations in practice. Continued simulation-based airway education could ensure reinforcement of learning.

Abstract 16

Dural Puncture Epidurals: The Current Evidence

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Background/Discussion/Question: The dural puncture epidural (DPE) technique is identical to the conventional epidural technique (CE) until after identification of the epidural space. A spinal needle is then threaded through the epidural needle until puncture of the dura mater. Free flow of cerebrospinal fluid (CSF) is noted through the spinal needle after the puncture. No medication is administered through the spinal needle. Recent literature has explored the benefits of the DPE technique, such as increased caudal spread, more symmetrical and faster pain relief, and decreased catheter failure rates. A PICO question was created to search the literature: For parturients undergoing epidural placement for labor analgesia (P), does the dural puncture epidural (I) in comparison to the conventional epidural technique (C) decrease onset time of analgesia as evidenced by decreased pain scores?

Methods/Evidence Search: The Texas Medical Center Library Health Sciences Research Center Portal was used to review the databases: PubMed, Cochrane Library, and Embase. Searches were conducted using the following keywords: dural puncture epidural AND labor analgesia. In the Cochrane Library, the search was expanded to just "dural puncture epidural" to yield more results. Searches were limited to articles published between 2012 and the present, in the English language, and only displaying randomized control trials, clinical trials, meta-analyses, reviews, and systematic reviews. Reference lists from retrieved articles were used to manually identify relevant articles; the articles were then systematically reviewed for their appropriateness to the clinical question. A total of 16 articles were identified, including 10 randomized control trials, four meta-analyses, and two retrospective studies. The studies were then evaluated and graded based on their statistical strength and usefulness in recommending practice change.

Synthesis of Literature/Results/Discussion: The DPE group had a faster onset of pain relief when compared to the CE group in laboring adult parturients ($P < .05$). The mean score of analgesia quality was also shown to be higher in the DPE group when compared to the CE group ($P < .05$). Data revealed that the DPE provided a better sacral block spread with a higher degree of symmetrical sensory blockade than the CE ($P < .05$). For patients undergoing repeat cesarean section, the DPE was also shown to provide higher quality anesthesia compared to the conventional epidural due to its rapid onset of analgesia, better cranial and sacral sensory blockade, and higher motor blockade. Evidence also showed a lower total consumption of medication and less provider top-up boluses in the DPE when compared to the CE ($P < .05$). It was demonstrated that the DPE technique is associated with lower rates of epidural catheter failures and subsequent rCEacements compared to the CE technique ($P < .05$). Complications associated with the DPE technique are rare and do not occur more frequently when compared to both the CE and CSE techniques. The incidence of post dural puncture headache (PDPH) in patients receiving a DPE are < 1%, which is not higher than either the CE or CSE techniques. The DPE does not have a higher incidence of maternal hypotension, pruritus, or meningitis when compared to the CE ($P > .05$).

Conclusion/Recommendations for Practice: Ideal candidates for the DPE include healthy (ASA I or II), adult parturients in which a faster onset of analgesia is desirable and/or who have had unclear loss of resistance and require verification of epidural space identification. The DPE offers patients a faster onset of analgesia without additional risks, complications, or adverse effects for the mother or fetus. The DPE technique is suitable for use in cesarean deliveries. The dural puncture can be performed using a 25-27G Whitacre spinal needle. Common epidural medications include 0.08% to 0.125% bupivacaine or 0.08% to

0.2% ropivacaine with opioid adjuncts administered in aliquots of 2.5-10 mL with total volumes of 10-20 mL given over two to five minutes. Maintenance dosing can be administered continuously at a rate of 6-10 mL/hr or via intermittent boluses of 10 mL every hour.

Abstract 17

Effects of Debriefing Methods on the Development of Non-technical Skills: An Evidence-based Educational Module

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Background/Discussion/Question: Simulation-based education (SBE) is integral to nurse anesthesiology training. SBE cultivates effective clinical decision-making in dynamic environments and is conducive for non-technical skills (NTS) to flourish. The consequences of undeveloped NTS in the student registered nurse anesthetist (SRNA) have the potential for egregious and adverse outcomes. However, NTS is not routinely evaluated in nurse anesthesiology training programs. Eighty percent of errors are attributed to unawareness or failure to execute NTS. This capstone project aims to demonstrate the use of quantifiable assessment tools for developing NTS in the SRNA, and seeks to address the following: In the SRNA undergoing anesthesiology academic training, how do quantifiable assessment tools during debriefing compare to verbal-only debriefing aid in empirically evaluating and developing NTS?

Methods/Evidence Search: After approval from the institutional review board, a quasi-experimental pre-test/post-test design was used to investigate the effect of an educational module on anesthesia provider awareness of quantifiable assessment tools to measure and develop non-technical skills to optimize clinical performance. A literature search was performed using the following databases: Embase, PubMed, and CINAHL. The search keywords used included: non-technical skill, situational awareness, simulation-based education, debriefing, and student registered nurse anesthetist. The search results were limited by publication date, population, language, and research design. Inclusion criteria included: English language; assessment of non-technical skills in a professional medical trainee (student nurse anesthetist or medical resident); a debriefing tool was used; the research design (qualitative or quantitative) was performed between 2015-2022. All studies reviewed contained the following outcomes: quantifiable debriefing tool that improved NTS in trainees.

Synthesis of Literature/Results/Discussion: Following a literature review, 10 articles were chosen, including five quasi-experimental studies, two longitudinal studies, two systematic reviews, and one focused qualitative group study design. Various education modalities such as simulation-based training, key action checklist, anesthetists' non-technical skills framework, and proper debriefing proved beneficial for developing non-technical skills (NTS) in student registered nurse anesthetists (SRNA). Quantifiable assessment tools can be used to ensure the satisfactory achievement of NTS. Evidence supports using the Anesthesia Non-Technical Skills (ANTS) checklist to evaluate and develop NTS in anesthesia providers during their training programs. The ANTS checklist provides structure to the debriefing process using a four-point scoring system to precisely assess the four main categories of NTS: situation awareness, decision-making, task management, and teamwork. In addition, using the ANTS checklist addresses the individual and collaborative aspects of NTS. Simulation-based training in concurrence post-scenario debriefing provides an excellent opportunity for educators to apply the ANTS checklist tool.

Conclusion/Recommendations for Practice: Sustainable development of NTS can be accomplished using quantifiable assessment tools. The ANTS checklist is a tool educators and preceptors can use to quantify evaluations of NTS in SRNAs during SBE and clinical scenarios. Evidence supports that using the ANTS checklist can improve the four pillars of NTS: situation awareness, decision-making, task management, and teamwork. The tangible benefits of SBE can be realized through the deliberate practice of debriefing after a simulation. The development of NTS in SRNAs leads to an enriched knowledge base and improved

skill sets, thus improving forthcoming clinical performance and optimizing patient care. Standardizing and validating an instrument to assess the performance and behaviors of SRNAs is paramount for measuring their education's success and ensuring optimal patient safety. The comprehensive understanding gained in this educational module will encourage awareness about the effectiveness of using evaluative debriefing tools to develop NTS successfully in SRNAs.

Abstract 18

Erector Spinae Plane Blocks for Patients Undergoing Cardiothoracic Surgery

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Background/Discussion/Question: Pain is a common complication following cardiothoracic surgery (CTS). Despite being preventable, pain is reported to be moderate to severe in about 75% of patients. Poorly managed pain has been associated with a prolonged hospital stay, substantial psychological effects, chronic pain-related morbidity, and a higher incidence of post-sternotomy pain syndrome. Neuraxial approaches, such as thoracic epidurals and paravertebral blocks, are often avoided due to risks for hemorrhage and hemodynamic compromise. The lack of sufficient pain management justifies multimodal anesthesia (MMA) in patients undergoing CTS. Reducing perioperative pain and narcotic consumption is an ongoing evidence-based project effort. While current CTS guidelines support regional blocks as an adjuvant of MMA, a standardized technique remains in question.

Methods/Evidence Search: The research compared an erector spinae plane block (ESPB) with other pain management interventions used in CTS. Search databases included PubMed, BMJ, Gale Academic, Science Direct, and Google Scholar. Search keywords consisted of continuous, single-shot, bilateral, erector spinae plane blocks, and variations of CTS. Exclusion criteria included: abstracts, case series, case reports, editorials, commentaries, and narrative reviews. Inclusion criteria comprised full-text, peer-reviewed journal articles dated within 10 years; focused adults and pediatric patients undergoing CTS who received ESPBs of varying techniques; randomized controlled trials (RCTs); prospective cohort studies; and retrospective cohort studies. The following PICOT question was developed: In adult and pediatric patients undergoing cardiothoracic surgery, does the administration of an ESPB compared to thoracic epidural and paravertebral blocks improve anesthesia provider knowledge and attitude, decrease narcotic consumption, and increase patient safety and quality of care?

Synthesis of Literature/Results/Discussion: The studies discussed varying approaches to ESPB administration in adult and pediatric patients undergoing open-heart surgery (OHS) and minimally invasive thoracic surgery (MITS). Two studies examined single-shot (SS) ESPBs for adult OHS, revealing less narcotics consumption, pain duration, and post-op sedation level. Three studies found that continuous-catheter (CC) ESPBs for adult OHS resulted in less opioid consumption, earlier chest tube removal and first-mobilization, prolonged analgesia, and fewer post-op adverse events. Nagaraja et al. noted decreased pain duration and ICU length of stay in patients who received CC-ESPBs vs. CC-thoracic epidural anesthesia and analgesia (TEA). Three studies looking at SS- and CC-ESPBs for pediatric OHS had similar outcomes to the adult studies. Five studies looked at SS- and CC-ESPBs for MITS. Toscano et al. revealed improved post-op analgesia with a CC-ESPB vs. a CC-serratus anterior plane block (SAPB). Elsabeeny et al. compared a CC-ESPB to an SAPB and TEA for MITS, demonstrating better hemodynamic stability with the ESPB vs. TEA and improved pain duration and opioid consumption with the ESPB vs. the SAPB. Future research should compare ESPBs with other novel blocks to determine a standardized regional approach for CTS patients. The evidence suggests ESPBs are a viable pain management option for CTS patients.

Conclusion/Recommendations for Practice: When implementing ESPBs for patients undergoing CTS, the research shows decreased perioperative narcotic consumption and pain. Recently published Enhanced Recovery After Cardiac Surgery (ERACS) protocols have incorporated ESPBs, emphasizing the quality of perioperative analgesia, reduced narcotic consumption, hemodynamic support, and ease of administration. This evidenced-based project supports the implementation of ESPBs for CTS patients,

evidenced by fewer opioid requirements, decreased post-op ventilator times, early postoperative mobility, shorter ICU time, decreased hospital length of stay, fewer vasopressor requirements and hemodynamic swings, and shorter administration time. The emergence of ESPBs for CTS patients offers a safe and effective way to reduce narcotic consumption and pain to improve perioperative outcomes. This evidence-based project will inform anesthesia providers about ESPBs, which have fewer risks yet similar analgesic properties to TEA and a better analgesic profile than other thoracic wall fascial plane blocks.

Abstract 19

GLP-1 Agonists for Perioperative Glycemic Control

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Background/Discussion/Question: It is becoming increasingly common to see patients prescribed GLP-1 agonists for diabetes mellitus (DM) and weight loss. The proven safety and efficacy of GLP-1 agonists for treating type II DM have fostered an interest in their use in the operating room (OR) and intensive care unit (ICU) for glycemic control. This integrative review aimed to assess the efficacy and safety of GLP-1 agonists for glucose control in the operating room compared to standard insulin therapy. Utilizing the PICOT format, the following question was asked: (P) In adult surgical patients (I) does the use of GLP-1 receptor agonists (-natide or -glutide) (C) compared to traditional insulin therapy (O) increase the risk of hypoglycemia (T) throughout the surgical process?

Methods/Evidence Search: PubMed and Embase were systematically searched for relevant literature using a date range from 2010 to 2022. PubMed was searched using a combination of search terms, including: GLP-1 agonist, intravenous, operating room, OR, perioperative, ICU, critical care, and glucose, retrieving 100 results. Embase was searched with the same terms, retrieving 160 results. Limits were applied, such as: English, humans, and adults 19+ years, narrowing the result to less than 30 for PubMed and less than 40 for Embase. Outcomes of interest included blood glucose and hypoglycemia. Best-evidence articles were identified from these citations yielding six randomized controlled trials (RCT).

Synthesis of Literature/Results/Discussion: Of the 70 articles retrieved, six single-center studies were found to best correlate with the PICOT question relating to safety and efficacy when comparing GLP-1 agonists to traditional IV insulin therapy in the perioperative period. Of the six appraised articles, five concluded that GLP-1 agonists decreased the mean blood glucose level during the intraoperative period compared to standard insulin therapy. One appraised article concluded no change in mean blood glucose levels. There was no significant difference in the incidence of hypoglycemia when comparing GLP-1 agonists to standard insulin therapy. Of note, some studies that reported hypoglycemia concurrently infused IV insulin while IV GLP-1 agonists were used for glycemic control. GLP-1 agonists are a novel approach to perioperative glycemic control and offer a safe and effective alternative to standard IV insulin therapy. Although the risk of hypoglycemia appears to be similar between GLP-1 agonists and insulin infusions, the risk is inherently low. Further studies with larger sample sizes are needed to determine the most effective GLP-1 agonists and the safest and most effective dosing regimen for perioperative glycemic control.

Conclusion/Recommendations for Practice: Current research shows that incretin-based therapy, such as GLP-1 agonists, helped lower blood glucose without increasing the incidence of hypoglycemia. Of the six RCTs reviewed, five articles showed statistical significance in improved glucose control with GLP-1 agonists compared to traditional insulin therapy. Furthermore, when insulin administration was required, there was a reduced need for insulin administration. Although current research shows the potential for using GLP-1 infusions intraoperatively for glucose control, further studies are needed to determine the safest and most effective GLP-1 agonist, dosing regimens for that medication, and possible patient-specific contraindications. It is recommended that further studies be done with larger sample sizes to assess the efficacy and safety of GLP-1 agonists compared to traditional insulin therapy.

Abstract 20

GLP-1 Receptor Agonists and Preoperative Gastric POCUS

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Background/Discussion/Question: Gastric emptying is affected by many coexisting conditions and medications, and knowledge of the effects of gastrointestinal hormones on motility is rapidly evolving. Glucagon-like peptide-one receptor agonists (GLP-1RAs) are a model example of drugs that can slow gastric emptying. This mechanism may increase gastric residual volume despite adequate fasting. Due to recently expanded prescribing criteria, anesthesia providers will likely encounter more preoperative patients with delayed gastric emptying secondary to GLP-1RA therapy. Gastric Point-of-Care Ultrasound (POCUS) is an emerging tool in preanesthetic assessment. This evidence-based practice synthesis investigates the following question: In adult patients taking GLP-1 agonists, does gastric POCUS, compared to standard fasting only, identify more patients at increased risk for aspiration during the preoperative period?

Methods/Evidence Search: References for this review were obtained through searches of CINAHL, Embase, Health Source, MEDLINE, and PubMed. The search included references published through 2022. Guidelines issued by the American Society of Anesthesiologists, the European Society of Anesthesiology, and the American Association of Nurse Anesthesiology were included. Redacted articles, references without full-text English-language editions, and conference abstracts were excluded. Medical Subject Headings (MeSH) included: pneumonia, aspiration; anesthesia, general; ultrasound imaging; gastric emptying; and glucagon-like peptide-1 receptor. Free-text terms included: aspiration risk, pulmonary aspiration, delayed gastric emptying, gastric ultrasound, and GLP-1 agonists. Fifty-five articles met the inclusion criteria. An evidence hierarchy scale was utilized to rank the risk of bias, designated by Roman numerals I through V. The certainty of net benefit or harm and usefulness in clinical practice were described with letter grades (A, B, C, D, or I).

Synthesis of Literature/Results/Discussion: Aspiration prevention remains a pillar of airway management due to the significant morbidity and mortality of aspiration events. A recent analysis of anesthesia malpractice claims identified 115 cases of pulmonary aspiration of gastric contents. Death was directly related to the aspiration event in 57% of cases; severe permanent injury was noted in 14% of cases. Preoperative fasting is a mainstay in aspiration prevention. Published guidelines identify only the minimum time required for fasting and can fail to protect patients with slow gastric motility. GLP-1RAs exhibit an effect on serum glucose through a delay of gastric emptying. Critics have indicated that inadequate methodology has resulted in equivocal conclusions regarding the magnitude and duration of action of GLP-1RAs. This ambiguity leaves clinicians without definitive data for an evidence-supported airway management plan. Qualitative and quantitative POCUS methods provide data about gastric vacuity. Qualitative gastric POCUS was validated by randomized and single-blinded studies to rule out a full stomach, demonstrating a sensitivity of 1.0 and specificity of 0.975 [CI 95%]. A systematic review found a linear correlation (0.61-0.91) between antral cross-sectional area and gastric volume. A mathematical model based on this correlation was validated to predict a gastric volume up to 500 mL ($r = 0.86$).

Conclusion/Recommendations for Practice: Substantial evidence supports the use of gastric POCUS to evaluate residual gastric volume in patients at risk for delayed gastric emptying. Evidence to quantify gastric emptying rates of adult patients receiving GLP-1RA therapy is inconsistent and insufficient to recommend a standardized pre-operative NPO interval specific to this patient population. In addition to

currently practiced standard fasting recommendations, sufficient evidence supports a proposal to perform gastric POCUS in adult preoperative patients taking GLP-1RAs to evaluate residual volume that may increase the risk of aspiration. The benefits of offering gastric POCUS to adult patients receiving GLP-1RA therapy for any indication are anticipated to outweigh any potential harm. Based on the reviewed evidence, it is recommended to add gastric POCUS to the preoperative examination of adult patients receiving GLP-1RA therapy for optimized aspiration-risk stratification and subsequent airway management.

Abstract 21

Going Backward to Move Forward: Retrograde Autologous Priming and Blood Conservation in Cardiac Surgery

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Background/Discussion/Question: Cardiac cases using cardiopulmonary bypass (CPB) comprise 4% of national surgical volume but represent the majority of blood usage in surgical cases and 20% of the country's total annual blood usage. The need for blood conservation methods such as retrograde autologous priming (RAP) is even greater with COVID-19 decreasing the national blood supply. RAP is a blood conservation technique that displaces crystalloid priming volume by passively exsanguinating the patient's native blood into the venous and arterial CPB cannulas. This review evaluated whether RAP reduces hemodilution and perioperative transfusions in cardiac surgery compared to standard blood conservation methods. It also aimed to provide clinicians with a comprehensive understanding of its other potential benefits.

Methods/Evidence Search: A systematic electronic search for English-language articles was performed on PubMed, OVID Medline, Scopus, and Science Direct databases using the following search terms: retrograde autologous priming, retrograde autologous priming and cardiac surgery, and retrograde autologous priming and cardiac surgery and hemodilution. The search yielded 262 articles, from which 59 duplicates were removed, leaving 203 articles for screening. Further exclusion criteria were applied, such as articles without quantitative data analysis, irrelevant articles, and articles published before 2018. A total of eight studies met the inclusion criteria after removing articles that focused on other perfusion techniques or anticoagulation and that did not have transfusion as one of their primary outcomes.

Synthesis of Literature/Results/Discussion: All eight studies showed a statistically significant reduction in hemodilution and, consequently, significantly higher hematocrit levels among the RAP groups compared to non-RAP groups. Importantly, all of the studies also showed a statistically significant reduction in perioperative transfusion rates among RAP groups compared to non-RAP groups. Two of the studies, one in 2021 and another in 2020, included meta-analyses of 12 randomized controlled trials and 10 randomized control trials respectively. Both found significantly reduced odds ratios for perioperative transfusion of 0.58 and 0.19 respectively. Furthermore, a study done on pediatric patients found that RAP led to better pulmonary mechanics, shorter mechanical ventilation time, improved lung compliance, and lower ventilation settings. Another study analyzed the cost-effectiveness of implementing RAP. It showed that implementing RAP is more cost-effective compared to transfusing two units of red blood cells. Further research is necessary to determine if RAP is superior to other blood conservation techniques utilized in cardiac surgery, such as acute normovolemic hemodilution and the use of cell savers. Additionally, more research, likely in the form of prospective trials, is required to identify the ideal priming volume needed to confer maximal benefit with RAP.

Conclusion/Recommendations for Practice: Each year, more than 300,000 cardiac bypass surgeries are carried out in the United States, with at least one-third of patients requiring transfusions during the procedure. The national blood supply has been reduced by COVID-19, emphasizing the importance of employing blood conservation techniques such as RAP. Currently, RAP is a grade I recommendation, meaning that there is substantial evidence to support its use in patients. Incorporation of RAP can significantly reduce perioperative allogenic transfusion rates and has many other potential benefits. CRNAs should collaborate with perfusionists and cardiac surgeons to determine which patients are ideal candidates for RAP.

Abstract 22

How Does the Addition of Dexmedetomidine to the Intrathecal Space as an Adjunct to Local Anesthetic Impact the Duration of Sensory Blockade

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Background/Discussion/Question: Spinal anesthesia is a common technique for patients undergoing cesarean section; however, one disadvantage is there is a limited duration of block achieved with a single-shot spinal anesthetic. The purpose of this integrative review was to evaluate the potential use of dexmedetomidine in the intrathecal space and its effect on the duration of sensory blockade. The following question was asked: In parturients aged 18-40 undergoing elective cesarean section, what is the effect of dexmedetomidine as an adjunct to local anesthetic in the intrathecal space compared to local anesthetic alone on the duration of sensory block assessed by the pinprick method immediately following intrathecal injection up to six hours post injection?

Methods/Evidence Search: CINAHL and PubMed were searched with the following keywords: dexmedetomidine, spinal anesthesia, and cesarean section. This search yielded 14 articles in CINAHL and 55 articles in PubMed. Five best-evidence articles were chosen from the search results: four were randomized controlled trials (RCTs) and one was a systematic review with meta-analysis. All articles in this review utilized 5-10 mcgs of dexmedetomidine as an adjunct to local anesthetic, with the control being local anesthetic alone. The pinprick method was utilized by the RCTs to identify the duration of sensory blockade.

Synthesis of Literature/Results/Discussion: Populations for each study were similar, with parturients varying in age between 20 and 35 years old and having uncomplicated pregnancies. All studies demonstrated that the use of dexmedetomidine in the intrathecal space significantly prolonged the duration of sensory blockade. The administration of dexmedetomidine in the intrathecal space is considered an off-label use by the federal Food and Drug Administration, which constitutes concern regarding the safety profile of the use of this medication in this manner. However, multiple studies examined the patients for maternal and neonatal adverse events and reported no adverse events with either group. Additional characteristics of the use of dexmedetomidine in the intrathecal space should be studied, such as its effect on motor blockade, shivering, and duration of analgesia. Another secondary finding included that dexmedetomidine could reduce the ED95 of bupivacaine from 12.1 mg to 8.4 mg. Further research should focus on this topic for the benefit of decreased adverse effects associated with a decrease in dosage of local anesthetic.

Conclusion/Recommendations for Practice: One limitation of spinal anesthesia is a finite duration of sensory blockade. The usage of dexmedetomidine as an intrathecal adjunct to prolong sensory blockade is supported by the evidence. In parturients aged 18 to 40, the use of intrathecal dexmedetomidine as an adjunct to prolong sensory blockade assessed by the pinprick method is supported by five studies included in this integrative review. A dosage of 5-10 mcgs of dexmedetomidine is a consistently studied intrathecal dose for patients with uncomplicated pregnancies. The use of intrathecal dexmedetomidine is a potentially advantageous adjunct in spinal anesthesia for patients undergoing cesarean section since it can be used to prolong sensory blockade.

Abstract 23

Intravenous Amisulpride for the Prevention and Treatment of Postoperative Nausea and Vomiting

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Background/Discussion/Question: Postoperative nausea and vomiting (PONV) is one of the most common patient complaints after surgery. Some patients fear PONV more than postoperative pain. The incidence of PONV is roughly 30% after general anesthesia, but rates can be as high as 80% in high-risk groups. In February 2020, amisulpride was the first FDA-approved medication to prevent and treat PONV. Given its recent approval, many anesthesia providers are unaware that amisulpride is an option for PONV. The purpose of project was to to educate anesthesia providers on intravenous amisulpride and provide evidence-based recommendations for its use, and to answer the question: How does intravenous amisulpride compare to other anti-emetics in preventing and treating PONV within 24 hours?

Methods/Evidence Search: Literature was accessed from the databases PubMed, Ovid MEDLINE, Embase, and The Cochrane Library. The search was comprised of the following MeSH terms: amisulpride, ADP421, and ponv. The Boolean operators "AND" in addition to "OR" were employed to create the search "amisulpride OR ADP421" AND "ponv." No date limits or search modifiers were added to capture as many sources of evidence as possible. The number of results initially obtained from each database were 12, 12, 37, and 11, respectively. The snowball technique was then employed on the references of the 72 total results to identify additional articles of interest. Articles were excluded if they were duplicates from the other databases, offered no new statistical analysis or new research, or were only summaries of previously completed randomized controlled trials (RCTs). After the exclusion criteria, 18 articles remained as sources of evidence. The articles were then graded according to the U.S. Preventive Services Task Force's system for strength and quality of evidence.

Synthesis of Literature/Results/Discussion: Intravenous amisulpride has been studied in randomized controlled trials as a preventative and curative measure for PONV. For the treatment of established PONV, a 10 mg dose of amisulpride is superior to a placebo for patients regardless of their PONV risk. For prevention, 5 mg of intravenous amisulpride is superior to a placebo in low-risk patients. In high-risk patients, administering 5 mg with another antiemetic is superior for prevention to administering a placebo with another antiemetic. Comparing the efficacy of amisulpride to other antiemetics is difficult due to a lack of studies. To date, no study has been done that directly compares amisulpride to another antiemetic; amisulpride has only been compared to placebos. Future research should include direct comparisons. However, systematic reviews quantifying the risk ratio of experiencing PONV after administering various antiemetics demonstrates that amisulpride has yet to be proven superior to other antiemetics as a single agent for the prevention of PONV. For treatment of established PONV, the rates of breakthrough nausea or vomiting after administration appear similar between amisulpride and other agents like ondansetron, but the studies are heterogenous. Despite the relatively few studies on amisulpride, it is now included in the Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting.

Conclusion/Recommendations for Practice: Amisulpride is the only FDA-approved drug for the treatment of established PONV. It's approval has brought dopamine antagonists back into the arsenal of anesthesia providers. The use of other dopamine antagonists, like droperidol, declined after the FDA black box warning was issued for QTc prolongation and sudden cardiac death. Amisulpride allows anesthesia providers to more easily follow the Consensus Guidelines for the Management of PONV. The

guidelines recommend to treat established PONV with medications from different classes that have already been given for prophylaxis. Amisulpride is a safe option from a different class than commonly administered antiemetics.

Abstract 24

Intravenous Ketamine for the Reduction of Suicidal Ideation 24 Hours Post-infusion

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Background/Discussion/Question: Suicide is the second leading cause of death in the population category aged 10 to 34. Despite the current treatment options, suicide has increased. Ketamine, a glutamate N-methyl-d-aspartate (NMDA) receptor antagonist, has become a new treatment option available for suicidal ideation reduction. Ketamine has been found to act on α-amino-3-hydroxy-5-methyl-4-isoxazole propionic acid (AMPA) receptors and acutely increase brain-derived neurotrophic factor (BDNF), creating rapid anti-depressant effects. This project aimed to identify the effectiveness of a single ketamine infusion on suicidal ideation. The following question was asked: In the adult patient population with suicidal ideation, what is the effect of intravenous ketamine when compared to intravenous midazolam on the Montgomery-Åsberg Depression Rating Scale-Suicide Item (MADRS-SI); or, what is the composite suicidal ideation score at 24 hours post-infusion?

Methods/Evidence Search: A detailed search of the literature was conducted to find best-evidence articles. PubMed and Embase were systematically searched, without limits placed on the date range. The combination of search terms ketamine, midazolam, suicidal ideation, and Montgomery-Åsberg Depression Rating Scale retrieved eight initial citations from PubMed and 34 citations from Embase. Additional limits of English-only and adults-only were placed, resulting in eight citations from PubMed and 15 citations from Embase. Best-evidence articles were sought first by identifying randomized controlled trials (RCTs) and systematic reviews (SRs) with or without meta-analyses (MAs). However, all study designs were also considered later. Additional inclusion criteria included a post-infusion time frame of 24 hours. Three RCTs were retrieved.

Synthesis of Literature/Results/Discussion: All three articles conducted a double-blind method and utilized intravenous racemic ketamine hydrochloride at a concentration of 0.5 mg/kg over 40 minutes. After a review of literature was conducted on all three RCTs, the intravenous ketamine group revealed a significantly lower MADRS-SI or composite suicidal ideation score at 24 hours post-infusion, compared to the intravenous midazolam group. One of the studies found that 53% of the ketamine group participants scored 0 on a composite suicidal ideation score (based on the MADRS-SI, Beck Scale for Suicide Ideation, and Quick Inventory of Depressive Symptomatology-suicidality item) compared to 24% of the midazolam group ($P = 0.03$). However, one of the RCTs found that the MADRS-SI score was not significant in the ketamine group at 48 hours post-infusion. While ketamine was revealed to be consistently effective at 24 hours post-infusion, the effects are short-lived after a single infusion. It is unclear what the ideal frequency of ketamine infusions should be to maintain a reduction in suicidal ideation while also avoiding untoward side effects. Future research should be conducted to determine if multiple infusions of intravenous ketamine are needed to create a sustained effect that is more consistent across studies.

Conclusion/Recommendations for Practice: The issue of suicide holds significant relevance in the anesthesia world because it has created new opportunities for Certified Registered Nurse Anesthetists (CRNAs) to provide interventional therapy in specialty ketamine clinics and in conjunction with pain clinics. All three studies showed that in the adult patient population with suicidal ideation, intravenous racemic ketamine hydrochloride at a concentration of 0.5 mg/kg over 40 minutes significantly lowered suicidal ideation scores to a greater extent compared to intravenous midazolam at 24 hours post-infusion. The evidence demonstrates that intravenous ketamine can be implemented into clinical practice for the use of the reduction of suicidal ideation within 24 hours post-infusion. Although

intravenous ketamine is recommended for future practice for suicidal ideation reduction, research should also be continued to determine how the effects of ketamine can be sustained beyond 24 hours post-infusion.

Abstract 25

Intravenous Lidocaine to Reduce Postoperative Pain for Video-assisted Thoracoscopic Surgery

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Background/Discussion/Question: Thoracic procedures have progressed to include minimally invasive video-assisted thoracoscopic surgery (VATS). Anesthetic management of VATS patients plays a key role in postoperative pain control, whereas failure to adequately manage pain can contribute to patient morbidity. Intravenous (IV) lidocaine is a popular adjunct medication used to reduce postoperative pain and opioid use for certain procedures. The development of pain management protocols requires anesthesia providers to be able to discern if a given medication is appropriate for their patients. The purpose of this review was to answer the following research question: In adult patients aged 18 and older undergoing VATS, does the use of intraoperative IV lidocaine infusion versus placebo reduce postoperative pain as evidenced by decreased postoperative pain scores or decreased postoperative opioid consumption?

Methods/Evidence Search: PubMed, Embase, Web of Science, and Scopus were systematically searched on January 20, 2021, for relevant literature. PubMed was searched using a combination of search terms, including "intravenous lidocaine OR lidocaine OR perioperative lidocaine" AND "VATS OR video-assisted thoracoscopic surgery OR lobectom OR pneumonectom" AND "pain OR postoperative pain OR analgesia OR postsurgical pain," resulting in 31 citations retrieved. Results were then limited to adults aged 18 and older, narrowing the results to 20 citations. Embase, Web of Science, and Scopus were queried using the same search terms with 104, 20, and 152 citations retrieved, respectively. Selected studies were limited to those that included intravenous lidocaine use for VATS with postoperative pain or opioid consumption as measured outcomes. Best-evidence articles were identified from these citations yielding five randomized controlled trials (RCTs).

Synthesis of Literature/Results/Discussion: The results of the five studies included in this review were conflicting, with two reporting a decrease in postoperative pain and three reporting no decrease in postoperative pain when intraoperative IV lidocaine was compared to placebo for VATS. Gaps in the literature included discordance in lidocaine dosages and postoperative pain assessment tools among studies. Additionally, all studies were conducted at single-center institutions. Three of the studies in this review measured postoperative pain as a primary outcome while the other two measured pain as a secondary outcome. All studies reported homogenous participant demographics between control and treatment groups. All studies except for one reported blinding of participants, providers, and outcome accessors to group allocation of participants. Based on the studies included in this review, intraoperative IV lidocaine was not found to consistently reduce postoperative pain for VATS when compared to placebo. The current systematic review on the efficacy of lidocaine for treating postoperative pain only included one study that evaluated lidocaine for VATS. Future research would benefit from a large multi-center study that worked to control for confounding variables such as other adjunct medications used throughout the perioperative period.

Conclusion/Recommendations for Practice: Based on the studies included in this review, lidocaine was not found to effectively reduce postoperative pain for VATS. Postoperative pain management should be patient-specific with efforts made to reduce opioid use. Until more research is available on this topic, other adjunct medications in addition to regional anesthesia should be utilized in collaboration with the surgeon. Lidocaine's mechanisms of action are complex and may have benefits unrelated to pain, and therefore its use in this procedure cannot be entirely discounted. If intraoperative IV lidocaine infusion is

used for VATS, anesthesia providers should be sure to communicate with the surgeon as it is currently not advisable to use IV lidocaine within four hours of regional anesthesia or if a significant amount of local anesthetic is used for infiltration during surgery.

Abstract 26

Ketamine's Utility in Preventing Postoperative Depressive Symptoms

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Background/Discussion/Question: Postoperative depressive symptoms impact 10% to 30% of surgical patients. Obstetric patients and patients undergoing cardiovascular surgeries have been identified as high-risk populations. Postoperative depressive symptoms can result in a number of complications, including increased incidences of surgical site infections and postoperative delirium. Ketamine has been found to exhibit rapid-acting and sustained (up to one week) antidepressant properties. Research has recently shifted to its use intraoperatively to prevent complications associated with postoperative depressive symptoms. The research question is as follows: In adult patients undergoing a general or neuraxial anesthetic, does the intraoperative use of a sub-anesthetic dose of IV ketamine compared to a placebo or no ketamine improve depressive symptoms within the first seven days postoperatively?

Methods/Evidence Search: A literature search was conducted using multiple databases including Embase, PubMed, and Web of Science and using the following terms and Boolean operators: "ketamine AND (surg OR surgic) AND depress." The Medline OVID database was also utilized, using the following MeSH terms: ketamine; surgical procedures, operative; depression; and depressive disorder. Common filters applied within the databases included works published within the last 10 years, written in English, on adult human subjects. In total, 20 articles were found to be applicable to the research question. Two meta-analyses, one systematic review, and three literature reviews were excluded from the final analysis as no additional studies were found from these publications. Statistical significance of findings regarding ketamine's prevention of postoperative depressive symptoms was defined as a P value of < 0.05. Common tests utilized to determine significance included the Chi-square test and the two-sample independent t-test. Variance analysis was also utilized.

Synthesis of Literature/Results/Discussion: All 14 studies examined were randomized controlled trials (RCTs). The majority of studies ($n = 9$) were conducted in China. Major surgical procedures examined included elective cesarean sections (which were all under neuraxial anesthesia), mastectomies, craniotomies, hysterectomies, dilation and curettage, video-assisted thoracic surgery, lower extremity fracture repairs, and reduction of upper- and lower-extremity fractures. The method of ketamine administration varied between the studies; the majority of studies administered ketamine after induction of general anesthesia (or after clamping of the umbilical cord for cesarean sections), with the most common dosage administered being a 0.5 mg/kg intravenous bolus of racemic ketamine. This dosage was found to be effective at significantly ($P < 0.05$) reducing postoperative depressive symptoms for up to seven days. Additional benefits included significantly ($P < 0.05$) reduced postoperative pain scores and increased levels of neurotransmitters associated with depression when deficient. S-ketamine was used in four studies; it was found to be more effective than racemic ketamine in reducing depressive symptoms and had a more favorable side effect profile. Overall side effects of ketamine therapy versus placebo were not found to be significant in most studies, likely due to the use of premedication with a benzodiazepine as well as lower doses of ketamine.

Conclusion/Recommendations for Practice: A 0.5 mg/kg IV bolus of racemic ketamine should be administered to adult patients undergoing major surgery who are identified as being at risk given analysis of overall risk factors as well as analysis of a preoperative screening tool such as the Patient Health Questionnaire 9. Timing of administration is procedure- and patient-dependent; research did not show a difference in administering this dose of ketamine with or after induction of general anesthesia. In

obstetric patients, ketamine should not be administered until the umbilical cord is clamped in order to reduce fetal effects. Recommendations for future research regarding ketamine's utility in reducing postoperative depressive symptoms include comparing the different formulations of ketamine with one another to see if one is reliably and consistently superior; considering different routes for administration of ketamine; examining ketamine use in pediatric patients; and performing a cost-effectiveness analysis on complications associated with postoperative depressive symptoms.

Abstract 27

Nociception Monitoring and Intraoperative Opioid Usage

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Background/Discussion/Question: The complexity of the nociceptive system can result in unsatisfactory treatment of pain due to ongoing inflammation and sensitization. Opioids are used to treat pain and have many negative side effects. Despite this, opioids are an important component of anesthesia and analgesia. Appropriate use of opioids improves patient outcomes. Nociceptive monitoring devices provide an objective method of monitoring a patient's nociception and a way for practitioners to tailor the anesthetic to the patient's requirements. The specific question this research explored was as follows: In adult patients undergoing general anesthesia for surgical procedures, does the use of intraoperative nociceptive monitoring devices compared to the standard of care for administering opioids intraoperatively contribute to a difference in intraoperative opioid consumption?

Methods/Evidence Search: Several databases including PubMed, the Cochrane Library, and CINAHL were systematically searched for relevant literature. Combinations of the search terms opioid, nociception, monitoring device, nociceptive, and intraoperative were utilized which yielded 21 to 41 results. A date-range filter was applied to search for literature from the last 10 years. From these results, six randomized controlled trials (RCTs) were selected for critical appraisal of the evidence based on their study of nociceptive devices and the effect of these devices on opioid usage.

Synthesis of Literature/Results/Discussion: Six RCTs were evaluated for comparisons between opioid usage in a standard of care group versus a treatment group utilizing a nociceptive monitoring device. Four of the studies found no difference in intraoperative or postoperative opioid use between the control and treatment groups because the sample sizes were small and limited to a specific patient population which makes it difficult to generalize results. One study found a statistically significant difference in intraoperative opioid use in the treatment group ($P = 0.016$) while another found remifentanil consumption was statistically different between the control and the various treatment groups ($P < 0.001$). Several of the studies had potential bias because of funding and conflicts of interest that were disclosed. Further prospective research should be conducted in larger, more diverse patient populations. No serious postoperative complications or adverse events were reported and no significant differences in positive outcomes were found to be related to the use of the nociceptive monitors. Further study of this topic is required with larger, more diverse patient populations. Nociceptive monitoring may be another tool to validate suspicions of intraoperative nociception but should not be relied upon as a sole indicator without further confirmation of its reliability through further studies.

Conclusion/Recommendations for Practice: Most studies found intraoperative nociceptive monitoring devices did not create a difference in the use of intraoperative opioids versus the standard of care. No serious postoperative complications or adverse events were reported. There were no significant differences in positive outcomes; however, the studies were limited to mostly healthy patients. The studies included in this review were homogenous with strong internal validity; however, it is challenging to compare them to one another as each studied a very specific patient population. Further study is required before recommendations for practice can be made; however, it seems hemodynamic changes and practitioner-guided opioid administration is as effective as nociceptive monitoring in treating intraoperative nociception and limiting negative postoperative outcomes. Nociceptive monitoring may be another tool to validate suspicions of intraoperative nociception but should not be relied upon as a sole indicator without further confirmation of its reliability through further study.

Abstract 28

Opioid-sparing Ultrasound-guided Quadratus Lumborum Block For Postoperative Cesarean-section

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Background/Discussion/Question: The pain after cesarean section has been treated primarily with opioids and presents considerable adverse effects that impact both the parturient and newborn. An integrative review was conducted to compare the postoperative analgesic requirements of quadratus lumborum blockade to control blocks in adult patients undergoing elective cesarean section.

Methods/Evidence Search: The literature outlined in this review was extracted from a comprehensive electronic search of PubMed, Embase, and Cochrane databases systematically utilized for relevant literature by the date range of 2016 to 2023. A combination of terms were searched, including: cesarean delivery, morphine, quadratus lumborum block, analgesia, and postoperative pain Eighty citations were retrieved. Limits such as English-only and adult females 18yrs+ were applied, narrowing the results to 47 citations. Best-evidence articles were identified from these citations by searching for randomized controlled trials and systematic reviews with or without meta-analyses. Other research study designs were considered randomized or systematic; controlled trials were also available. Seven relevant articles were retained for integrative review. Four randomized controlled clinical trials, two meta-analysis reviews, and one prospective, double-blinded, placebo-controlled trial were retrieved for final analysis.

Synthesis of Literature/Results/Discussion: Seven evidence-based practice articles were included in the final analysis: Irwin et al. (2020), Blanco et al. (2015), Marcin et al. (2018), Christian et al. (2019), Mohamed et al. (2022), Xu et al. (2020), and Zhao et al. (2021). The synthesis of the selected articles demonstrated that ultrasound-guided quadratus lumborum block (QLB) reduces the incidence of opioid consumption in adult female patients 18yrs+ undergoing elective cesarean section (ESC) under spinal anesthesia. QLB was associated with a lower incidence of pruritis, nausea, vomiting, and poor patient satisfaction. Six out of the seven clinical studies revealed that QLB decreases morphine consumption for postoperative analgesia, and all seven of the studies clinically revealed that QLB reduced postoperative pain scores. Additionally, Mohamed et al. and Xu et al. revealed increased maternal satisfaction from the use of QLB. The studies recommend several critical gaps be addressed to strengthen future research designs, including: larger sample sizes with all QLB approaches to identify optimal QLB methodology; directly comparing QLB with other regional anesthetic techniques for ESC; and further investigation into the dispersion of local anesthesia throughout the paravertebral space. Lastly, the optimal concentration, dose, approach, and catheter-insertion technique of QLB must also be further explored.

Conclusion/Recommendations for Practice: This opioid-sparing multimodal approach to ESC postoperative pain management requires further study. Additional research should address all identified limitations to establish a more substantial evidence base for implementing ultrasound-guided QLB in clinical practice for adult female patients 18yrs+ undergoing ECS under spinal anesthesia and to better understand how QLB affects analgesic requirements and decreases morphine opioid consumption in the postoperative period. Implementing ultrasound-guided QLB for postoperative ECS as a standardized practice will lead to a lower incidence of pruritis, nausea, vomiting, and poor patient satisfaction. In return, it encourages early ambulation which reduces the risk of thrombotic events, increases patient satisfaction, and decreases the risk of chronic pain development, ultimately leading to reduced complications, cost, and length of hospital stays in the postoperative phase for mothers undergoing ECS.

Abstract 29

Optimal Dosing of Dexmedetomidine Additive in Peripheral Nerve Blocks for Total Knee Arthroplasty

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Background/Discussion/Question: There is no consensus concerning safe yet efficacious dexmedetomidine (DEX) dosing added to local anesthetics (LA) in motor-sparing peripheral nerve blocks (PNB) for total knee arthroplasty (TKA). DEX is added to LAs for perineural administration in a wide range of doses. Anesthesia providers may underdose DEX in PNBs fearing adverse effects including hypotension, bradycardia, prolonged sedation, and extended motor block. The purpose of this work is to describe the evidence on the safety and efficacy of adding 0.5-1.0 mcg/kg max of 75mcg DEX to LAs in PNBs to reduce postoperative pain. This work also describes the implementation and results of an anesthesia practice change based on the evidence. The effectiveness of implementation was answered by asking the following questions: Was a practice change made and were outcomes improved?

Methods/Evidence Search: The Cumulative Index of Nursing and Allied Health Literature (CINHAL), Cochrane Library, PubMed, and Ovid databases were searched using keywords from the following PICOT question: Do patients undergoing total knee arthroplasty (P) who receive peripheral nerve blocks with local anesthetic and dexmedetomidine (I) compared to similar patients receiving peripheral nerve blocks without dexmedetomidine (C) have less pain (O) 24 hours postoperatively (T)? Several synonyms were used to expand the search results. For total knee arthroplasty, TKA and total knee replacement were used. Synonyms to expand the literature search for peripheral nerve blocks (PNB) were adductor canal block (ACB), femoral nerve block (FNB), and saphenous nerve block. For dexmedetomidine, the brand name Precedex was used. Synonyms to expand the literature search for post-operative pain were postoperative pain, post-surgery pain, and post-surgical pain.

Synthesis of Literature/Results/Discussion: Five randomized controlled trials (RCTs) were critically appraised evaluating DEX addition to LAs in PNBs for patients undergoing TKA. DEX dosing included 0.25 mcg/kg (Goyal et al., 2017), 0.5 mcg/kg (Goyal et al., 2017 and Thapa et al., 2019), 1 mcg/kg (Fultambkar et al., 2022), and 25-75mcg (Abdulatif et al., 2016). These doses were effective at reducing postoperative pain and rescue opioids compared to PNBs with LAs alone. DEX 0.5 mcg/kg improved analgesia compared to 0.25 mcg/kg (Goyal et al., 2017). The evidence supported DEX safety, efficacy, and dose range of 0.5 mcg/kg to 1 mcg/kg with a maxium dose of 75mcg to LAs in PNBs. Goyal et al. (2017), Thapa et al. (2017), and Fultambkar et al. (2022) evaluated DEX with LAs in adductor canal blocks. Li et al. (2017) studied efficacy in femoral nerve blocks (FNBs). Abdulatif et al. (2016) evaluated dosing 25-75 mcg in FNBs for TKA. Before a quality-improvement presentation at a southern Midwestern facility in the U.S., 14% of providers used the recommended dosing suggested by the evidence. Within three months after the presentation of evidence, 71% of providers adopted this practice. A facility internal review showed an average discharge pain score for patients who received recommended dosing at 1.09 (n = 43) compared to 1.62 (n = 38) for patients who didn't receive recommended dosing.

Conclusion/Recommendations for Practice: Based on these findings, it is recommended that DEX be administered at 0.5-1.0 mcg/kg with a maximum of 75 mcg added to LAs in PNBs for patients undergoing TKA to reduce postoperative pain. Evidence shows that this practice also reduces rescue analgesic administration. Through three months of this evidence-based practice project implementation, providers demonstrated an increased willingness to adopt the practice of adding DEX to LAs in PNBs. Further, the

Anesthesia Department had overall reduced pain scores for patients who received the recommended dosing of DEX with LAs in PNBs for TKA.

Abstract 30

Prophylactic Tranexamic Acid in the Prevention of Postpartum Hemorrhage

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Background/Discussion/Question: Postpartum hemorrhage (PPH) is an obstetric emergency. It remains the leading cause of maternal mortality both in the U.S. and worldwide, making it both a national and international public health issue. The 2022 updated AANA Analgesia and Anesthesia in Obstetric Patients practice guidelines recognize tranexamic acid (TXA) as an effective adjunctive treatment in PPH. It has been postulated that TXA may exert its action by preventing coagulopathy rather than treating it. To date, there are no practice guidelines or standards of care for the use of prophylactic TXA in preventing PPH. This study sought to address the following question: Does prophylactic administration of tranexamic acid when compared to standard treatment for hemorrhage in parturients undergoing cesarean section decrease the incidence of maternal blood loss?

Methods/Evidence Search: A literature search was conducted utilizing the following databases: CINAHL, PubMed, and Ovid MEDLINE. Keywords searched included: tranexamic acid, postpartum hemorrhage, and cesarean section connected by the Boolean operator "AND." A search limitation of five-year publication dates was utilized. After de-duplication, a total of 39 articles were identified and screened for inclusion criteria. Inclusion criteria included: (1) any research article evaluating prophylactic IV TXA during cesarean section, (2) studies comparing TXA with placebo, and (3) research articles available in full text and English language. Thirty-one articles were excluded for the following reasons: not retrievable (*n* = 2), grey literature (*n* = 1), coadministered interventions (*n* = 3), not research (*n* = 10), missing/not outcome of interest (*n*=15). Eight relevant articles remained.

Synthesis of Literature/Results/Discussion: All eight articles showed that coadministration of TXA resulted in a statistically significant reduction in blood loss and/or reduced change in hemoglobin and hematocrit (Hgb/Hct). Mean blood loss difference ranged from ~130 to 360ml. Five articles reported a decrease in transfusion requirements. Three articles reported a decrease in utilization of additional uterotonics. One article reported a decrease in hospitalization time. The Neutral: One article examined maternal coagulation activity and showed no differences except a decrease in D-Dimer on postoperative day one. Five articles showed no difference in adverse thromboembolic events. The Negative: One article reported an increase in minor adverse events (n/v, h/a, dizziness), and one article examined neonatal outcomes and reported a higher mean neonatal pH. Given that seven studies were conducted on low-risk parturients, the generalizability and standardization of prophylactic TXA administration was limited. While one article suggested auspicious results of prophylactic TXA in high-risk parturients, larger-sized trials are needed to validate these results given the small sample size of this study. Future research is needed to create PPH risk stratification predictor tools with high sensitivity and specificity which can prove invaluable in prophylactic TXA patient selection.

Conclusion/Recommendations for Practice: This literature review demonstrates in parturients undergoing cesarean section that prophylactic TXA administration in addition to routine uterotonics results in a statistically significant decrease in postpartum hemorrhage; however, the absolute quantity of blood loss reduction was small. There is insufficient evidence to recommend prophylactic TXA as a part of standardized care. One may consider prophylactic TXA administration in cases that carry the highest risk of PPH such as suspected invasive placentation (placenta previa and placental abruptio). A standardized clinical PPH risk-assessment predictor tool is needed to serve as a guide for prophylactic TXA administration in select parturients undergoing cesarean section. As nurse anesthesia providers,

anticipation, prevention, and treatment of PPH is critical to positively impact maternal health outcomes. TXA has a strong potential to be an effective preventative intervention among select women undergoing cesarean delivery elucidating improved quality of peripartum care.

Abstract 31

Reducing Excessive Noise in the OR and Beyond: Recommendations for a "Silent" Paging System

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Background/Discussion/Question: Does hospital noise from overhead paging affect patients, families, and anesthesia providers? Noise has an adverse effect on patients' healing while impairing the performance of healthcare workers. Levels in hospitals reached up to 88.6 decibels during the day, impairing anesthesia providers' focus on tasks, and 68.8 decibels at night, when patients should be resting. Anesthesia providers require precise communication and concentration within the operating room. Between January and February 2023, 353 overhead pages were called at an academic urban hospital; 33% were rapid response pages and 22% were stroke alerts. Responses of a select few are required, yet overhead pages are announced throughout the entire facility. A systematic search of literature was conducted to ascertain negative impacts of excessive hospital noise on patients and healthcare workers.

Methods/Evidence Search: A systematic search was conducted utilizing these databases: PubMed, DOJA, Ovid MEDLINE, Elsevier, and Springer Open Access. Search terms included: hospital, paging, overhead, noise, patient experience, patient perception, patient satisfaction, staff experience, staff performance, staff satisfaction. The initial search returned 107 articles. Articles included were peer reviewed within the last five years, available in full-text form, and in the English language. After duplicates were removed and titles/abstracts screened, 18 articles remained. Using the John Hopkins Evidence Appraisal Tool, the levels of evidence included: 3 level I-A, 4 level II-A, 7 level III-A/B, and 4 level V.

Synthesis of Literature/Results/Discussion: Alarms and overhead paging were perceived as the most noxious sounds among healthcare workers and patients. Noisy environments impacted patients and anesthesia providers alike. It disrupted patients' rest resulting in impaired immune healing, cardiovascular stress, anxiety, and delirium. Noise exposure reduced anesthesia providers' short-term memory and ability to react quickly to patient changes. Communication and concentration, critical points of anesthesia providers' responsibilities as operating room leaders, were obstructed by excessive noise. Literature reported some international healthcare systems no longer rely on overhead paging; utilization of a "silent" communication system supported a quiet environment for patients and healthcare workers. These systems deliver alerts to designated team members directly via a phone-based application integrated into the electronic health record and encrypted to protect patient health information. It was possible to successfully transition from overhead pages to a silently activated method without sacrificing safety metrics and perceptions on code performance. Current practices at the academic urban hospital in this study do not align with recommendations in the literature for noise suppression and present an opportunity for improvement.

Conclusion/Recommendations for Practice: Reducing noise results in improved satisfaction, focus, and performance among healthcare workers. Furthermore, patients experience better rest, improved recovery, and increased satisfaction. Recommendations include reduction of more than 50% of overhead paging with the initial transition of rapid response and stroke pages to a "silent" system. Anesthesia providers are expected to distinguish between extraneous sources of noise and important alerts in the operating room. Implementation of this technology will only enhance patient, family, and anesthesia provider experience. Further research is needed to examine the specific effects of excess noise on anesthesia providers' workflow.

Abstract 32

Regional Anesthesia for Sternotomy Analgesia: The Erector Spinae Plane Block

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Background/Discussion/Question: The erector spinae plane block (ESPB) is a novel and versatile regional block providing both somatic and visceral analgesia which spans three to four dermatome levels cranially and caudally. When performed bilaterally, ESPBs provide circumferential coverage making it a regional anesthesia option for sternotomy. Traditionally, analgesia for sternotomy is opioid-based, making pain management a limiting factor when promoting cardiac ERAS programs. The purpose of this evidence-based project was to determine if literature supported ESPB as an effective strategy to manage sternotomy analgesia. The project answers the following question: In patients undergoing midline sternotomy, does the preoperative administration of a single-shot bilateral ESPB compared to no block decrease the incidence and severity of postoperative sternotomy pain, thereby reducing opioid consumption in the first 24 hours?

Methods/Evidence Search: PubMed, Embase, MEDLINE Complete, and the Web of Science research databases were systematically searched for relevant literature. Search terms (Erector Spinae Plane Block OR ESPB) AND (sternotomy OR cardiac surgery) AND (pain OR regional anesthesia OR analgesia) were applied. PubMed resulted in 46 citations, Embase 68, MEDLINE Complete 46, and Web of Science 53. Limiters applied included randomized controlled trials (RCTs), meta-analyses, systematic reviews, and anesthesiology as a research area. Articles found were published between 2018 and 2022. Both pediatric and adult populations were searched due to limited results when narrowed. Articles were searched for inclusion criteria of patients undergoing midline sternotomy, patients receiving a bilateral single-shot erector spinae block, and comparison of block versus placebo, no block, or traditional care. Four RCTs were selected as best-evidence and included in the final analysis: Athar et al. (2021), Krishna et al. (2019), Kushal et al. (2020), and Karacer et al. (2022).

Synthesis of Literature/Results/Discussion: In all articles, the erector spinae plane block groups showed a decrease in total postoperative opioid analgesia consumption for the first 24 hours when compared to the control ($P < 0.05$). Three of the articles showed a decrease in pain scores for the first six to 12 hours postoperatively and an increased duration in time to first rescue analgesic dose administered ($P < 0.05$). Karacer et al. did not measure time to first rescue analgesic dose as an outcome and did not show a decrease in measured pain scores; however, total opioid consumption did decrease when comparing the block group to the control group. The relevance of these findings supports the research question for utilization of ESPB in favor of traditional opioid use in sternotomy procedure patients of all ages. Future research should examine how ESPB analgesia could be prolonged either using adjunct drugs or continuous catheter placement. Block coverage for the entire peak sternotomy pain period may allow a further deduction in opioid use. Prolonging the block may also have a greater effect on secondary outcomes such as shorter extubation times, lower sedation scores, improved postoperative respiratory status measured by incentive spirometry, increased postoperative mobility, and decreased length of ICU and hospital stays.

Conclusion/Recommendations for Practice: Erector spinae plane blocks are effective in improving post-sternotomy pain. ESPBs are easy to perform and have minimal risks. No adverse outcomes such as hematoma, pneumothorax, or local anesthetic toxicity were observed in any of the studies reviewed. Practice recommendations for adult use of ESPBs in sternotomy patients include performing them preoperatively, bilaterally, and around the T3-4 vertebral area, with 20-30 mL volumes of a long-acting

local anesthetic for maximal spread covering the traditional sternotomy region. To confirm block effectiveness and opioid reduction, pilot studies using standardized postoperative pain regimens can be performed at the initiating facilities. Pilot studies can help to confirm postoperative opioid reduction and begin to look closer at the beneficial secondary outcomes that promote enhanced recovery after surgery (ERAS) programs.

Abstract 33

Regional Anesthesia Toolkit for Resource Limited Settings

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Background/Discussion/Question: The perioperative mortality rate in resource limited settings (RLS) is at least threefold greater than in high resource settings (HRS). Access to regional anesthesia provides a safe alternative to general anesthesia. Many providers in RLS do not receive education or training in the field of regional anesthesia. Hands-on, service-based volunteers create short-term solutions but do not empower communities to take ownership over their training. This project addressed the following question: What are the best methods to deliver lasting education in regional anesthesia in RLS, and what resources can be provided to do so? Educational initiatives are a sustainable means to address regional anesthesia shortages in RLS. Our goal was to provide a regional anesthesia toolkit, easily accessible to RLS providers, written in a series of concise steps, outlining the most useful regional anesthesia blocks.

Methods/Evidence Search: A literature search was conducted using CINAHL, PubMed, and Google Scholar. Search terms included: toolkit, education, and low resource. Results were exported into a citation manager and duplicates were removed. Five articles remained. The articles were evaluated using the Johns Hopkins appraisal tool and the Cochrane risk-of-bias tool and were rated by two reviewers. The studies included one retrospective study, two prospective single-center observational studies, one quasi-experimental study, and one qualitative study. The studies examined the impact of regional anesthesia curriculums on learners in RLS. One study attempted to verify areas of interest in knowledge of anesthesia providers in both RLS and HRS by examining “hits” or “clicks” within anesthesia applications.

Synthesis of Literature/Results/Discussion: Four studies were identified evaluating the effectiveness of short-course curriculum and regional anesthesia training in RLS. All curriculum included both didactic and hands-on workshops. Pre-course questionnaires reported varying degrees of comfort with different regional techniques prior to the courses; however, the majority of respondents reported being somewhat or very dissatisfied with the amount of training in regional anesthesia they had received in their residency. All four studies reported that participants “strongly agreed” their knowledge and comfort with regional anesthesia had increased after the courses. Participants reported having pride in learning innovative techniques which led to an increase in morale in the department. All studies’ post-course questionnaires demonstrated increased participant use of regional anesthesia techniques after the course. than prior to the course.

Conclusion/Recommendations for Practice: A regional anesthesia toolkit is effective in educating providers in RLS. Increasing the knowledge base and skill set of providers in regional anesthesia will improve patient safety and expand access to regional anesthesia for patients in RLS. This toolkit assists providers in developing regional anesthesia techniques that can benefit their patients. The comprehensive approach to the toolkit will allow users to train others on techniques that fit the needs of the communities they serve. Partnering with a learning institution or nonprofit organization would benefit RLS utilizing a regional anesthesia toolkit. Limitations encountered while developing a toolkit include recruiting training personnel and securing funds for equipment. A partnered institution with shared goals of providing education and increasing patient safety can be beneficial. By building an accessible format with links to current web tools and resources, this toolkit aims to create an up-to-date reference for teaching regional anesthesia in RLS

Abstract 34

Skin Pigmentation and the Incidence of Occult Hypoxemia

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Background/Discussion/Question: Pulse oximeters are noninvasive devices used as a surrogate measurement (SpO2) of the percentage of hemoglobin molecules in arterial blood that are saturated with oxygen (SaO2). Occult hypoxemia refers to a low SaO2 measurement with a concurrent normal SpO2 measurement, falsely indicating adequate oxygen levels. Undetected hypoxemia can result in hypoxia and organ damage. The tendency of patients with high levels of melanin in their skin to experience less accurate pulse oximetry readings has been documented in the literature for decades, but not commonly researched until recently. A PICOT question was developed to guide a literature search: For adult patients utilizing a pulse oximeter to monitor oxygen saturation, do high levels of melanin pigmentation within the skin in comparison to low levels of melanin pigmentation increase the risk of occult hypoxemia?

Methods/Evidence Search: The Texas Medical Center Library Portal was used to search PubMed, The Cochrane Library, Ovid MEDLINE, Embase, and CINAHL. MeSH terms used were pulse oximetry and hypoxemia, along with the key search terms race and ethnicity. Full-text, peer-reviewed articles published between 2012 and 2022 were included. Examination of reference lists resulted in additional relevant articles. Thirteen articles were selected, including two systematic reviews and 11 cohort studies. The samples for each cohort study were categorized into at least two groups by documented race or ethnicity: Black or Non-Hispanic Black, or White or Non-Hispanic White. In each article, those identified as Black were assumed to have high levels of melanin pigmentation within the skin, whereas those identified as White were assumed to have low levels.

Synthesis of Literature/Results/Discussion: Examination of the collected literature revealed an increased incidence of occult hypoxemia (OH) for Black patients compared to White patients, even when adjusted for other variables such as comorbidities, smoking status, age, and gender ($P < .05$). Black patients were anywhere from 1.65 to 2.84 times more likely to experience OH than White patients ($P < .05$). Black patients had a higher SpO2 for a given SaO2 than White patients ($P < .05$), and the bias (difference between SpO2 and SaO2) was larger at lower SaO2 values. More than 45% of paired readings from Black patients had greater than a 10% error bidirectionally between SaO2 and SpO2. Multiple studies demonstrating an SpO2 below 96% were most associated with OH for Black patients. Black patients who sought hospital care for a COVID-19 diagnosis had a significantly lower chance of recognition of eligibility for treatment and recognition than White patients ($P < .05$). Black patients in an intensive care unit had lower median supplemental oxygen delivery rates than White patients and the increased SpO2 to SaO2 discrepancy was found to be a major cause ($P < .05$). Black patients with OH in an intensive care unit had a significantly greater chance of a longer hospital stay as well as in-hospital mortality than White patients with OH ($P < .05$).

Conclusion/Recommendations for Practice: The main goal of this project was to increase awareness of the increased risk of occult hypoxemia in patients with dark skin. Until improved devices are available, there is a recognized need for an interim mitigation strategy so anesthesia providers can best provide equitable and safe care. The following recommendations apply to adult patients in an acute care setting who are identified as Black: Clinicians should 1) have a low threshold for drawing a validating ABG when clinical signs are inconsistent with SpO2, 2) consider more frequent use of ABG analysis overall, and 3) maintain an SpO2 threshold of 96% or greater to ensure a low risk of occult hypoxemia. Future research

should include additional prospective studies, more accurate methods for classifying degree of skin pigmentation, and standardized paired SpO2 and SaO2 measurements. Multiple research institutions are currently working to develop a device that is not subject to the inaccuracies caused by dark skin pigmentation.

Abstract 35

The Application of Radiofrequency Ablation in Acute and Chronic Pain Management

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Background/Discussion/Question: Opioids are the mainstay for acute and chronic pain conditions despite the evolving opioid epidemic. As more nurse anesthesiologists are involved in acute and chronic pain management, it is crucial for anesthesia providers to keep abreast of the current new pain modalities. The purpose of this project was to determine the use of radiofrequency ablation in the treatment of various pain conditions. The project addressed whether radiofrequency ablation is a viable option in the treatment of both acute and chronic pain.

Methods/Evidence Search: A comprehensive literature review was conducted to search for articles relevant to radiofrequency ablation, nonsurgical pain interventions, and the benefits and outcomes of radiofrequency ablation applied to both chronic and acute pain. Key search terms included: radiofrequency ablation, rhizotomy, neurolysis, analgesia, acute pain, chronic pain, and pain management. Several electronic databases were searched through the University of South Florida's InterLibrary database, including PubMed, CINHAL, EBSCO, PsycINFO, and MEDLINE. Systematic reviews and metanalysis references were searched for landmark studies involving radiofrequency ablation. This search strategy produced 102 potential references. Excluded articles included those that were not focused on the topic, were without full-text access, were published in a language other than English, or were published prior to 2000. All articles focused on adult patients 18 years of age or older. This produced 45 articles used in the literature review and synthesis.

Synthesis of Literature/Results/Discussion: Radiofrequency ablation is a novel pain management modality that has demonstrated widespread success and efficacy in various clinical studies. Given the minimally invasive nature of the procedure and the advancements in technological imaging, RFA has demonstrated great safety, ease of performance, and increased patient satisfaction. RFA can target a wide range of anatomical locations and painful conditions including back pain, post-mastectomy pain, joint pain, facial pain, and even cancer pain. Furthermore, as more pain fellowship-trained nurse anesthesiologists manage patients with chronic pain conditions, RFA has great potential for treating pain; however, further research is required to better quantify the benefits as well as to fully understand the mechanism of action of RFA, specifically related to neuromodulation.

Conclusion/Recommendations for Practice: In summary, RFA is a safe and effective pain management procedure for many conditions including intractable pain that are difficult to control with other modalities. However, this is a new modality and only a limited number of clinical trials with adequate sample sizes are available. Hence, further research is necessary to corroborate the efficacy in various pain conditions. Future studies need to focus on standardizing the delivery technique, including the temperature, frequency, and duration of treatment to optimize RFA therapies. There is a growing need for pain management services in the United States, and as practice barriers that prevent Certified Registered Nurse Anesthesiologists (CRNAs) from providing pain services are removed, more CRNAs can be trained to utilize this modality to provide more pain services to patients in critical access areas or in dire need of better pain management.

Abstract 37

The Effect of Oral Midazolam Versus Intranasal Dexmedetomidine on Pediatric Anxiety during Preoperative Parental/Caregiver-Child Separation

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Background/Discussion/Question: Pediatric preoperative anxiety may result in damaging medical, social, and psychological consequences. Adverse effects of oral midazolam 0.5 mg/kg are respiratory depression, paradoxical reactions, and amnesia. Intranasal dexmedetomidine is a possible alternative because of its sedative, sympatholytic, analgesic, and anxiolytic properties; more accepted administration route; and lower risk of respiratory depression. The modified Yale Preoperative Anxiety Scale (m-YPAS) is an assessment tool for pediatric anxiety. The PICOT question of this integrative review is: In children aged 2-12 years old who are scheduled for general anesthesia, what is the effect of using the premedication of intranasal dexmedetomidine versus oral midazolam on parental/caregiver-child separation anxiety, as measured by the m-YPAS, at the time of parent/caregiver-child separation?

Methods/Evidence Search: The databases searched were PubMed Central, BioMed Central, and Health Research Premium Collection. Search terms included combinations of intranasal dexmedetomidine, oral midazolam, premedication, and preoperative anxiety. The inclusion criteria were pediatrics and m-YPAS score. The exclusion criterion was the use of tools other than the m-YPAS score for preoperative anxiety. The highest level of evidence was four randomized controlled trials (RCTs) that met the criteria. No systematic reviews or systematic reviews with meta-analyses were available.

Synthesis of Literature/Results/Discussion: Four RCTs assessed the difference in pediatric anxiety at parent/caregiver-child separation after receiving either intranasal dexmedetomidine or oral midazolam as a preoperative anxiolytic. In all four RCTs, parentl/caregiver-child separation occurred in the preoperative holding area. A specific clinical data recorder collected scoring, and a designated researcher prepared the drugs. The clinical data recorder and anesthesia professional were blinded to the drug assignments; however, the results were incongruent among the studies. Two RCTs reported lower m-YPAS scores in the patients who received intranasal dexmedetomidine compared to those who received oral midazolam. One RCT reported higher m-YPAS scores in the patients who received intranasal dexmedetomidine, and one RCT reported no statistically significant differences between patients receiving intranasal dexmedetomidine and those receivingoral midazolam. Recommendations for future research include having a larger sample size and an equal number of participants from each gender to generalize findings. In addition, a narrower age range, such as 2-6, should be investigated. Scoring of children aged 2-12 cannot be appropriately compared because of the various levels of development. Equivalent medication dosages must be used in all studies to treat groups equally.

Conclusion/Recommendations for Practice: In children aged 2-12 years of age scheduled for general anesthesia, the effect of intranasal dexmedetomidine compared to oral midazolam resulted in variable m-YPAS score data. Two studies reported favorable results for intranasal dexmedetomidine, one study reported results favorable for oral midazolam, and a fourth study reported no statistically significant difference between groups on m-YPAS scores at parent/caregiver separation. The current practice of administering oral midazolam for preoperative separation anxiety in pediatric patients should remain in place based on the evidence. The use of intranasal dexmedetomidine requires further research to assess its effects as a preoperative anxiolytic. CRNAs should be aware that intranasal dexmedetomidine has a lower risk of respiratory depression, and the route of administration is more readily accepted by children compared to oral midazolam. The current research comparing intranasal dexmedetomidine to oral

midazolam regarding preoperative pediatric separation anxiety is equivocal.

Abstract 38

The Effectiveness of Aromatherapy to Prevent PONV

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Background/Discussion/Question: Postoperative nausea and vomiting (PONV) is a complex physiological response involving both central and peripheral receptors and occurs in 20% to 50% of surgical patients. Aromatherapy may offer an alternative treatment for PONV; however, it is unclear if aromatherapy is an effective prevention and treatment strategy for PONV. The purpose of this evidence-based project (EBP) was to describe the evidence on the effectiveness of aromatherapy in the prevention and treatment of PONV. Four literature databases were searched using keywords from the following PICOT question: Do surgical patients (P) receiving aromatherapy postoperatively (I) compared to surgical patients who did not receive aromatherapy postoperatively (C) have less PONV (O) in PACU (T)?

Methods/Evidence Search: The following four literature databases were used: PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), The Cochrane Library, and ScienceDirect. Literature search keywords included: nausea and vomiting, aromatherapy, and postoperative. The literature search was expanded through the use of synonyms. Synonyms for the keywords nausea and vomiting included emesis and PONV. Synonyms for aromatherapy included aroma therapy, essential oils, inhalation therapy, alternative therapy, and nonpharmacologic. Synonyms for postoperative included post operative, post-operative, postsurgical, perioperative, periprocedural, and postprocedural. Additional keywords were included using the Boolean operator "AND" while the synonyms of keywords were included using the Boolean operator "OR." While not all searches contained all of the keywords at once, the use of additional keywords, synonyms, and specific data limiters provided more refined results.

Synthesis of Literature/Results/Discussion: Four randomized controlled trials (RCT) evaluating the efficacy of aromatherapy in PONV prevention were critically appraised. Fearrington (2019) and Ahmadi and Maghami (2020) examined the effectiveness of peppermint oil on reducing nausea and frequency of antiemetic administration. Fearrington and Karaman (2019) evaluated the effects of ginger on PONV using visual scales to quantify the severity of PONV episodes and found reductions in the occurrence of PONV and the need for antiemetic medications with ginger essential oils compared to placebo groups. Karaman (2019) and Ahmadi and Maghami (2020) found reductions in the severity of PONV when peppermint essential oil was administered. These studies showed consistent decreases in the occurrence and severity of PONV and antiemetic use with either peppermint or ginger. The use of aromatherapy, specifically ginger and peppermint essential oils, was effective in decreasing the occurrence of PONV.

Conclusion/Recommendations for Practice: This evidence consistently showed aromatherapy was effective in the prevention of PONV within the PACU setting. From this evidence a change in practice was made by anesthesia providers and PACU nurses using aromatherapy consisting of ginger and peppermint.

Abstract 39

The Effectiveness of Coloaded Fluid Administration in Preventing Spinal-induced Hypotension in Obstetrical Patients

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Background/Discussion/Question: Neuraxial anesthesia via a subarachnoid block with local anesthetic can cause hypotension due to vasodilation and a reduction in preload. Coloaded intravenous crystalloid fluid bolus administration given at the time of neuraxial block placement reduces the associated hypotension more effectively than preloaded administration. The purpose of this project is to describe the evidence showing the benefits of coloaded fluid administration over preloaded fluid administration in reducing spinal-induced hypotension.

Methods/Evidence Search: A search of four literature databases was done using keywords from the following PICOT question: Do obstetrical patients undergoing cesarean section with a spinal anesthetic (P) who receive a coloaded bolus of intravenous crystalloids (I) compared to patients who do not receive a coloaded fluid bolus (C) experience less hypotension (O) throughout the perioperative period (T)? The four databases investigated were The Cochrane Library, PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and ScienceDirect. The search terms used were spinal anesthesia, fluid administration, blood pressure, hypotension, neuraxial anesthesia, cesarean section, and fluid bolus.

Synthesis of Literature/Results/Discussion: One meta-analysis and three randomized controlled trials (RCTs) were critically appraised. Khan et al. (2013) and Rupnar and Fernandes (2018) used coloaded fluid administration of Ringer's lactate solution initiated at the time that cerebrospinal fluid (CSF) was identified. Both studies demonstrated decreased hypotension and vasopressor requirements in the coload group compared to the preload group. Oh et al. (2014) used Hartmann's solution initiated just after intrathecal injection of local anesthetic. Their results indicated that the coloaded group had less hypotension, vasopressor requirements, and nausea compared to the preloaded group. In their meta-analysis, Ni et al. (2017) showed 10 RCTs with reduced episodes of hypotension and eight RCTs with a reduction in vasopressor requirements in the coload groups. The results of these studies consistently showed less hypotension and vasopressor requirements in the coloaded group and comparable neonatal outcomes between the preload and coload groups.

Conclusion/Recommendations for Practice: Using coloaded crystalloid administration when administering a spinal anesthetic for elective cesarean section patients is beneficial in reducing the incidence of spinal-induced hypotension. A change in practice was made based on this evidence resulting in an 82% increase in patients receiving coloaded fluid administration.

Abstract 40

The Little Product that Could: Is Fibrinogen Concentrate the Future of Fibrinogen Repletion for Traumatic Hemorrhage?

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Background/Discussion/Question: One of the main preventable causes of mortality in trauma-related injuries is coagulation dysfunction which precipitates uncontrolled hemorrhage. Hypofibrinogenemia is an independent predictor of mortality in the trauma population and is associated with hemostatic impairment. It is suggested fibrinogen levels be maintained at > 1.5-2 g/L in patients with severe trauma. Traditionally, cryoprecipitate and fresh frozen plasma (FFP) are administered to replete fibrinogen levels. There are several advantages fibrinogen concentrate (FC) offers to patients experiencing traumatic hemorrhage. These advantages include immediate availability and no required conformation of ABO compatibility. The purpose of this review was to assess if FC also aids in decreasing the amount of blood products needed for resuscitation of trauma patients, thereby maximizing hospitals' blood bank reservoirs.

Methods/Evidence Search: A review of literature was performed using the databases Ovid MEDLINE, Pubmed, and ScienceDirect. Keywords included: fibrinogen concentrate, hemorrhage, blood transfusion. and trauma. This yielded 456 articles once duplicates were removed. The articles were screened by title and abstract for correct population and relevance and to ensure they were published within five years. A total of 16 articles were generated. One article could not be retrieved, and the remaining 15 articles were reviewed. After applying the inclusion and exclusion criteria, eight studies were included in the final analysis. Exclusion criteria consisted of studies still in progress, assessed TEG and ROTEM outcomes, focus on administration of other products not including packed red blood cells (PRBCs), opinion articles, and articles which discussed the gap in literature. Inclusion criteria included amount of blood products administered as an outcome measurement. The final eight articles consisted of four retrospective studies, a quasi-experimental study, an RCT, an observational study, and a systematic review.

Synthesis of Literature/Results/Discussion: Results varied among the studies. Three of the studies concluded that there was a reduction of PRBC transfusions when the patients were administered FC compared to a placebo, FFP, or cryoprecipitate. One study discussed patients who received FC had a higher transfusion requirement initially within the first six hours after Emergency Department (ED) arrival but an overall lower transfusion requirement at 24 hours compared to cryoprecipitate. Studies that found an increased number of transfusion requirements for the FC cohort or found no significant difference all noted that the FC group of patients had greater Injury Severity Scores resulting in greater hemodynamic instability. No statistical difference in mortality was found when patients were administered FC compared to other products. One retrospective study did find greater mortality in the FC arm which was concluded to be related to the higher incidence of hemorrhagic shock. Furthermore, three of the studies evaluated thrombotic events in the FC group and all determined there was no significant risk of thrombosis. Many of the studies had small sample populations, were retrospective, and were conducted abroad where FC is used as the primary fibrinogen supplementation for traumatic hemorrhage.

Conclusion/Recommendations for Practice: The current evidence is variable and does not definitively support FC in reducing the amount of PRBCs needed for resuscitation of patients experiencing traumatic hemorrhage. Additional research, especially RCTs with larger sample sizes, is warranted to evaluate the effectiveness of FC in the trauma population. There are still numerous factors that make FC a desirable

alternative to other fibrinogen supplemental products, including the following: viral inactivation, higher standardized concentrations, no necessary ABO compatibility, seemingly no increase in thrombotic events, and convenience of administration. However, the price of FC, which is almost double the cost of cryoprecipitate and FFP, limits its use within hospital settings. Future research should continue to assess if FC has physiological outcome advantages, decreases the amount of PRBC required, and reduces ICU and hospital length of stay which would compensate for its financial constraints.

Abstract 41

The Safety of Breastfeeding after Perioperative Opioids

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Background/Discussion/Question: Historically, it has been recommended that breast milk from lactating mothers be discarded 24-48 hours following surgery because of the possibility of the transfer of anesthetic drugs including opioids to the infant. It is unclear if it is safe for infants to consume breast milk from mothers who have received opioids. The purpose of this evidence-based practice (EBP) project was to describe the evidence on the safety of breastfeeding after maternal opioid consumption as measured by appearance, pulse, grimace, activity, and respiration (Apgar) scores and infant behavioral scores.

Methods/Evidence Search: The PubMed, CINAHL, MEDLINE, and Cochrane Library databases were searched with keywords for the following PICOT question: Do infants receiving breast milk from lactating mothers (P) who receive opioids (I) compared to similar infants who do not receive breast milk (C) have adverse outcomes (O) in the perioperative period (T)? Keywords used included fentanyl, analgesia, lactation, pain medication, opioids, breastfeeding, and breast milk.

Synthesis of Literature/Results/Discussion: Evidence from four randomized controlled trials (RCTs) were critically appraised. The RCTs found normal Apgar scores in infants who accepted breast milk from mothers who received intravenous (IV) meperidine, IV morphine, IV remifentanil, and IV fentanyl. Douma et al. (2010) studied mothers who received IV fentanyl, IV remifentanil, and IV meperidine. Apgar scores of their newborns were measured at one and five minutes and Neurologic and Adaptive Capacity Scores (NACS) at 15 and 120 minutes. Goma et al. (2008) evaluated mothers who received IV fentanyl and assessed infant Apgar scores at one and five minutes and assessed neonates using the Preterm Infant Breastfeeding Behavior Scale (PIBBS). Stocki et al. (2013) assessed Apgar scores at one and five minutes of neonates whose mothers received IV remifentanil. Wittles et al. (1990) compared Apgar scores at five minutes as well as behavioral scores via the Brazelton Neonatal Behavior Assessment Score (NBAS) at 72 hours in neonates whose mothers received IV and oral morphine or IV and oral meperidine. All four studies consistently found normal Apgar scores regardless of the opioid consumed. Wittles et al. showed significant drowsiness in infants 72 hours after their mothers received IV and oral meperidine. This drowsiness was demonstrated via the NBAS. All other infant behavioral scale scores were within normal limits.

Conclusion/Recommendations for Practice: It is recommended from this evidence that it is safe for mothers who are currently lactating to breastfeed after receiving IV morphine, IV remifentanil, or IV fentanyl. When a mother is awake and alert enough to breastfeed after anesthesia, the milk is safe to be consumed by the infant. The plan for implementation of this project was based on this evidence. Our change in practice has been executed, but post-implementation data are still being collected.

Abstract 43

The Use of the Erector Spinae Plane (ESP) Block for Postoperative Abdominal Pain

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Background/Discussion/Question: Abdominal surgical patients have been treated with opioids and regional anesthetic techniques such as the transversus abdominis plane (TAP) block to provide primarily postoperative somatic pain relief; however, none cover visceral pain. The erector spinae plane (ESP) block has shown promise as a regional anesthesia block alternative for both somatic and visceral pain treatment. The ESP block is another fascial plane by which local anesthetic is injected beneath the erector spinae muscle allowing for its diffusion to both ventral and dorsal rami of the spinal nerves. This allows for control of both visceral and somatic pain for thoracic and abdominal pain in levels T2-L5. The purpose of this project was to describe the evidence on the effectiveness of ESP block compared to the TAP block in preventing postoperative pain for patients undergoing abdominal surgery.

Methods/Evidence Search: The Cochrane Library, PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and MEDLINE databases were searched using keywords from the following PICOT question: Do patients undergoing abdominal surgery (P) who receive an erector spinae plane block (I) compared to patients undergoing abdominal surgery who receive the transversus abdominis plane block (C) experience less pain (O) postoperatively (T)? Synonyms for the keyword erector spinae plane block included the abbreviation ESP with the addition of the word block to broaden search results. A Likert survey was provided to the nurse anesthesiologist staff members to assess their knowledge regarding the techniques of performing the ESP block. Education was subsequently provided to the staff members on how to correctly and safely perform the block, and another Likert survey was conducted post-education to demonstrate perceived level of proficiency.

Synthesis of Literature/Results/Discussion: The evidence from four randomized controlled trials (RCTs) was critically appraised. Abdelhamid et al. (2020) found that the ESP block had lower postoperative pain scores and less opioid consumption compared to the TAP block. Altiparmak et al. (2019) observed that the ESP block had less postoperative opioid consumption and pain scores compared to the TAP block. Kamel et al. (2020) found the ESP block provided more potent and longer postoperative analgesia with less opioid consumption. Malawat et al. (2020) found the ESP block provided prolonged analgesia and less opioid consumption. Project results from Likert survey pre- and post-education: Before education 66% of respondents did not know how to perform the ESP block (mean 1.67, standard deviation 0.47). One hundred percent of respondents reported proficiency with the TAP block, with 66% strongly agreeing and 33% agreeing with the statement (mean 1.33, standard deviation 0.47). Given an ultrasound (US) image of the ESP block approach, before education only 33% of respondents identified proper placement, while after education 100% identified proper placement. Thirty-three percent of respondents agreed ESP block is efficacious in blocking postoperative pain for the target population, with the remaining 66% strongly agreeing (mean 1.33, standard deviation 0.47). Fifty percent of respondents agreed with the statement that they will use the ESP block for abdominal surgical patients in the future, with the other 50% strongly agreeing (mean 1.50, standard deviation 0.50).

Conclusion/Recommendations for Practice: Based on the findings of these four RCTs, it is recommended that the ESPblock be used for the surgical procedures in the studies in place of the TAP block. It is also recommended that the ESP block be used whenever possible as a regional anesthetic adjunct to general anesthesia for the purpose of reducing postoperative pain as well as opioid consumption. Pre-

oxygenating obese surgical patients in the head-elevated position is a simple and effective way to prevent hypoxemia. A change in practice was made based on this evidence resulting in an increase in the number of patients with a head-elevated position during the induction of general anesthesia.

Abstract 44

The Use of Viscoelastic Assays in Coagulopathic Pediatric Patients

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Background/Discussion/Question: Bleeding induced coagulopathy continues to be a leading cause of morbidity and mortality in children. Resuscitation in the adult bleeding patient often uses a 1:1:1 ratio of platelets, plasma, and packed red blood cells (PRBCs). This adult practice has been applied to the pediatric population with little evidence to support its use. The use of viscoelastic hemostatic assays (VHA) to manage bleeding has been widely studied in the adult population; however, the benefit in children is poorly understood. VHAs provide valuable information in the management of bleeding-induced coagulopathy. These assays, mainly thromboelastography (TEG) and rotational thromboelastometry (ROTEM), reveal a more dynamic picture of the coagulation process, clot kinetics, and fibrinolysis. This review investigated anesthesia provider use of VHAs in managing coagulopathic children.

Methods/Evidence Search: The purpose of this literature review was to answer the question of whether the use of VHA reduces mortality in the pediatric population. The MEDLINE, PubMed, and Embase databases were searched using the keywords pediatrics, bleeding, and viscoelastic assays through the Columbia University Library. Full-text, English-language articles published between 2018 and 2022 were included. After duplicates were removed, an initial search yielded 110 articles which were screened by title and abstract. Inclusion criteria included bleeding pediatric and neonate patients and utilization of VHA, TEG, and/or ROTEM. Exclusion criteria consisted of results not relevant to pediatrics and patients older than 5 years. After exclusions were applied, 101 articles were excluded. Nine full-text articles were reviewed and included in the final analysis. Of the articles included in this review, four were systematic reviews, two were retrospective studies, two were randomized controlled trials (RCTs), and one was a literature review.

Synthesis of Literature/Results/Discussion: After synthesis of results from the included studies, several themes emerged. Eight of the nine articles stated that viscoelastic assays are a better tool at detecting coagulopathies than traditional coagulation tests, such as PTT, PT, and INR. Blood transfusions are associated with adverse effects, prolonged ventilation, pulmonary complications, and increased length of stay. Six of the articles reviewed showed that the use of VHAs to guide transfusions reduced the number of overall blood transfusions and reduced complications in children and neonates. One of the RCTs showed that the volume of total blood components, FFP, and platelets was significantly lower in pediatric patients receiving a ROTEM-based transfusion strategy. Additionally, six articles supported the use of VHAs in pediatric bleeding algorithms, with two among these suggesting replacement of coagulation defects using viscoelastic studies as an alternative to fixed-ratio-based protocols. One article did not find any mortality benefit with the inclusion of TEG in pediatric trauma patients. None of the articles included in the review reported a reduced mortality rate with the inclusion of VHA in the pediatric population.

Conclusion/Recommendations for Practice: The use of VHAs to guide blood component replacement is an emerging practice in children. Viscoelastic assays can provide more information than conventional coagulation tests and allow for customization of massive transfusion protocols for individual patients. Targeted replacement of identified coagulation defects guided by VHAs is an alternative to fixed ratio-based transfusion protocols. Therefore, anesthesia providers are encouraged to use VHA to guide blood transfusions when managing the hemorrhaging pediatric patient in the perioperative setting. The

inclusion of VHAs is shown to improve bleeding management, cost efficiency, and patient outcomes in the pediatric and neonate population. Further robust pediatric-specific studies need to be conducted to evaluate the relationship between VHA utilization and mortality rates in coagulopathic children.

Abstract 45

Total Intravenous Anesthesia to Improve Surgical Visibility during Endoscopic Sinus Surgery

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Background/Discussion/Question: Adequate surgical visualization during endoscopic sinus surgery is critical in order to ensure the integrity of neurovascular structures and reduce the risk of inadvertent injury. The chosen anesthetic technique may affect intraoperative bleeding and therefore surgical visualization. The purpose of this project was to delineate which, if any, anesthetic regimen optimizes surgical visualization by minimizing intraoperative bleeding. The project aimed to answer the following question: For adult patients undergoing endoscopic sinus surgery, how does total intravenous anesthesia (TIVA) compare to inhalational anesthesia (IA) in improving surgical visualization during the intraoperative period?

Methods/Evidence Search: PubMed, Embase, and Cochrane Library databases were systematically searched for relevant literature. Date ranges were applied to include articles published after 2010. The keywords TIVA, sinus OR sinus surgery, and visualization were entered into the search bar for each database. PubMed produced 14 relevant articles, Embase 11, and Cochrane Library 13. Inclusion criteria limited appraisal to those studies that included surgical visualization as the primary outcome. After eliminating duplicates, systematic reviews (SRs) were independently evaluated to ensure that any randomized controlled trials (RCTs) analyzed in each review were not redundantly included in this project. The synthesis plan included a comparison of statistical analyses presented in each article with an evaluation of the strength of each author's conclusions. Appropriateness of recommendations were assessed as a result of the rigor of methodological procedures. Best articles were identified and included: six SRs, one RCT, one retrospective chart review, and one survey.

Synthesis of Literature/Results/Discussion: Synthesis of the included articles ultimately showed conflicting results. Some studies elucidated that TIVA was superior to IA in improving surgical visibility, but confounding variables such as use of vasopressors were not consistently controlled. The authors repeatedly noted that direct statistical comparison was difficult due to the lack of a standardized visibility grading scale. Additionally, the medications used in TIVA varied. The most common approach was a propofol infusion; however, additional research has demonstrated that remifentanil use may be the determining factor in improving surgical visualization due to its parasympathetic effect on the patient's hemodynamic profile. As a whole, the currently available literature does not provide clear support that TIVA is superior to IA in improving surgical visibility. Synthesis of the evidence demonstrated that controlled hypotension is likely the integral component affecting bleeding conditions and subsequently visualization. The mechanism of achieving that hypotension has not been shown to independently affect intraoperative conditions. Development of a standardized grading scale and superior control of variables are warranted in future studies to allow accurate comparison and assess the effect of anesthetic technique on other fiscally relevant outcomes such as surgical time and patient length of stay.

Conclusion/Recommendations for Practice: Surgical visualization is an essential contributor to the safety of endoscopic sinus surgery. In order to facilitate clear working conditions, anesthesia providers should exercise prudent consideration in choosing the appropriate anesthetic approach. This project shows that TIVA may allow for surgical optimization but the supporting literature is unfortunately inconsistent. Remifentanil is likely the adjunct of choice for this surgery and should be considered an integral component of TIVA therapy. Recommendations for practice based on current literature include a prioritization of controlled hypotension and manipulation of hemodynamic parameters. Continuous and

timely communication with the surgical team will inform anesthetic decision-making in the intraoperative period. Anesthesia providers should receive education about the current state of the science surrounding this issue to facilitate the delivery of safe patient care.

Abstract 46

Ultrasound Guided Regional Anesthesia Integrating Artificial Intelligence to Increase Provider Success

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Background/Discussion/Question: Ultrasound-guided regional anesthesia (UGRA) has a steep learning curve of needle guidance and recognition of sonoanatomy. This limits provider capability and confidence to perform UGRA. Artificial intelligence (AI) has been developed for UGRA to address the problems in identifying anatomical structures, decreasing risk of needle injury and redirection, and predicting insertion point and depth. Ultrasound that integrates AI combats these problems through highlighting and labeling anatomical structures in real time by applying a color overlay. The purpose of this evidence-based project was to increase anesthesia provider success, knowledge, and attitude utilizing ultrasound integrating AI to increase identification of anatomical structures, decrease risk of needle injury and redirections, and predict insertion point and depth for regional and neuraxial anesthesia.

Methods/Evidence Search: The literature search was conducted utilizing the databases PubMed, Google Scholar, and MEDLINE. The search key words included variations of ultrasound-guided regional anesthesia, neuraxial anesthesia, and artificial intelligence. Eligibility criteria included articles with human subjects, written in English, published within the last 10 years, and full-text availability. Systematic reviews, literature reviews, and meta-analyses were excluded. Following the application of automation tools and manual assessment for eligibility, 14 articles were selected and analyzed for the evidence-based project. Research focused on AI for regional and neuraxial anesthesia to increase provider success. The following PICOT question was developed: In adult patients receiving UGRA for regional and neuraxial anesthesia, does ultrasound scanning that integrates AI improve anesthesia provider success in increasing identification of anatomical structures, decreasing risk of needle injury and redirections, and predicting insertion point and depth?

Synthesis of Literature/Results/Discussion: The studies discussed the use of ultrasound integrating AI for UGRA. Bowness and colleagues investigated the benefit of AI to confirm the correct ultrasound view for UGRA and to improve the identification of sonoanatomical structures on ultrasound. Ni et al. demonstrated the advantage of AI for decreasing the risk of needle injury for UGRA. Three studies revealed the use of AI ultrasound to decrease the number of needle passes and redirections for neuraxial anesthesia. Three studies examined the advantage of AI ultrasound for assisting in identification of needle insertion point for neuraxial anesthesia. Tiouririne et al. and Carvalho et al. studied the application of AI ultrasound to predict needle depth for neuraxial anesthesia. All studies showed the use of advanced ultrasound systems that integrate AI for improved anesthesia provider success for peripheral nerve blocks and neuraxial anesthesia. Future research should aim to study the efficacy of AI-integrated ultrasound for improved performance and outcomes of ultrasound guided regional and neuraxial anesthesia. Research demonstrates that UGRA is associated with many challenges and illuminates the need for advanced technologies to increase anesthesia provider knowledge and success to improve patient outcomes and access.

Conclusion/Recommendations for Practice: The current practice of UGRA in the clinical setting is limited to a select few anesthesia providers, restricting patient access to evidence-based care and improved outcomes. Due to the steep learning curve and known challenges, less-experienced providers may have difficulty with learning and performing UGRA. The literature revealed that AI ultrasound may be useful for enhanced performance and patient outcomes. For UGRA, the evidence demonstrates that AI ultrasound confirms the correct ultrasound view, improves the identification of sonoanatomical

structures, and reduces the risk of needle injury. For neuraxial anesthesia, AI ultrasound decreases the number of needle passes and redirections, assists in identification of the needle insertion point, and predicts needle depth. Implementation of an evidenced-based educational module will improve anesthesia provider knowledge and attitude regarding AI ultrasound for UGRA and allow providers to play an integral role in increasing patient access to regional and neuraxial anesthesia.

Abstract 47

What's Old is New Again: Amisulpride, a New Antiemetic to Combat PONV

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Background/Discussion/Question: Postoperative nausea and vomiting (PONV) leads to multiple adverse consequences that impact patients and anesthesia providers. Despite adequate risk-based prophylaxis, failure rates > 30% occur. When PONV occurs postoperatively, repeated doses of ondansetron are not as effective. Antiemetics from other classes are less commonly used due to safety or efficacy concerns. Droperidol, a D2-antagonist, was a drug of choice for PONV prophylaxis until its use was limited due to concerns over QT prolongation and extrapyramidal toxicity. Amisulpride, a D2/D3 antagonist with a favorable side-effect profile, has been used as an oral antipsychotic for over 30 years in Europe. It may also offer antiemetic benefits. The purpose of this review was to determine if amisulpride has the potential to be safely added to the repertoire of antiemetics to prevent or treat PONV.

Methods/Evidence Search: A systematic review of literature was performed through the Columbia University Library portal utilizing the databases CINAHL, MEDLINE, and PubMed. Keywords included: amisulpride, postoperative nausea vomiting, PONV, postoperative, and ondansetron. Full-text English articles published between 2013 and 2021 were included. After removal of duplicates, initial search yielded 39 articles which were then screened by title and abstract. After inclusion and exclusion criteria were applied, 31 articles were excluded. Inclusion criteria consisted of administration of amisulpride, the perioperative setting, and PONV. Exclusion criteria consisted of studies unrelated to PONV, animal studies, wrong patient population, and non-research reports. Eight full-text articles were reviewed and included in the final analysis. Among included articles, five were randomized, double-blind, placebo-controlled trials, two were systematic reviews with meta-analyses, and one was an overview of one of the comprehensive systematic reviews.

Synthesis of Literature/Results/Discussion: All included studies demonstrated that IV amisulpride was efficacious for PONV. Amisulpride was administered at different time periods perioperatively under various conditions. Six randomized controlled trials (RCTs) used amisulpride as the sole agent and two RCTs used it in combination with another antiemetic from another drug class. Based on the Apfel score, the risk level for developing PONV varied between the studies from low-to-moderate, moderate-to high, high-risk only, or did not specify the risk level. Most studies investigated amisulpride's effect on PONV when given as prophylaxis on induction of anesthesia. Two studies administered it as a rescue medication after PONV occurred postoperatively, and one examinated its use when given at any point in the perioperative period. A majority of studies achieved significant antiemetic efficacy with a 5mg dose of amisulpride while one study found 10mg of amisulpride to have a better antiemetic response. However, amisulpride in greater doses does not promise better antiemetic effects as one study found a 20mg dose of amisulpride to not have much improvement over placebo. All studies found that amisulpride had a safety profile similar to placebo with no clinically relevant adverse events, laboratory or electrocardiogram abnormalities, QT prolongation, extrapyramidal side effects, or sedation. No study found significant central nervous system or cardiac side effects.

Conclusion/Recommendations for Practice: Combatting PONV continues to be an area with unmet needs limited by concerns of inefficacy and adverse side effects of the current antiemetics from various pharmacological classes. Polytherapy by combining different classes of antiemetics for PONV prophylaxis and treatment may put the patient at risk for QT prolongation, extrapyramidal effects, or further sedation leading to prolonged length of stay. Through a review of the literature, low-dose intravenous

amisulpride has been proven to be efficacious in preventing and treating PONV with a benign safety profile. A 5mg, or 10mg, dose of IV amisulpride can be given on induction of anesthesia as PONV prophylaxis or as a rescue medication postoperatively for failed prophylaxis. Amisulpride is a valuable addition to the current selection of antiemetics without the extra risk of adverse effects. Future research can explore the integration of amisulpride into current PONV consensus guidelines and the impact of amisulpride on PACU and hospital length of stay.

Quality Improvement

Abstract 48

Waste Reduction of Arterial Line Access Tray

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Background: In the United States, hospitals generate more than 7000 tons of waste per day. A study done at the Duke Ambulatory Surgery Center (ASC) examined waste in the OR. Up to eight 30-gallon garbage bags of plastic and blue wrap were created by one OR at the ASC for three cases. The ASC performs 35 cases per day. This equals approximately 100 30-gallon garbage bags per day or roughly 700 pounds of garbage. It has been estimated that the operating room generates 20% to 33% of total waste produced in hospitals. The recent increase in disposable and single-use products has exacerbated waste production. Unused items also represent a serious source of waste in the OR. One institution observed 58 neurologic cases for unused item waste and estimated a yearly cost of $2.9 million in unused items wasted in the neurosurgical department alone. This represented 13% of surgical supply cost. To reduce the waste of unused items, this quality improvement project evaluated the OR arterial access tray in a large academic hospital.

Method: Across all adult surgical areas, a survey was attached to each of the original arterial access trays. The survey contained a list of each item in the tray and the user was asked to check whether the item was used or not used. Based on these results, a simplified sterile arterial access tray was created reducing the number of items from 15 to 5 that were regularly used. The simplified tray was introduced in all surgical areas except the cardiac surgical and cardiac catheterization areas. These areas retained the original trays because of item-use identified in the original survey, such as access to sterile lidocaine. A follow-up survey was conducted in the same format as the first to reassess the use of each item in the simplified tray as well as provider satisfaction. The results of the two surveys were compared to determine the amount of waste reduction that occurred.

Results: Significant waste was found in the original sterile arterial access tray in the form of unused items. The original tray had a total of 15 items per tray. We surveyed 195 trays equaling 2925 items of which 2211 (76%) items were not used. The simplified tray had five items. A total of 102 simplified trays were surveyed, equaling 510 items of which 98 (19%) were not used. Of the 98 items that were wasted, the foam needle holder accounted for 88% of them. Of the providers surveyed, 92% were equally satisfied or more satisfied with the simplified tray.

Discussion: There was a significant decrease in waste between the original sterile arterial access tray and new simplified tray. The most frequently wasted item in the new tray was the foam needle holder. Despite its low utilization, the foam needle holder is considered necessary for safety reasons. There were challenges in receiving enough of the original surveys from each OR area to adequately assess tray items used. The first survey was a paper survey attached to the outside of each tray that was then collected after it was complete. The second survey was online. It was linked to a QR code sticker placed on the outside of each simplified tray. This inadvertently made it more difficult to collect responses. Unlike the paper survey, which could be set aside to fill out later, the QR code sticker was often thrown away with the outer packaging and missed. As healthcare providers and stewards of the environment, it is our responsibility to manage our resources well. Waste reduction and provider satisfaction were improved

with the simplified tray. The significant number of unused waste items from the original tray reflects similar patterns of unused waste in the OR from previous research. This illustrates the necessity of additional quality improvement projects focused on waste reduction.

Funding Source: Mayo Clinic Anesthesia Department Equipment Committee

Abstract 49

Certified Registered Nurse Anesthetist Acceptance of Perioperative Guidelines to Prevent Emergence Agitation in Veterans with Post-traumatic Stress Disorder: A Quality Improvement Project

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Background: The Veterans Affairs (VA) system is the largest integrated healthcare system in the United States, annually performing 418,000 surgeries. Roughly 8.8% of these perioperative patients hold a post-traumatic stress disorder (PTSD) diagnosis. A PTSD diagnosis increases the risk for emergence agitation (EA), which can be triggered by anxiety, pain, or medical equipment. About 25% of veterans experience EA. In 2018, the Pittsburgh VA developed Project Golden Eagle, a multi-component intervention aimed at reducing EA. The St. Louis VA adopted its own version, “Project Eagle,', in 2022. Lack of participation by Certified Registered Nurse Anesthetists (CRNAs) can interfere with the adoption of new practice guidelines and contribute to the knowledge-to-practice gap between research and clinical practice. Successful implementation requires ongoing evaluation, auditing, and compliance with the guidelines. The purpose of this project was to evaluate CRNA acceptance of the new PTSD guidelines and improve patient outcomes with CRNA education.

Method: This QI project was approved by and conducted in cooperation with the St. Louis VA. A survey questionnaire was developed using content validity evaluation to assess CRNA experience with PTSD patients as well as their knowledge, acceptance, execution, and satisfaction with Project Eagle. The questionnaire was disseminated during a weekly staff meeting to the CRNAs who practice under a medically directed model. Questionnaire analysis revealed current acceptance of and barriers to guideline implementation. Educational resources such as a formal in-person presentation and physical handout were developed to address any barriers to practice uncovered by the questionnaire and promote the utilization of Project Eagle. The education focused on why each guideline was important in reducing risk and severity of EA. A reassessment survey questionnaire was distributed four weeks later to assess changes in CRNA knowledge, acceptance, execution, and satisfaction with Project Eagle.

Results: Twelve CRNAs completed the initial survey questionnaire. Analysis revealed multiple barriers which prevented guideline utilization that were beyond CRNA control, such as anesthesiologist medical direction, lack of participation by the perioperative team, limited medications available in the operating room, and patient comorbidities that limited medication management. It was noted that three CRNAs cited knowledge as a barrier. Seven CRNAs (58%) attended the in-person education, and handouts were placed in all CRNA mailboxes. The reassessment survey questionnaire was completed by 11 CRNAs. Barriers to guideline utilization included increased work and time and anesthesiologist medical direction.Only one CRNA cited knowledge as a barrier, and more CRNAs noted the use of available Project Eagle resources. The reassessment survey showed higher scores for coordinating with the anesthesiologist and perioperative team. Most scores for percentage of guideline utilization remained the same; however, two CRNAs reported using the guidelines more, and one used them less.

Discussion: Results of the initial survey showed CRNAs were aware of the guidelines and felt they received adequate training. Most of the surveyed CRNAs reported a low incidence of EA during their career and may not have seen a need for such guidelines. However, there was no correlation between EA experience and the percentage of guideline utilization. The ability of CRNAs to execute Project Eagle guidelines was limited by barriers outside their control. Patient comorbidities can limit the types of medications that can be safely administered. Overall utilization could improve by extending education to anesthesiologist and other perioperative staff. Total intravenous anesthesia is recommended, but an

increased quantity of medications such as propofol would need to be available in every OR. These barriers were shared with Project Eagle champions to provide feedback to improve utilization. Other limitations to the project included three newly hired CRNAs without formal training from Project Eagle champions. Despite best efforts at recruitment and retention, not all CRNAs attended the education presentation or completed the reassessment survey. Studies of the Pittsburg VA's Project Golden Eagle proved that it reduced the incidence of EA. Further studies can address the incidence of EA at the St. Louis VA and the effects of Project Eagle utilization. Continued QI efforts to audit, evaluate, and enhance Project Eagle are recommended.

Abstract 50

Decreasing Postoperative Opioid Consumption with Intraoperative Magnesium Sulfate

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Background: Opioids have been the mainstay of anesthesia for decades. Anesthesia providers often give opioid analgesics on induction, intraoperatively, and postoperatively to control surgical pain and increase patient comfort. Magnesium provides analgesia via N-methyl-D-aspartate (NMDA) receptor antagonism, utilizing intravenous, spinal, epidural, and even oral administration to reduce anesthetic requirements in the perioperative setting. The purpose of this work is to describe the evidence on the effectiveness of intraoperative intravenous magnesium sulfate at reducing postoperative opioid administration.
Method: Keywords from the following PICOT question were used to search four literature databases: Do surgical patients (P) who receive intravenous magnesium sulfate infusions intraoperatively (I) compared to similar patients who do NOT receive magnesium sulfate infusions intraoperatively (C) require less opioids (O) postoperatively (T)? Four randomized controlled trials were critically appraised. The results of these studies found a decrease in pain up to 48 hours postoperatively, a decreased need for opioid consumption, and an increased time interval before patients' first required postoperative analgesia.
Results: The randomized control trial (RCT) by De Oliveria et al., (2013), found that the use of magnesium sulfate intraoperatively improved quality of recovery scores in ambulatory surgeries and that patients required less opioids. Tsaousi et al., (2020), found that postoperative analgesic consumption was reduced by an average of 63.4 % in favor of magnesium sulfate when used intraoperatively with lower analgesic demands for 24 hours postoperatively and that there was a longer time interval for the first analgesic demand. Another RCT by Shin et al., (2016), showed that patients who received magnesium sulfate intraoperatively had lower visual analog pain scores and used less rescue analgesics during the first 48 hours postoperatively. Sousa et al., (2016), also found that patients who were treated with magnesium sulfate had less pain postoperatively as well as less overall morphine consumption.
Discussion: Magnesium used in the surgical population decreases postoperative pain up to 48 hours postoperatively, thereby decreasing the number of opioids given to patients during this time. Based on the cumulation of evidence, a change in practice will be recommended to increase the use of magnesium administration intraoperatively and decrease opioid consumption post project implementation.

Abstract 51

Decreasing the Incidence of Postoperative Urinary Retention (POUR) in Patients Undergoing Total Knee Arthroplasties

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Background: POUR is a common complication following total joint arthroplasty (TJA). It requires urethral catheterization that can prevent early patient discharge, increase length of stay (LOS) and hospital cost, and increase urinary tract infections (UTI)—ultimately causing an increased risk for periprosthetic joint infection. There are risk factors associated with the development of POUR. Anesthesia providers can intercept POUR incidence by identifying risk factors, including limiting intravenous glycopyrrolate and intrathecal narcotic use, selecting the appropriate local anesthetic, and increasing awareness of fluid administration. The overarching goal of this project was to implement a best-practice recommendations tool for identifying and preventing POUR in patients undergoing total knee arthroplasty (TKA).

Method: A care practice deficit was identified at a full-service hospital with a high volume of TKAs. No available best-practice guideline or protocol existed for patients at risk of POUR for anesthesia providers to reference. The objectives for this project were to reduce the occurrence of POUR, increase surveillance of patients at risk of POUR, reduce practice gaps, and increase CRNA knowledge about POUR management. A best-practice recommendations tool was created by synthesizing current evidence-based practice (EBP) for implementation at the clinical site. An in-service was held for staff, and the new EBP POUR tool was introduced. Pre- and post-test surveys were administered to assess provider knowledge regarding the practice change.

Results: Prior to implementation of this project, a chart audit was performed over the course of a month to identify the incidence of POUR. A total of 80 TKAs were performed, and 8.8% (n = 7) of these patients developed POUR. Additionally, there was no process in the preoperative setting for identifying patients at risk of POUR. Upon implementation, 12 staff members participated in pre- and post-test knowledge surveys of POUR risk factors and management. The mean score increased significantly (P =0.002) from a pre-test mean score of 3.58/10 and a post-test mean score of 6.58/10. A month following implementation, 49/74 (66.2%) of patients undergoing TKA were identified preoperatively as being at risk of POUR. Furthermore, there was an observed occurrence of 1.4% (n = 1) of POUR with a significance of (P = 0.039) following the implementation of this project.

Discussion: A total of 154 patients underwent TKAs in two months. Literature has identified the occurrence of POUR to range from 7% to 84% of surgical cases. Prior to the implementation of this project, the occurrence of POUR at this hospital fell within the identified percentages (8.8%). Following the implementation of identifying patients at risk of POUR and developing the EBP POUR tool, the occurrence of POUR dropped to 1.4% with a mean of 5.2%, which is below the identified percentages. POUR is a multifactorial problem that begins with the patient's comorbidities and is affected by the care provided in the pre-, intra-, and postoperative phases. The incidence of POUR is decreased if providers are aware of potential risk factors and follow best-practice recommendations. Limitations to this project include inconsistencies found in documentation while performing chart audits. Additionally, using the EBP POUR tool is encouraged but entirely up to the provider's discretion. Early interventions optimize patients throughout the care process to decrease complications. Ultimately, the healthcare system and patients benefit by identifying risk factors, optimizing patients, and decreasing complication rates.

Abstract 52

Endotracheal Tube Loss of Resistance Air Release Method

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Background: Safe range for endotracheal tube (ETT) cuff pressures is 20 to 30 cmH2O. When pressures are above 30 cmH2O, tracheal blood flow is decreased. Approximately 88.9% of cuff pressures are beyond the safe range, increasing the risk of airway complications. Instead of using more objective measurements, most anesthesia professionals determine the ETT cuff pressure by palpating the pilot balloon. The best method for obtaining and maintaining safe cuff pressures (20 to 30 cmH2O) is the cuff pressure manometer, although it is not generally used because of its high cost. Depending on how many operating rooms a hospital has, this equipment may be expensive; manometers range in price from $200 to $400 each. There is currently no institutional or universal protocol in place to objectively measure cuff pressures. The loss of resistance (LOR) air release method decreases overall pressures within the ETT in up to 90% of cases.

Method: OMRU framework and AGREE-REX tool were incorporated for clinical viability. A paired t-test compared pressures before and after, and a descriptive analysis for statistical evaluation was completed. During the phase 1 practice analysis, 42 random ETT cuff pressures were measured showing 88% overinflation rate. Recommendations were developed in phase 2, an educational program was formed in phase 3, dissemination of the recommendations occurred in phase 4, and a reassessment was conducted in phase 5. An instructional video of the LOR air release method was recorded in the simulation lab. After confirming appropriate ETT position, the pilot balloon was inflated with air using 10mL syringe. The syringe was not fully compressed, leaving less than two mL to decrease resistance to equalization within the trachea. Excessive pressure within the trachea enabled air to return to the syringe, providing a conduit for normalizing the cuff's pressure by releasing excess air.

Results: Fifteen CRNAs participated and 10 pre- and post-intervention ETT cuff pressures were assessed. Paired t-tests evaluating the difference between phase 1 and phase 5 cuff pressures were statistically significant ($P = 0.001$). The mean ETT cuff pressure pre-implementation was 65 cmH2O and post-implementation was 26.7 cmH2O. It was discovered that 79% of the providers were previously unaware of this method, only 33% knew the recommended cuff pressure range, and 85.7% had no prior technique for checking excessive pressures. Provider willingness to change their practice and ease of adaptability were 100%. Rating the level of importance of the values and preferences of anesthesia providers with implementing the LOR air release method, 93% believed the level was of the highest importance, while 7% remained neutral. Overall, 100% of CRNAs correlated usage of the LOR air release method with achieving appropriate cuff pressures, and 86.7% found the technique effective in decreasing the risk of adverse patient outcomes.

Discussion: Key findings showed a decrease in 100% of the cuff pressures using the LOR air release method, with 80% of the pressures decreasing into the recommended range of 20 to 30 cmH2O. Only two cuff measurements were slightly above the recommended range after the intervention. One measurement at 32 cmH2O occurred after correcting an underinflated cuff, and one at 34 cmH2O reflected a decrease from the initial 90 cmH2O. For comparison, a level I RCT by Bulamba et al. found that 66.3% of cuff pressures maintained the recommended pressure of 20 to 30 cmH2O using the LOR air release method, while an RCT by Laksono et al. found 77% accuracy using a similar technique known as passive air release. This practice recommendation did not significantly impact current practice activities. After ETT pilot balloon inflation with a 10mL syringe, the providers left it attached until the pressures

equilibrated. Some limitations are checking the ETT cuff pressure only after tracheal intubation but not at continuous intervals during the procedure, not including any special tubes other than regular ET tubes, and not including patients with neck pathologies. In conclusion, the LOR air release method reduces excess pressure on the trachea, requires no extensive deviation from current practice, is easily adaptable, cost-effective, and enhances patient outcome.

Abstract 53

Enhancing Anesthesia Providers' Knowledge and Utilization of Intraoperative IV Methadone for Pain Management

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Background: Due to high prevalence of chronic back pain, opioid-tolerant military veterans may need higher intraoperative does of opioid drugs, increasing the risks of persistent opioid use. Veterans are twice as likely to die from accidental opioid overdose when compared to the general population. Despite the addictive nature of opioids, 98.6% of US surgical patients receive opioids for perioperative pain management. CRNAs play a significant role in perioperative opioid administration. This quality improvement (QI) project focused on increasing anesthesia providers' knowledge of methadone's benefits for pain control in the intraoperative period at a regional Veterans Affairs (VA) medical center. The project's aim was to increase provider knowledge and assess readiness to implement knowledge through educational presentations, educational materials, and implementation of a patient pre-screening tool.

Method: This QI project followed The Johns Hopkins Evidence-Based Practice (EBP) model for nurses and healthcare professionals. It used the three-step process P-E-T: practice question, evidence, and translation. The goal of the model was to compile the latest evidence on intraoperative methadone use and incorporate best practice recommendations for surgical patients. Synthesis of evidence was used to develop an educational poster, an anesthesia-specific educational fact sheet, and multimedia presentations. An evidence-based patient screening tool was developed to assist in patient pre-screening for the safe administration of intraoperative methadone and was embedded in the electronic health record (EHR) system for easy access. Pharmacy was consulted on the ordering recommendations. Data were gathered via a demographic questionnaire, a six-question pre-and post-education quiz, and a two-question Likert scale. Fifteen anesthesia providers participated: six CRNAs and nine SRNAs. A samples t-test was used to analyze the data with the statistical software Jamovi.

Results: Fifteen participants answered four demographic questions and six pre- and post-education quiz questions. Knowledge scores increased from a mean of 48.8% to a mean of 98.1%. The participants also answered two Likert-scale survey questions concerning their comfort with using methadone and their likelihood of using the methadone pre-screening tool. Comfort with the use of methadone for intraoperative pain management increased by 22%. The likelihood of anesthesia providers using the methadone patient pre-screening tool increased by 23%. Monitoring for the utilization of the methadone pre-screening tool is ongoing and is being measured by provider self-reporting and chart audits. One-month post-implementation, seven patients have received intraoperative methadone for pain management with no adverse outcomes reported.

Discussion: The project's main objective was met, as an evidence-based QI practice change was incorporated at the regional VAMC. Anesthesia providers received education based on the latest peer-reviewed research and are currently utilizing the newly created tools embedded in the EHR charting to administer methadone intraoperatively. A pre-and post-education test showed statistically significant outcomes of the educational efforts. Most notably, patients at the VAMC have begun to receive IV methadone for intraoperative pain control as a direct result of the multidisciplinary team's efforts. As part of the sustainability plan, the newly created methadone pre-screening tool and a methadone pharmacy order tool have been embedded in CPRS, the VA's charting system. These have been successfully utilized by the staff. The tools have also been made available as physical copies. A strong

relationship has been established with the anesthesia team at the VAMC. An onsite champion will continue to address concerns and provide education afterthe project has been completed. Educational and reference materials have been made readily available for public use and continue to be shared among the pharmacy and anesthesia teams. The veteran patient population is now benefiting from the utilization of methadone, with seven patients treated with the medication without any adverse side effects.

Abstract 54

Enhancing Anesthetic Management of Heart Failure Patients During ICD Implant Using Clinical Practice Guidelines

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Background: The severity of disease in heart failure patients presenting for implantable cardioverter-defibrillator (ICD) surgery complicates patient stability under anesthesia, yet no clinical practice guidelines (CPGs) exist describing their ideal anesthetic management. Without CPGs, anesthesia providers are missing a key decision support tool that could offer perspective, insight, and peace of mind in a high-acuity setting. The purpose of this evidence-based, quality improvement (QI) project was to develop, implement, and evaluate the effects of population-specific CPGs on anesthesia provider knowledge and self-efficacy while anesthetizing patients for ICD implant.

Method: Set in the electrophysiology (EP) lab of an urban, tertiary care facility known for its heart failure clinic, this project utilized a pre- and post-test design comparing anesthesia provider knowledge and self-efficacy. A convenience sample was drawn from the anesthesiologists and nurse anesthetists staffing the EP lab during the 12-week project period from September to December 2022. The intervention was anesthesia provider self-education and application of web-based guidelines, which were provided at the point of care. Surveys used to assess impact included a novel instrument to measure provider knowledge and a pre-validated scale to measure self-efficacy.

Results: Thirty-four participants who met inclusion criteria were recruited from the pool of anesthesia providers working at the project hospital EP lab. A total of 26 completed the pre-test, accomplished the intervention, and completed the post-test. All data were self-reported, compiled in Qualtrics, and analyzed with SPSS following project conclusion. A statistically significant improvement in median anesthesia provider self-efficacy was demonstrated via the Wilcoxon signed-rank test (33.5 vs 34, P = 0.038), with no change in median anesthesia provider knowledge (13 vs 13, P = 0.145).

Discussion: This project advanced the field by delivering concrete outcome measures on the clinical application of theory-based QI goals. While no studies have been conducted to quantify the impact of CPGs on anesthesia provider clinical practice, project findings were consistent with current theories which posit that the application of CPGs increases the likelihood of desirable outcomes and the provision of care congruent with contemporary professional standards. Significantly improved anesthesia provider self-efficacy advanced the goal of using CPGs to manage precursors before they develop into problems. The project's limitations were that the CPG development process and product were deeply characterized by the project hospital, which may not match the need or resources available at other facilities. The knowledge survey was developed de novo for this project under the guidance of experts and evaluated for face and content validity but was not piloted for validity or reliability. The sample size was small (N = 26) and underwent substantial attrition from project start (N = 34). Adding CPGs to the pool of resources available to anesthesia providers, however, is both feasible and effective in the clinical environment. Findings from this project can be used to advocate for the provision of population-specific CPGs in unique, remote, and under-supported clinical settings.

Abstract 55

Ensuring Patient Safety: Developing Strategies to Minimize Medication Errors with Look-alike Vials

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Background: Drug errors occur in up to 41.3% of hospital admissions and lead to 22% of readmissions after discharge. Medication errors are concerning in high-demand areas such as the operating room (OR). Anesthesia professionals (AP) are typically the sole providers involved in prescribing, formulating, dispensing, and administering drugs. This responsibility creates space for large errors. AP have medication trays with a variety of high-risk medications often containing more than one look-alike vial. Medications with identical appearances or naming account for 10% of medication errors, with 29% due to look-alike or sound-alike medicines. The goal of this project was to prevent medication errors related to look-alike vials in the OR. The objectives were to evaluate practice gaps related to medication safety in the OR; increase provider knowledge on medication safety; and evaluate providers' perceptions of near-misses and medication errors.

Method: This project was conducted in the ORs at a regional Veterans Affairs (VA) hospital with a focus on anesthesia providers. The Iowa Model translational framework was followed along with a pre- and post-test design. An environmental assessment was performed at the clinical site with deficiencies noted in medication tray layouts in current dispensing machines. Pre-test and Likert scale surveys were completed before modifying medication trays. Implementation of an evidence-based practice (EBP) checklist for medication tray safety was initiated, which included removing unused medications, moving infrequently used medications toward the back, and separating look-alike vials. "Look-alike" warning stickers and cognitive aids were placed over every medication machine. AP were given an educational session on medication safety recommendations and newer tray setups. Post-test surveys were completed. A post-implementation environmental assessment occurred using the same checklist.

Results: The pre-implementation environmental assessment revealed that zero items (0/5) were met from the EBP checklist. Therefore, one unused medication was removed from the cart, one infrequently used medication was moved to the back of the anesthesia tray, and two sets of look-alike vials were separated. Following implementation, 4/5 items were met from the EBP checklist, demonstrating an 80% improvement. Provider knowledge was assessed following an educational session using a pre- and post-test design. Pre-test mean scores were 4.2/8, and post-test mean scores were 7.7/8 (n = 10). Analysis of data revealed a statistically significant increase in anesthesia providers' knowledge regarding medication safety with a P value = 0.006. The Likert scale perceptions survey regarding medication errors and AP habits revealed 86.7% of providers agree that AP fail to report drug errors out of fear, and 86.7% also agree to rely on other visual pointers such as size, color, and location of vials when dispensing medications (n = 15).

Discussion: Decluttering anesthesia trays and separating look-alike vials is a cost-effective method to decrease the risk of medication errors. Additionally, environmental checklists serve to identify and lessen practice gaps. Inexpensive measures such as stickers and cognitive aids may add a visual alert to warn providers of "look-alike" vials. While the literature on medication errors within anesthesia is limited, anonymous Likert scales surveys are an adequate way to assess providers' perceptions. The AP perceptions survey revealed a variety of important information with important implications for practice. AP did admit to inadvertently selecting the wrong vial based on appearance, which exhibited this project was significant. It also confirmed that most AP have heard of or witnessed a medication error or near-miss during their careers. Furthermore, the survey revealed AP avoided reporting errors due to fear. This

project was a great opportunity for institutions to look at the adoption of a just-culture where providers feel safe reporting errors, thus avoiding future patient harm. Additionally, the project showed that solutions are best met using an interdisciplinary team. Building a strong relationship with the pharmacy team was vital within the perioperative area and could help prevent future medication errors.

Abstract 56

Evaluating the Impact of a Standardized Oxytocin Protocol on Maternal Hemorrhage after Caesarean Delivery

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Background: Maternal hemorrhage is the leading cause of morbidity and mortality during delivery, resulting in 70,000 maternal deaths annually (WHO, 2023). These complications are experienced 3x higher in Black women than White women (CDC, 2019). Despite medical advances, maternal death rates continue to rise in the United States, highlighting the vital need for assessment of practice. While the first-line treatment for hemorrhage is administering oxytocin, the dosing, infusion modes, and rates vary. When administration relies on provider discretion, unconscious bias can factor into the care provided. Literature shows that standardized oxytocin protocols decrease hemorrhage rates, decrease uterotonics, and reduce blood product requirements (Seagraves, et al., 2019). These reductions improve care and facilitate decreased costs to the hospital and the patient. The purpose of this project was to evaluate the impact of a standardized oxytocin administration protocol for Caesarean delivery (CD) on hemorrhage rates and if related racial and ethnic minority disparities exist.

Method: Two hospitals within one healthcare system implemented an oxytocin protocol in October 2021 as an initiative to standardize care and reduce hemorrhages. This quality improvement (QI) project aimed to evaluate the protocol's impact utilizing a retrospective chart review of electronic health records for CDs between January 2022 and December 2022 at the academic medical center, a Level IV maternal care unit supporting ~ 2500 deliveries per year. The chart review extracted demographics, quantitative blood loss (QBL), uterotonics, and blood products required. Exclusion criteria included factors that significantly increase hemorrhage risk such as placenta abnormalities and multiple gestations. All other CDs with a QBL > 1500 mLs were included in the chart audit and were individually reviewed for outcomes and protocol adherence. Extracted data for a one-year period prior to October 2021 were compared to the post-protocol data using an unpaired t-test. Data with P values < 0.05 were determined to be variables significantly impacted by protocol implementation.

Results: A total of 909 CDs occurred post-protocol. Sixty-nine recorded cases of QBL ≥ 1500 mLs were evaluated. A total of 38 patients were included and 31 patients excluded. The pre-protocol period included 699 CDs, with 38 cases meeting inclusion criteria. The demographic difference of these two groups was not significant. Post-protocol the occurrence of hemorrhage was determined to be 4.18%. The average QBL was 2022 mLs with an adjusted average excluding outliers determined to be 1763 mLs. In the pre-protocol period, the occurrence of hemorrhage was 5.4%. The average QBL was 2037 mLs with an adjusted average showing 1836 mLs. This demonstrates a decrease in both hemorrhage occurrence and average QBL in the post protocol period. When examining drug utilization post protocol, it was determined that there was a significant decrease in doses of oxytocin per patient (P < 0.0001), doses of methergine per patient (P = 0.0005), and doses of TXA per patient (P = 0.02).

Discussion: After implementation of the oxytocin protocol, the occurrence of hemorrhage with CD decreased from 5.4% to 4.18%. While the average QBL, both with and without outliers, also showed a decrease post-protocol, the decrease was minimal and not determined to be significant. However, the impact of the protocol on average blood loss suggests that it decreases QBL since a significant decrease in the doses of both methergine and TXA were found per patient in the post-protocol period. The significant decrease in doses of oxytocin per patient is also noteworthy since oxytocin is a high-alert medication with multiple side effects directly correlated to increase in dose. From this collection of data,

it can be reasonably concluded that the implementation of an oxytocin protocol during CD is a beneficial and clinically significant tool for preventing the occurrence of hemorrhage. Additionally, it can be concluded that implementation of the protocol also decreases the requirements for additional medications which is financially beneficial and safer for patients. One limitation of this study was the unique events of the COVID-19 pandemic which was at its height during the pre-protocol period of the study. Another limitation was missing or incorrectly charted data since the study relied on chart completeness and validity.

Funding Sources: HRSA Healthy Start grant at Cincinnati Children's Hospital Medical Center, Maternal Mortality subcontract to the University of Cincinnati.

Abstract 57

Implementation of a Medical Mission Experience in a Doctor of Nurse Anesthesia Practice (DNAP) Degree Program

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Background: Students across the United States are showing increased interest in medical mission opportunities during their education. Participation in medical mission experiences provides numerous positive outcomes for students, including increased confidence in medical knowledge and skills, improved cultural and interpersonal confidence, and professional development. Since the Doctor of Nurse Anesthesia Practice (DNAP) Program at the project institution did not provide any formal global health opportunities for student registered nurse anesthetists (SRNAs), developing a process for offering SRNAs such an opportunity was identified as a potential area of growth for the program. The purpose of this quality improvement (QI) project was to develop a comprehensive, elective medical mission opportunity for SRNAs. Development of the experience involved assessing SRNA perceived barriers to medical mission participation, alignment with a mission organization, securement of funding to support SRNA participation, and development of educational materials to ensure adequate SRNA preparation for the experience.

Method: A survey was developed to assess SRNA interest and perceived barriers to medical mission participation. An investigation into potential medical mission organizations with which to align was undertaken, and a partnership was subsequently formed with an organization from the Midwest. The SRNA investigator then participated in a mission trip with this organization in 2022 which allowed the investigator to gain first-hand experience and insight that provided the basis for development of a toolkit to prepare future SRNAs for medical mission participation. The DNAP Program also aligned with the institution's International Health Program (IHP) to acquire funding for student participation, and an application and selection process for interested SRNAs was developed.

Results: Sixty SRNAs responded to the survey regarding motivators and barriers to medical mission participation. The top motivators included serving others, opportunities for new experiences, and improved resourcefulness. These motivators were consistent with the student investigator's mission trip experience. The top barriers identified were cost, time away from family, and limited anesthesia experience. Regarding cost, the DNAP Program aligned with the institution's IHP to obtain funding to support SRNA participation. Lack of anesthesia experience was addressed by the creation of a pre-departure toolkit for future SRNA use. Toolkit content was evidence-based and included insights gained by the SRNA investigator during their mission experience. It was decided that only senior students would be eligible for participation and must be supervised in a 1:1 model while on the trip. Lastly, an application process that included essays, references and program director approval was developed to ensure that only the most qualified SRNAs be considered for participation.

Discussion: The SRNA survey revealed enthusiasm for participation in medical mission experiences, which is consistent with the literature. The survey also helped identify barriers to SRNA participation; interventions to reduce these barriers provided the foundation for much of what was accomplished by this project. -The immersive experience of participating in a medical mission experience, viewed through the lens of the investigating SRNA, provided invaluable insights that allowed an elective medical mission opportunity to be incorporated into the DNAP Program. Alignment with a funding source in the institution helped to overcome the identified barrier of cost. The application/selection process will be

utilized for the first time in the summer of 2023 for mission participation in April 2024. The true impact of the project will not be known until after the first SRNA participates; however, all indicators point to this being a successful addition to the DNAP Program. Anticipated long-term impacts include increased SRNA personal enrichment and inspiration for continued medical mission involvement during an SRNA's anesthesia career.

Abstract 58

Implementing and Evaluating a Virtual Continuing Professional Development Platform for Nurse Anesthetists in Cameroon

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Background: Insufficient anesthesia workforce and lack of continuing education for trained providers are barriers to developing and retaining nurse anesthetists (NAs) in many systems. These barriers impact access to safe surgery. Cameroon, a bilingual Central-West African Low-Middle Income Country (LMIC), records just 0.7 trained anesthesia specialists per 100,000 population compared to the accepted minimum recommendation of four or five anesthesia specialists per 100,000. In addition to inadequate human and technical resources for anesthesia delivery, following graduation Cameroonian NAs have little access to continuing professional development (CPD) and professional networking where knowledge and ideas are shared. Infrastructure factors impede developing formal CPD programs. To fill these gaps, this quality improvement (QI) project implemented and assessed the impact of including Cameroonian NAs in an existing monthly virtual (v)CPD program organized by NAs in Liberia and the US and based on International Federation of Nurse Anesthetist (IFNA) practice competencies.

Method: This QI project employed pre- and post-intervention Qualtrics-generated questionnaires that were deployed via WhatsApp in French and English. The pre-questionnaire (28 items) assessed practice needs, demographics, and desire to participate in vCPD. An established monthly vCPD program, run by Boston Africa Anesthesia Collaborative members in Liberia and US, was broadcast via Zoom or YouTube to NAs in Cameroon over nine months. Participants who joined at least two vCPD sessions during the project period provided post data. Post-intervention questionnaires (30 items) explored the perceived practice impact of CPD and solicited feedback on content, impediments, and professional value. Data were downloaded from Qualtrics to Excel and underwent SPSS statistical analysis. A comparison of the pre-and post-survey responses and content analysis of qualitative evidence were completed using descriptive statistics and cumulative data analysis. Combined evidence analysis was used to recommend best content and structure for future CPD.

Results: The pre-survey was completed by 71 anesthetists and the post-survey by 58. Just over half the participants chose the English survey version. Patient safety concerns were reported including lack of skilled colleagues, not routinely integrating the surgical safety checklist, unavailability of pulse oximetry in the PACU, and being asked to anesthetize more than one patient concurrently. Over a third of NAs described simultaneously caring for more than one patient. Safety concerns were greater at rural hospitals, but urban centers also showed areas for practice improvements. The post-survey reflected satisfaction with the content of the vCPD in both Likert and qualitative analysis. Satisfaction with vCPD was noted by 100% of English-speaking respondents and 73% of French speakers. Participants cited poor connectivity as the main barrier to participation, with work conflicts and language difficulty also noted. All subjects agreed topics were valuable and reported perceived positive impact on their anesthesia practice.

Discussion: Both the IFNA and International Council of Nurses (ICN) have published global guidelines for the advanced practice of nurse anesthesia that include competency-based CPD which they label as “core professional requirements.” Research shows that participating in CPD can improve practice and retention of health professionals. NAs perform most of the anesthetics in Cameroon, but formal CPD is unavailable. This QI project determined the feasibility and impact of broadcasting monthly anesthesia

vCPD programming to Cameroonian NAs through a joint effort of Liberian and US NAs. Preintervention results showed that the Cameroonian NAs desired CPD and also demonstrated opportunities for cost-neutral practice improvement such as regular use of a surgical checklists, consultation, and limiting anesthesia coverage to one case at a time. The post-survey was deployed to NAs who attended vCPD sessions on Zoom or YouTube. Programs during the project period included case reports of complications such as pneumothorax or hemorrhage, obstetric management, anesthesia equipment workshops, and EBP discussions. All participants found the topics relevant to their practice. Recommendations include upgrading WiFi, adjusting the schedule for broadcasts, and including Cameroon-context topics. This project reveals that there is an opportunity for transnational collaboration for vCPD that can promote perceived positive impact on anesthesia practice.

Abstract 59

Increasing Utilization of Electromyography Neuromuscular Monitoring to Prevent Residual Neuromuscular Blockade

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Background: It is estimated that residual neuromuscular blockade (rNMB) occurs in 20% to 40% of patients. rNMB is associated with airway obstruction and other harmful consequences. It is imperative that neuromuscular monitoring is utilized considering the dangers of rNMB. Acceleromyography (AMG) and electromyography (EMG) neuromuscular monitors are widely used technologies capable of estimating the TOF ratio. Although the literature shows that AMG has superior accuracy and specificity compared to peripheral nerve stimulators (PNS), AMG inaccurately estimates the train-of-four (TOF) ratio if the stimulated limb is immobilized. Even when the elicited arm movement is limited, EMG monitors show improved reliability and specificity and even outperform AMG in tracheal extubation readiness. Additionally, EMG is associated with a decrease in postoperative reintubation rates. The goal of this quality improvement (QI) project was to increase the utilization of quantitative electromyography neuromuscular monitors in patients receiving neuromuscular blocking agents.

Method: To assess the current utilization, both electronic medical records and in-person observation were utilized. The participants were administered pre- and post-knowledge surveys. The surveys included questions that evaluated their knowledge of rNMB, familiarity with the EMG device, the advantages of technology, existing barriers to usage, and readiness to adopt new practices. A learning module covering rNMB and related technology was provided via email and then supplemented with in-person training. The participants completed the pre-knowledge survey, participated in the learning module, and then completed the post-knowledge survey. The pre-knowledge survey gathered demographic data, as well as information on rNMB effects and EMG technology knowledge, self-reported EMG device usage, willingness to change current NMB monitoring practices, confidence in NMB monitoring, the benefits of monitoring, and barriers for utilization.

Results: EMG utilization from weeks one and two (*N* = 19) were compared to weeks three and four (*N* = 19), with a total of 38 cases. In the first two weeks, eight out of 19 cases (42%) were monitored with EMG; during the second two weeks, 10 out of 19 (53%) cases were monitored. There was an increase in utilization by 11% when comparing weeks one and two to weeks three and four. Of the 38 patients who received neuromuscular blocking agents (NMBAs), a total of 47% (*n* = 18) were monitored by the EMG device during the total four weeks, while the remaining 53% were monitored by PNS or did not receive neuromuscular monitoring. A total of 19 nurse anesthetists participated in the project: 14 CRNAs and five SRNAs. Statistical tests from pre- and post-surveys were performed by a paired t-test to compare their test scores before and after the learning module. Adjustments were made to the *P* value through the Bonferroni correction test. The average score on the pre-knowledge survey mean was 9.42, while the post-survey average score was a mean of 9.95 with a median of 10.

Discussion: The project's goal was to increase the utilization of EMG devices by 20%. An increase of 11% was achieved. The sample size of 38 cases was determined to be sufficient representation of the current utilization rate. Knowledge scores increased, showing a positive correlation between education and increased utilization. The initial assessment was to measure automatically recorded TOF ratio data; however, this capability wasn't functioning in the implementation phase, thereby limiting the sample size. Hardware limitations included missing devices, broken cables, and broken monitors. A sustainability strategy involved an alert box on the electronic medication administration record (eMAR) which

provided a reminder to apply the neuromuscular monitor. The development of practice standards is urgent because of postoperative airway complications, muscular weakness, and delay in PACU discharge. In this project, clinicians were encouraged to adopt enhanced standards of neuromuscular monitoring which can lead to policy changes by enforcing the use of objective monitors for every patient receiving NMBAs. The project positively impacted the utilization of EMG monitors and initiated indispensable discussion on practice improvement of NMB monitoring, improved provider knowledge, confidence, and utilization. It is imperative that all patients receive appropriate monitoring, a major opportunity for improvement in anesthesia.

Abstract 60

Leveraging System Interventions: An Automated Dispensing Cabinet Alert Influences Anesthesia Provider Medication Preparation in a Remifentanil Waste Reduction Initiative

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Background: Remifentanil is an expensive anesthesia adjunct that when wasted increases financial, environmental, and diversion risks. Preventable remifentanil waste, defined as disposing of IV infusion bags containing ≥ 1 mg or ≥ one full vial of unused drug, is generated by reconstituting more remifentanil lyophilized powder than required for the surgical case. Prior internal quality improvement (QI) work highlighted wasteful practices concerning remifentanil overmixing leading to preventable waste. Baseline data suggest that 21.9% of cases using remifentanil have preventable waste. Interventions that target the preparation of remifentanil that is not administered are appealing because while cost-conscious, these approaches do not limit patients' treatment with remifentanil. This QI initiative aimed to decrease the occurrences of remifentanil waste of ≥ 1 mg (one full vial) by 25% in the surgical division of the Mayo Clinic Rochester Campus while maintaining 60% of providers' satisfaction with the remifentanil mixing workflow over one year.

Method: A time-series design QI initiative targeted preventable remifentanil waste. Individual interventions provided education, an awareness campaign, practice champions, and access to a dose estimation tool. An automated dispensing cabinet (ADC) alert served as the system intervention. The ADC alert displayed a message encouraging providers to reference a dose estimation tool when removing remifentanil. Staff had access to the individual level interventions for four weeks prior to the system intervention initiation. To validate the effectiveness of the ADC alert, it was active for 12 weeks, paused for 12 weeks, then reinstated for 12 weeks. Remifentanil waste data came from the ADC. As a counterbalance, pre- and post-intervention surveys were utilized to investigate providers' perceptions of the remifentanil mixing workflow. Data analysis occurred in SAS version 9.4 (SAS Institute, Carry, NC) and compared intervention periods using a chi-square test from JMP Pro 14.0 (SAS Institute, Cary, NC).

Results: Results showed a statistically significant reduction in remifentanil waste from 21.9% at baseline to 16.7% ($P < 0.001$) during the final data collection. After the online education module, preventable waste went to 20% ($P = 0.339$). Combining the education and activation of the ADC alert, preventable remifentanil waste decreased from 21.9% to 16.2% ($P < 0.001$). With the ADC alert pause, preventable remifentanil waste increased to 20.3% ($P = 0.006$). Reinstatement of the ADC alert showed preventable waste reduction to 16.7% ($P = 0.015$). The survey results included 116 respondents (23% response rate) to the pre-survey and 103 (20% response rate) to the post-survey. The pre- and post-survey respondents had similar roles ($P = 0.306$), years of experience ($P = 0.433$), and frequency of remifentanil use ($P = 0.306$) measured by a chi-square test. After the implementation, more providers felt satisfied with the workflow ($P = 0.002$), felt the workflow was more time efficient ($P = 0.019$), and felt that they never wasted more than 1 mg of remifentanil ($P < 0.001$).

Discussion: This initiative reduced preventable remifentanil waste by 24%, saving $27,000 (wholesale acquisition cost estimation). Education and an ADC alert resulted in the greatest waste reduction. Limited literature exists on remifentanil waste reduction, but broader evidence suggests system-level interventions are effective. The Institute of Safe Medication Practices (ISMP) recommends such interventions, as individual-level interventions alone lack power. The findings of this QI project support this, as individual-level interventions alone did not significantly reduce waste. Limitations include

incomplete ADC data points (0.23% of > 20,000), potential for human error in waste documentation, a shorter timeframe for the education intervention, and overlap of the baseline data for this project with an education intervention from a prior institutional QI project. We concluded that the system intervention of the ADC alert reduced preventable remifentanil waste more than education alone and a more conservative mixing workflow increased anesthesia providers' satisfaction. These findings provide valuable insights for anesthesia providers looking to drive change and reduce preventable waste in healthcare.

Funding Sources: This work was supported by departmental funding (Department of Anesthesiology, Mayo Clinic, Rochester, MN)

Abstract 61

Malignant Hyperthermia Crisis: Enhancing Provider's Emergency Response through Virtual Reality (VR) Simulation

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Background: Malignant hyperthermia (MH) is a rare, potentially fatal, inherited condition of genetically defective calcium channels in the skeletal muscle that presents as a hypermetabolic crisis triggered by exposure to inhalation anesthetics or succinylcholine. Crisis management for high-risk, low-frequency events such as MH can be challenging for Certified Registered Nurse Anesthetists (CRNAs) due to limited experience with or exposure to the condition and a lack of knowledge, self-confidence, or skills that are vital for a successful emergency response. High-fidelity traditional simulation offers a safe environment to practice crisis management but is costly and time-consuming. Virtual reality (VR) simulation provides a more cost-effective and efficient way of improving knowledge, confidence, and skills through three-dimensional graphical simulation education using VR headsets. This quality improvement (QI) project sought to enhance CRNAs' knowledge, self-confidence, and competency in responding to MH crises through VR simulation.

Method: This QI project was implemented in an academic hospital in Miami, FL. An MH infographic educational resource was distributed to the CRNAs prior to the training. The Oculus headset with MH VR simulation software, created by a Colorado-based technology company, incorporated voice technology enabled by artificial intelligence (AI). Avatars carried out the participants' commands while acting as team leaders. Each VR simulation was done in 15-20 minutes, including a debriefing session by the avatar. A 15-item MH knowledge test was designed to assess knowledge. Five-point Likert scales were utilized to evaluate self-confidence and satisfaction. The core competency checklist embedded in the VR simulation was used to assess participants' skills. A one-way ANOVA was used to test demographic relationships, and a Wilcoxon signed ranked test was used to statistically analyze the results of the knowledge and self-confidence tests. Based on the results of the skills test and satisfaction survey, a percentage data analysis was conducted.

Results: Demographic questions collected data including participants' age range, gender, years of experience, and prior MH crises experiences. Only two of the 16 participants had experienced an MH crisis. Analysis showed no correlation between the years of experience to MH knowledge and self-confidence mean pre-test scores. Half of the participants had worked as CRNAs for a period of six to 15 years, and three had worked for more than 25 years. After the MH VR simulation, there was a significant increase ($P < .005$) in MH knowledge and self-confidence. The MH knowledge mean pre-test score improved from 9.31 to a mean post-test score of 13.38 out of 15 questions. The self-confidence mean pre-test level of 3.44 went up to a mean post-test level of 4.75. The core competency skills test was passed by 62.5% of the participants Even though only one participant out of 16 had previously used a VR headset, all participants were highly satisfied with the VR simulation modality and would recommend it to others.

Discussion: Overall, the results showed significant improvements in MH knowledge and self-confidence after the CRNAs had gone through the MH infographic educational material and the MH VR simulation. Analysis of participants' technical skills revealed that only 62.5% of the CRNAs who participated scored more than 80% on the core competency test. After each simulation, a debriefing was conducted by the virtual moderator/avatar showing the participants what was missed. The low passing rate may be attributed to the novel simulation technology not encountered by the participants in the past and to the

limited exposure to MH crises. Due to time constraints, each participant only went through the simulation once. It is recommended to schedule at least one hour per participant to repeat and perform VR simulations with debriefing and to have more than one headset available at a given time. Multiple studies have proven the VR technology's effectiveness in simulation education in different fields. However, no study has been conducted to determine the effectiveness of MH VR simulation as an educational tool for anesthesia providers. In conclusion, MH is a high-risk, low-frequency event that may lead to serious adverse outcomes. VR simulation is an effective teaching method that improves the preparedness, knowledge, self-confidence, and competency of the CRNA during an MH crisis.

Funding Sources: This QI project received support from Jackson Health System (JHS), Miami, FL. The Oculus headset with MH VR Simulation software was provided free of charge by Health Scholars before purchase by JHS.

Abstract 62

Perioperative use of an aprepitant for the prevention of postoperative nausea and vomiting in pediatric patients

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Background: Postoperative nausea and vomiting (PONV) is one of the most frequent and distressing adverse events occurring during the postoperative period, with vomiting accounting for up to 77% of all adverse events in the post-anesthesia care unit. PONV can result in prolongation of the postoperative course, extended hospital stays for both inpatient and outpatient surgery, unanticipated hospital admission, and readmission. The incidence of PONV in children can be as high as 30% without prophylaxis, and can increase to 80% in high-risk patients. Current medications used for prophylaxis of PONV are generally effective but are not appropriate for all patients and all clinical scenarios. In a prior study at our hospital, we described our initial 12-month experience with the administration of an aprepitant in a perioperative scenario to a cohort of pediatric patients. The current study expands on that experience.

Method: A list of patients who received an aprepitant as generated. Patients < 18 and who previously received an aprepitant outside the perioperative setting were excluded. Patient records were retrospectively reviewed for demographic and patient history including PONV with anesthetic, associated PONV conditions, and contraindications to the use of dexamethasone or ondansetron. Data regarding procedure performed, inpatient or outpatient surgery, dose and type of aprepitant, maintenance anesthesia, length of stay postoperatively, and duration of stay in the PACU were also reviewed. Postoperative records were reviewed for PONV events and use of postoperative anti-emetic agents. Mean and standard deviation were calculated for continuous variables and number. Number and percentage were calculated for categorical variables. Analyses were performed using SAS 9.4.

Results: The study cohort included 144 patients, 31 of whom were reported in our previous study, who received an aprepitant over the 24-month review period. The patients ranged in age from 7 to 17 years (13.7 ± 2.5 years) and weight from 24.7 to 208.9 kilograms (70.5 ± 36.7 kgs). There were 67 male (47%) and 77 (53%) female patients. The hospital visit type was listed as an inpatient surgery for 87 patients (60.4%) and outpatient surgery for 57 patients (39.6%). Seventeen patients (11.8%) had PONV or received anti-emetic agents postoperatively compared to 127 patients (88.2%) who did not. The mean duration of stay in the PACU was 116.5 minutes. The total incidence of PONV during the first 24 postoperative hours was 11.8% (17 of 144 patients). There were no unplanned admissions related to PONV. No adverse effects related to aprepitant were noted.

Discussion: Given its cost, an aprepitan was generally used only for high-risk patients and high-risk surgical procedures with a reported higher incidence of PONV. Even in this high-risk population, PONV as determined by documented vomiting, complaints of nausea, or administration of additional anti-emetic agents postoperatively occurred in fewer than 12% of the patients. Furthermore, there were no unplanned admissions related to PONV. Our study had a PONV incidence of 11.8%, which was at the lower end of the reported range for children post-surgery. This result was consistent with results from adult an aprepitant preoperative studies that ranged from 9.7% to 22%, suggesting it is as effective an antiemetic in children as it is in adults. In addition, our study found no serious adverse effects of an aprepitant in the 144 children who received it.

Abstract 63

Remifentanil Waste Reduction in the Operating Room: An Evidence-Based Pilot

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Background: Healthcare spending in the United States is reaching a point that is unsustainable. It has been identified that between $0.30 and $0.40 of every healthcare dollar is wasted on poor quality due to overuse, underuse, misuse, duplication, system failures, and inefficiency. Anesthesia drugs make up a substantial portion of the budget for anesthesia departments, with some as high as 24%. Anesthesia providers have a direct impact on intraoperative anesthesia costs through their clinical practice, such as with the reconstitution of medications. Most of the studies available have focused on the waste reduction of commonly utilized medications in the intraoperative setting, often excluding remifentanil. The purpose of this evidence-based pilot was to develop and evaluate interventions to assist anesthesia providers in the appropriate reconstitution of remifentanil to decrease excessive waste.

Method: Remifentanil can be reconstituted from 1 mg in a 50 ml solution up to 5 mg in a 250 ml solution per the anesthesia providers' discretion. In the present study, excessive remifentanil waste was represented as waste bags containing at least 1 mg (≥ 1 mg) of remifentanil left over from reconstituting more drug than required for the surgical case. A pre-implementation audit of remifentanil waste occurrences revealed excessive remifentanil waste of 41.3%. A remifentanil dose calculator was developed to determine anticipated remifentanil dosages more accurately. The three-month implementation phase included disseminating the remifentanil dose calculator throughout the ORs and in an online format. The six-month post-implementation phase halted education and project reminders to analyze the sustainability of the project. Audits of excessive remifentanil waste were performed prior to and after the calculator was introduced. The total percentage of cases with waste ≥ 1 mg was compared between the pre- and post-implementation phases using Fisher's exact test.

Results: During the pre-implementation audit, 2795 surgical cases had remifentanil administration, and of these cases 1155 (41.3%) had excessive remifentanil waste with 1823 1-mg vials wasted. During the three-month implementation phase, 630 surgical cases had remifentanil administration with 110 (17.5%) cases having excessive remifentanil waste and 118 1-mg vials wasted. During the post-implementation audit, 1280 surgical cases had remifentanil administration with 236 (18.4%) cases having excessive remifentanil waste and 275 1-mg vials wasted. The reduction of vials wasted per month between the pre- and post-implementation audits was 55.4%, two-tailed $P < 0.0001$ using Fisher's exact test. During the pre-implementation audit there were an average of 65 vials wasted per 100 surgeries. In the post-implementation audit, there were an average of 19 vials wasted per 100 surgeries. Based on the published wholesale acquisition cost (WAC) of remifentanil, this resulted in a savings of $2819 per 100 surgeries.

Discussion: The introduction of a novel remifentanil dose calculator to an academic anesthesia practice resulted in a 55% reduction of excessive remifentanil waste with a substantial reduction in drug costs. Reference tools, such as this study's remifentanil dose calculator, are practical and cost-effective methods to improve the efficiency of drug utilization in the operating room as also noted in the other articles analyzed during the literature review. The positive effects of reference tools like the remifentanil dose calculator are sustainable with minimal interventions necessary. A potential limitation of this study is that it was performed on a single unit which may limit its external validity; however, this specific unit has a high utilization of remifentanil. Another important cofounder was that the study timeframe overlapped the COVID pandemic which was notable for many disruptions in normal practice, and these

could have influenced remifentanil use. Anesthesia providers have a significant and direct impact on the reduction of excessive drug waste based on their clinical practice. Based on the results, similar studies should be carried out on an institution-wide level and with other medications to improve the utilization of medications and decrease healthcare spending.

Abstract 64

Smart Glasses Technology as an Adjunct During Anesthesia and Procedural Tasks to Decrease Medical and Human Errors in the Perioperative Period

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Background: Patients presenting for surgical procedures have increasingly complex medical comorbidities and require vigilant monitoring. The anesthesia provider's direct view of the patient and monitors can be obstructed by the surgical positioning or the room's configuration in the intraoperative period. The anesthetist may be unable to view the display screen while performing intricate tasks such as arterial catheterization, direct laryngoscopy, ultrasound (US)-guided central venous access, peripheral nerve blocks, and regional anesthetic procedures. Smart glasses (SG) improves patient care and safety in the complex anesthesia realm as it affords the provider mobility, an unobstructed view of the hemodynamics, a direct view of the ultrasound screen, decreased excessive head shifting, and improved success with procedural tasks and peripheral nerve blocks.

Method: The databases utilized in the search included MEDLINE, the Cumulative Index to Nursing, Google Scholar, and PubMed. The search keywords included variations of smart glasses, Google glass, head-worn display device, head-mounted display, and augmented reality-assist device. Exclusion criteria were meta-analyses and literature reviews. Inclusion criteria were publications within the past 10 years, full text, randomized clinical trials, pilot, exploratory, and case studies. The research focused on SG use during the perioperative period. The literature studied featured SG use for vital signs monitoring, US-guided arterial or central line cannulation, direct laryngoscopy, and regional anesthesia procedures. The following PICO question was developed: In patients receiving anesthesia, does the utilization of smart glasses in the perioperative period compared to not utilizing smart glasses improve provider knowledge, attitude, situational awareness; decrease medical and human errors and adverse events; and increase quality of care?

Results: All studies demonstrated that smart glasses could improve perioperative patient management and there are several applications of SG technology in the field of anesthesia. Vital sign streaming with SG or similar platforms is feasible and may enhance procedural situational awareness. The provider can wirelessly transmit assessment data to the attending, providing flexibility and increasing efficient, informed, remote decision-making. SG increase the first-time intubation success, document airway assessment, and capture more comprehensive data. They assist in US-guided cannulation of an artery or central vein by giving the user a direct view of the ultrasound machine without the user having to shift their head or change their view. SG also enable users to share what they see with other users in other physical places, they improve provider ergonomics and the first-attempt rate for US-guided regional anesthetic blocks, and they reduce first-attempt procedure time and overall complication rates.

Discussion: The studies discussed SG use as an adjunct to patient monitoring and the performance of procedural tasks during the perioperative period. Iqbal and Liebert concluded that SG improve intraoperative patient vital signs monitoring and decrease time looking away

from the procedural field, causing earlier recognition of patient deterioration. Schlosser et al. and Kuge et al. investigated how supervising anesthesiologists could benefit from using a head-worn device (HWD) in monitoring multiple patients. They found that the HWD increases the supervising anesthesiologist's awareness. Almost 50% of the literature that evaluated the smart glasses application to procedural tasks and regional anesthetic techniques found that SG wearers had significantly fewer head movements, thus demonstrating that the SG technology significantly improves ergonomics. Jang et al., 2021, found that using SG improved the first-attempt success rate of radial artery cannulation, decreasing overall procedure time. Dias et al. postulated that augmented reality glasses could improve successful first-time intubations, while Spencer et al. cited that the new technology could revolutionize airway assessment and management. Future efforts should focus on comfort, battery life, the effects of long-term wearability, and reducing mental workload when supervising anesthesiologists monitor multiple patients with SG.

Quantitative Research

Abstract 65

A Comparison of Morphine Equivalents after Posterior Cul-de-sac Infusions vs. Other Intraoperative Local Anesthetic Techniques in Robotic Hysterectomies

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Introduction: Hysterectomies are the second most common surgical procedure performed on women. A previous study found that one in 11 women would report to the emergency room within 30 days complaining of pain after hysterectomy. Poorly controlled acute pain increases the risk of chronic pain, as well as opioid use and the associated complications in the future. Studies show Enhanced Recovery After Surgery (ERAS) protocols and regional anesthetic techniques can reduce opioid use; however, there is limited research on posterior cul-de-sac (PCDS) catheter infusions.

Methods: This was a single-site retrospective chart review of subjects who had undergone an elective robotic hysterectomy between December 3, 2021, and August 24, 2022. These subjects received a PCDS infusion which involves placing a 15 cm multiport catheter percutaneous under laparoscopic guidance to infuse local anesthesia in the pelvic floor or other local anesthetic techniques (non-PCDS) including some combination of trocar site injections with local anesthetics, intraperitoneal instillation of local anesthetics, or bilateral transversus abdominis plane (TAP) blocks. Both the PCDS (n = 57) and non-PCDS groups (n = 23) received the same ERAS protocol. The primary outcome measured was IV milligram morphine equivalents (MME) on the day of surgery. Secondary outcomes included patient demographics, ERAS protocol compliance, mean pain scores, incidence of nausea and vomiting, length of hospital stay and surgical times, and readmission rates.

Results: Between the PCDS and non-PCDS groups, opioid consumption on POD0 was not significantly different (9.78 MME vs. 11.1 MME; P = 0.242). ERAS protocol compliance was high in both groups but also not significantly different (93.5% vs. 94.4%; P = 0.671). There was a significant difference in surgical time between the PCDS and non-PCDS groups (69 min vs. 132 min; P = 0.001). There was no significant difference in demographics, postoperative nausea and vomiting (PONV) rates, mean pain scores from post anesthesia care unit to discharge, length of hospital stay, emergency department admission rates at 30 or 60 days, or hospital admission rates at 30 or 60 days (P > 0.05). The highest average POD0 pain score for both the PCDS and non-PCDS groups came at the same time interval of 45 min postoperatively (5.3 vs. 4.7; P = 0.577).

Discussion/Conclusion: The PONV rates in both the PCDS and non-PCDS groups were approximately 30%, which were lower than recent literature that reported PONV after gynecological and obstetrical surgeries to be 40% to 80%. This study also found no significant differences in emergency room or hospital admission rates at any point in time, and even before removing the nonsurgical related admissions, these admission rates were lower than those found in previous research. The highest average POD0 pain score for the PCDS and non-PCDS groups was lower than previous research, reporting an average pain after a hysterectomy to be 6/10. This research demonstrates that the study site has an effective ERAS protocol for robotic hysterectomy surgeries to maintain opioid consumption to approximately 10 MME while reducing PONV, admission rates, and pain scores regardless of the surgeon and their local anesthetic technique.

Abstract 66

Comparing Accuracy Between Palpation vs. Ultrasonography in Accessing the Cricothyroid Membrane by Novice Resident Registered Nurse Anesthesiologists

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Introduction: Emergency front of the neck access is a high-acuity, low-frequency event. The reported incidence of performing cricothyrotomy (CTY) is 0.003% (Kwon et al., 2019). The most common complications of a failed CTY, at a rate of 0% to 31.6%, involve injury of cartilaginous structures with failure to obtain an effective airway (DeVore et al., 2019). Identification of the cricothyroid membrane (CTM) with ultrasound (US) is more accurate compared to palpation techniques, 81% vs 8% (Siddiqui, 2018) and results in less complications, 25% vs 74% (Siddiqui, 2015). There is no current literature assessing resident registered nurse anesthesiologists (RRNAs) and their ability to locate the CTM. Is there a difference between ultrasound identification of the CTM compared to palpation techniques? This study aimed to define pass/fail access attempts and accuracy in identifying the CTM between these methods.
Methods: A quasi-experimental design was used. The participants were first-year RRNAs. 3D printed laryngeal and neck models were used. Tape with a 5 mm target was placed within cricothyroid space. Homemade artificial skin was used to cover the models. Half of the models had palpable landmarks and represented normal distance with CTM depth of 6.5 mm. The other half of the models had no palpable landmarks with a CTM depth of 22mm akin to obesity. The study took place inside a simulated operating room. Participants were given two models of each method. They palpated the obese model first and the normal model second, then accessed the midline of the CTM with an 18-gauge needle. The next set of models involved the same sequence and equipment, but access was assisted with US. Pass/fail outcomes were considered “Pass” if accessed within the 5 mm target and “Fail” if outside. Secondary outcomes included time and distance from midline. Mann-Whitney analysis was used for the primary outcome and a chi-squared test was used for secondary outcome analyses.
Results: Mann-Whitney analysis showed there was no difference in success between ultrasound and palpation in identifying the CTM among a total of 96 attempts ($P = 0.224$). The success rate among the palpation groups was 58% (28/48) with a mean time of 32.33 seconds (sec) +/- 6.12. The ultrasound groups had a success rate of 46% (22/48) and a mean time of 47.34 sec +/- 7.59. The ultrasound groups were statistically significant for taking the longest when compared to the palpation groups ($P < 0.001$). The normal palpation group had a success rate of 66% (16/24) and a mean time of 19.8 sec +/- 9.8. The obese palpation group had a success rate of 50% (12/24) and a mean time of 46.71 sec +/- 8.63. The normal ultrasound group had a success rate of 58% (14/24) and mean time of 46.02 sec +/- 11.41. The obese ultrasound group had a success rate of 33% (8/24) and a mean time of 49.10 sec +/- 10.14. The obese ultrasound group was statistically significant for lowest accuracy ($P = 0.035$). The time between the subset groups of palpation and ultrasound was not statistically significant ($P = 0.251$, $P = 0.088$).
Discussion/Conclusion: When compared to current literature, our results did not correlate in terms of accuracy. Current literature states that ultrasound is more accurate than palpation. Our results showed that the palpation groups were more accurate than the ultrasound groups ($P < 0.224$). Our results were consistent with literature when analyzing times between palpation and ultrasound groups. Observations made during data collection that might have led to those results included scanning in multiple different planes (adding time), not adjusting depth or gain on the ultrasound, and using insufficient amounts of ultrasound gel. We believe that our study exposed areas for growth in education of ultrasound and difficult airway management for RRNAs. It also laid the foundation to expand simulation. We were able

to create a cost-effective, reproducible model that can be applied to a full simulation scenario to recreate high-acuity, low-frequency intraoperative events. Limitations included reduced anatomical likeness of the models, limited stability of the gelatin for the palpation models, and increased time between education and execution of the study. Future research diving into the correlation of nursing experience and identification of the CTM, using a different echogenic material, and assessing time plus accuracy for a CTY procedure in a simulated setting, might be worth investigating.

Abstract 67

Comparison of Post-anesthesia Care Unit Discharge Times Utilizing Chloroprocaine, Bupivacaine, and General Anesthesia

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Introduction: Spinal anesthesia reduces morbidity and mortality in the elderly; however, there is a need for safe, efficient alternatives for total knee arthroplasty (TKA) with comparable PACU discharge times to general anesthesia (GA). Despite the advantages of spinal anesthesia, GA is the predominant choice for TKA. Minimal research with conflicting results exists pertaining to the impact of intrathecal 1% chloroprocaine on PACU discharge times compared with other anesthetic techniques. The primary purpose of our study was to compare PACU discharge times for TKA patients receiving either intrathecal 1% chloroprocaine, intrathecal 0.75% bupivacaine, or GA as their primary anesthetic. Our null hypothesis was as follows: In patients undergoing TKA, there will be no difference in PACU discharge times between intrathecal chloroprocaine, intrathecal bupivacaine, and GA.

Methods: A quantitative, cross-sectional, retrospective chart review of subjects who received a primary TKA at a rural, regional medical center, between October 2019 and September 2022 was performed. PACU discharge time was the time, in minutes, the subject remained in Phase I recovery. Criteria for PACU discharge included a Modified Aldrete Score of 9 or higher and a pain score less than 7. Secondary outcomes measured were hospital length of stay (LOS), time to first micturition, PACU pain scores, postoperative opioid consumption, incidence of postoperative nausea and vomiting (PONV), 30-day ER visits, and 30-day readmission rates. One-way ANOVA and chi-square testing were performed to analyze primary and secondary outcomes. Tukey's multiple comparison tests were utilized if findings from the one-way ANOVA tests were statistically significant. Statistical significance was exhibited by a P value < .05. A G*Power analysis was performed with an effect size of .25, alpha error probability of .05, and a power of 0.8, calculating a desired sample size of 159 with 53 subjects per group.

Results: Of the 280 charts reviewed, 241 met inclusion criteria and were divided into three groups based on the type of anesthetic received: intrathecal chloroprocaine (n = 20), intrathecal bupivacaine (n = 67), general anesthesia (n = 154). There was no significant difference (P = 0.3534) in PACU LOS (in minutes) among the three anesthetic groups: chloroprocaine (60.9 ± 29.66), bupivacaine (61.94 ± 36.91), and general anesthesia (67.98 ± 30.78). No statistically significant differences were found among the three anesthetic approaches for time to first micturition, hospital LOS, incidence of PONV, 30-day ER visits, and 30-day readmission rates. At multiple time intervals, significant differences in PACU pain scores were found between bupivacaine and GA, as well as between chloroprocaine and GA. Significant differences in PACU opioid consumption were found when comparing GA to bupivacaine (P < .0001) and GA to chloroprocaine (P = .0122) with both neuraxial approaches demonstrating lower consumption.

Discussion/Conclusion: Spinal anesthesia demonstrated statistically similar PACU discharge times to GA, indicating its viability as an alternative for TKA patients. Although not statistically significant, the chloroprocaine group had the shortest PACU and hospital LOS, as well as the shortest time to first micturition. Compared to GA, chloroprocaine demonstrated lower pain scores and opioid consumption in the PACU. Results suggest that chloroprocaine provides adequate anesthesia for short duration procedures, while producing similar PACU discharge times to GA and bupivacaine in the inpatient setting. This is particularly important as previous literature associates neuraxial anesthesia for TKA with improved perioperative outcomes compared to GA. Limitations of this study were largely attributed to its retrospective design which lacked randomization, blinding, and consistent treatment plans among

subjects; the single, rural facility setting; and the underpowered chloroprocaine group. Recommendations for future research include a prospective multi-center design with larger sample sizes, randomization, blinding, and evaluation of subject experience and satisfaction. Moreover, evaluating each anesthetic approach strictly in the outpatient setting may reveal critical differences among GA and spinal anesthesia utilizing chloroprocaine and bupivacaine and their impact on patient readiness for discharge.

Abstract 68

CRNA Perceptions of the Barriers to Utilization of Enhanced Recovery After Surgery (ERAS) Protocols in Pediatric Open Abdominal and Urologic Surgery

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Introduction: Currently, research on ERAS primarily focuses on the adult patient population, where the benefits have been universally recognized and implemented. While several recent prospective cohort studies support improved outcomes when pediatric ERAS protocols are implemented, information regarding the widespread use of pediatric ERAS protocols remains unknown. The purpose of this study was to explore CRNA perceptions regarding the current use of ERAS protocols in children undergoing open abdominal and urologic surgery. Additionally, it sought to discover perceived barriers to implementing ERAS protocols in the pediatric population.

Methods: This exploratory, descriptive study was intended to evaluate CRNAs' utilization of ERAS protocols in pediatric open abdominal and urologic cases, focusing on perceived benefits and barriers to implementation. To accomplish these objectives, the researchers developed a survey after thoroughly reviewing the ERAS literature and evaluating aspects of ERAS protocols that have been highly utilized. Five expert reviewers were consulted to determine the validity and reliability of this de novo tool. Approval was obtained from the Georgetown University Institutional Review Board (IRB). Then the data tool was submitted to the AANA Research Department and dispersed to 3,000 randomly selected CRNAs by email. G*Power 3.1.9.7 was used to conduct a power analysis to acquire this study's minimum sample size (*N*). A minimum sample size of 305 CRNAs was required for a power of 0.80, using a one-way ANOVA with five groups with a small to medium effect size ($F = 0.20$) and an alpha of 0.05.

Results: CRNAs ($n = 31$) participating in pediatric open abdominal and urologic cases completed the survey. ERAS elements utilized at 100% included PONV prophylaxis and opioid-sparing, multimodal anesthesia. Ninety percent utilized goal-directed fluid therapy and neuraxial or regional anesthesia. The survey pursued the benefits providers notice using a designated ERAS protocol for pediatric patients. Ninety percent of CRNAs noted a reduction in opioid usage intraoperatively, 80% noted a decrease in PONV, and 70% noted a reduction in postoperative opioid usage. Perceived barriers to ERAS use in this population included "difficulty achieving consensus among providers regarding protocol design" (79%, $n = 22$) and "lack of provider familiarity with the protocols" (71%, $n = 20$). The third most reported barrier was lack of leadership support (63%, $n = 17$). Thirty-two percent of respondents indicated using a designated protocol. They were neutral about the existence of barriers and more likely to agree with having benefits over barriers to protocol use, $P = .013$.

Discussion/Conclusion: ERAS execution requires participation from the interdisciplinary team, with many elements lending responsibility to the CRNA. Barriers to implementation were unknown prior to this study. One-third ($n = 10$) of respondents had a designated ERAS protocol at their facility, and all agreed there were benefits to its use in the pediatric open abdominal and/or urologic surgery population. All CRNAs utilized PONV prophylaxis, with 80% noting a decrease in PONV. Another highly observed benefit was a decrease in intra- and postoperative opioid use. These observations parallel data assessing opioid analgesia in several studies comparing pediatric ERAS to a non-ERAS cohort. The highest perceived barrier was difficulty achieving consensus among providers for ERAS protocol design, followed by a lack of provider familiarity and leadership support. This corresponds with a recent study on ERAS in pediatric urology cases. This suggests there may be a need for universal guidelines and warrants a discussion about uniformity and consistency amongst providers. Only 30% of CRNAs who engaged in this

de novo survey met inclusion criteria, making the survey response rate less than 1% of the community; therefore, itmay not fully reflect the perceptions of practicing CRNAs. This study would need to be repeated on a larger scale to evaluate these results effectively.

Abstract 69

Development of Glutamate Transporter Modulators as a Novel, Non-opioid Treatment for Neuropathic Pain

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Introduction: Neuropathic pain (NP), a disease of the somatosensory nervous system, afflicts approximately 10% of people worldwide and adequate management with the current pharmacotherapies remains ineffective. NP is associated with excess synaptic glutamate, which overstimulates postsynaptic glutamate receptors and increases pain transmission. During the development of NP, excitatory amino acid transporter 2 (EAAT2), a transporter that clears most of the glutamate in the CNS, downregulates off the cell surface further increasing the levels of synaptic glutamate. To decrease glutamate levels and pain transmission, we have developed novel compounds that increase the activity of EAAT2 through positive allosteric modulation (PAM). We hypothesized that EAAT2 PAMs would provide antinociception in animal models of neuropathic pain.

Methods: In preliminary studies, our lead EAAT2 PAM, NA-014, provided antinociception in male rats seven days after spared nerve injury (SNI) surgery (an animal model of NP). We extended these studies to mouse models and included additional behavioral assays to measure hypersensitivity, including Von Frey (mechanical allodynia), Hargreaves (thermal hypersensitivity), dynamic weight bearing (DWB), and the mechanical conflict avoidance (MCA) paradigm. Male and female mice (n = 10-20/group) were tested with NA-014 (100 mg/kg), gabapentin (100 mg/kg), or vehicle via intraperitoneal injection weekly (7-28d) after SNI surgery. Two-way ANOVA was used to measure statistical significance across time and between treatment groups.

Results: Mice administered NA-014 and gabapentin demonstrated a tolerance to increasing forces of Von Frey filaments compared to vehicle at 28 days after SNI suggesting decreased mechanical hypersensitivity ($P < 0.05$). In addition, these mice also had a significant increase in time to paw withdrawal in the Hargreaves assay showing a decrease in thermal hypersensitivity. In DWB, SNI animals demonstrated a decrease in weight-bearing on the injured paw after SNI, which was not reversed by NA-014 or gabapentin at any time point, suggesting that these drugs may not affect weight bearing or that the DWB assay requires further optimization. Currently, we are using the MCA assay to study EAAT2 PAMs on the motivational, emotional, and affective aspects of pain by having the mouse (sham and SNI) choose between an aversive environment (bright light) or a painful stimulation (spiked floor hallway) that leads to a reward (dark room). As a new assay, the MCA requires optimization and results will be available at the poster presentation

Discussion/Conclusion: Animals that are drug "non-responders" will be further analyzed for EAAT2 expression in various brain regions, spinal cord, and dorsal root ganglia. Future studies will include molecular techniques to determine the level of EAAT2 expression in naïve animals and SNI animals across various timepoints (1-28 days). Assays will include western blotting and immunofluorescence which use antibodies to probe for EAAT2 in protein lysate and brain/spinal cord tissue slices. This will determine if animals become non-responders because the level of the target protein has downregulated to extremely low levels or cell death has occurred from glutamate-induced excitotoxicity. Overall, our current results suggest that increasing the activity of EAAT2 may serve as a novel mechanism to decrease nociception in animal models of NP and has the potential for further development as an emerging therapy for people suffering from NP.

Funding Source: AANA Foundation Art Zwerling Grant

Abstract 70

Does Circadian Rhythm Affect the Immune Deficiency Pathway of Drosophila Melanogaster during Sevoflurane Administration?

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Introduction: The immune response to anesthesia has gained increasing attention in recent years, with studies indicating that anesthetics can have significant effects on the immune system. Circadian rhythm regulates numerous physiological processes and has been shown to play a crucial role in the immune response to various stimuli. However, the potential interplay between circadian rhythm and the immune response following anesthesia remains poorly understood.

Methods: Mature Drosophilas melanogaster were housed at either the light-dark (LD) cycle or the reverse cycle dark-light (DL). Each of these groups were then divided into either 1% sevoflurane exposure for two hours (+SEVO) or no exposure controls (-SEVO). Following recovery, RNA was extracted from the flies, with seven to nine flies equaling one sample. After RNA conversation to cDNA, RT-PCR determined expression levels of target genes related to circadian rhythm (period, clock) and IMD pathway (PGRP-LC, IMD, relish, DPT, Cecropin- A1 (CecA1)). Each sample was normalized to the housekeeping gene Rpl32 and target gene expression levels were made relative to the control group (LD-SEVO), with > 1 meaning increased and < 1 meaning decreased expression to control. Data were analyzed for overall statistical significance ($P < 0.05$) using the one-way ANOVA test, with the Dunnett's post-hoc analysis used for comparing each group to the LD-SEVO control group.

Results: This study investigated the impact of circadian rhythm on the innate immune response (IMD pathway) in D. melanogaster after sevoflurane administration. We analyzed gene expression of key circadian genes (clock and period) and genes involved in the IMD pathway (PGRP-LC, IMD, relish, DPT, and Cecropin) using RT-PCR. Our results indicated a potential suppressive effect of sevoflurane on clock gene expression. Period gene expression showed the expected pattern but was less affected by sevoflurane. PGRP-LC, IMD, and relish expression levels were influenced by circadian rhythm and sevoflurane exposure, with relish being significantly affected. Antimicrobial peptide expression (DPT and Cecropin) displayed variations across groups, but changes were not statistically significant.

Discussion/Conclusion: Results demonstrated that sevoflurane impacted the expression of clock and period genes while modulating the immune response through the IMD pathway. Although most results were not statistically significant, a correlation was observed between sevoflurane administration and decreased expression of PGRP-LC, IMD, relish, Cecropin, and DPT. Relish expression was significantly affected, suggesting that it may have a more significant impact on downstream gene expression. These findings imply that sevoflurane anesthesia may compromise immune function, particularly in immunocompromised patients, and that dysregulated circadian rhythm can also suppress immune function. Future studies should explore larger sample sizes, other anesthesia types, and animal models to further understand the complex relationship between circadian rhythm, anesthesia, and immune response.

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Abstract 71

Does the Administration of Haloperidol with Ondansetron and a Steroid Increase the Risk of Torsade de Pointes in Adult Patients at High Risk for Postoperative Nausea and Vomiting?

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Mayo Clinic

Introduction: Postoperative nausea and vomiting (PONV) is a common complication after anesthesia. Many guidelines that aim to prevent PONV recommend utilizing a steroid and ondansetron for medium-risk patients as well as administering an antidopaminergic such as droperidol for high-risk patients. However, a national shortage of droperidol that started in 2020 has led to providers utilizing haloperidol in its place. To date, there has not been a study to investigate the incidence of torsade de pointes (TdP) or cardiac arrest when administering ondansetron, haloperidol, and a steroid concurrently. The aim of our retrospective study was to examine the safety of administering the triple antiemetic regimen – ondansetron, haloperidol, and a steroid – to surgical patients.

Methods: To identify incidences of TdP within 48 hours or cardiac arrest within seven days of triple antiemetic medication administration, pharmacy and surgical databases were utilized to identify patients who received anesthesia services and triple antiemetic therapy. The authors identified 19,874 patients who received 22,202 doses of triple antiemetics during a 2.5-year time frame. The identified patients were cross-referenced with ECG and adverse event databases to find any documented incidence of prolonged QTc (> 450ms), ventricular arrythmias or code events within 48 hours, or death within seven days of medication administration. The incidences of adverse events were summarized as the rate per 10,000 patients using point estimates and corresponding 95% confidence intervals, calculated using Poisson approximation.

Results: There were three patients who had documented ventricular tachycardia (VT) (*n* = 3, event rate = 1.4 per 10,000, 95% CI 0.3 to 3.9 per 10,000), but there were no documented incidents of TdP (*n* = 0, event rate = 0.0 per 10,000, 95% CI 0.0 to 1.7 per 10,000). There were nine codes called on patients within 48 hours of medication administration, none of which were due to ventricular arrythmias (*n* = 0). A total of 11 patients died within seven days of triple antiemetic therapy (*n* = 11, event rate = 5.0 per 10,000, 95% CI 2.5 to 8.9 per 10,000). Ten of the 11 deaths were determined to not be associated with the administration of triple antiemetics. One patient died at home within 24 hours of the procedure of an unknown cause (*n* = 1, event rate = 0.0 per 10,000, 95% CI 0.0 to 1.7 per 10,000). There were 192 patients who had documented prolonged QTc, none of whom developed TdP. There was one patient with documented prolonged QTc who did have a code called, but this was due to respiratory arrest that progressed to asystole.

Discussion/Conclusion: This study has shown that it is safe to administer ondansetron, haloperidol, and a steroid concurrently. We identified 19,874 patients who received the triple antiemetic therapy with no evidence suggesting that it causes adverse outcomes. Code events and VTs identified were not associated with the administration of the triple antiemetic medications. There was only one death within seven days of receiving the medications; however, the cause of death was unclear due to sudden passing at home. Due to the retrospective nature of this study, there are some identified limitations, including: uncaptured data, reliance on computer software to pull preliminary data from the electronic health record, and convenience sampling from one institution. Future research could perform a randomized control trial to compare rates of TdP and death between those who received triple antiemetic therapy and those who did not to better capture pre- and post- cardiac rhythms.

Abstract 72

Effects of Dexmedetomidine on TLR4-mediated Innate Immune Response in Human Macrophages

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Introduction: The U.S. population older than 65 is rapidly growing, further increasing the number of surgeries that inherently come with age. Postoperative cognitive dysfunction (POCD), caused by neuroinflammation, is a decline in cognitive function after surgery that does not depend on type of surgery or anesthetic, and the only identifiable independent risk factor is advanced age. Meta-analyses find dexmedetomidine reduces incidence of POCD in human patients and experimental studies find dexmedetomidine reduces neuroinflammation via attenuating the TLR4 pathway in mouse models. The purpose of this study was to evaluate dexmedetomidine's effect on TLR4 and TLR4-related proteins after stress with LPS in human macrophages.

Methods: This study was an experimental in vitro analysis of TLR4 and TLR4-related protein expression after stress with LPS and treatment with dexmedetomidine. HMC-3 and KG-1 macrophages were cultured under standard conditions and stressed with LPS for 24 hours. After 24 hours, the cells were treated with varying doses of dexmedetomidine. After three hours of treatment, the samples were processed and the expression of TLR4 and TLR4-related proteins was measured. One-way ANOVA was used to compare replicates averaged together against the control. Tukey's post-hoc test was used for individual comparisons between groups.

Results: KG-1 cell line: There was significant increase in TLR4 expression between the no LPS + no DEX group and the LPS only group ($P < 0.03$). There was a significant increase in IL-6 expression between the no LPS + no DEX group and the LPS only group ($P < 0.049$). There was a significant increase in IL-1β expression between the no LPS + no DEX group and the LPS only group ($P < 0.008$). All other comparisons between groups were not significant. HMC-3 cell line: The only significant change was TLR4 expression between the no LPS + no DEX group and the LPS only group ($p < 0.04$). All other comparisons between groups were not significant.

Discussion/Conclusion: The purpose of this research was to further examine the relationship between microglia and monocytes, TLR4, and dexmedetomidine. The U.S. population is aging, with the need for surgical procedures inherently growing with age. Because POCD is common in the aged patient and leads to decreased quality of life and increased healthcare costs, investigation into the root causes and prevention of the disease is warranted. The immune system is extremely complex, and its role in neuroinflammation and POCD has yet to be precisely defined. Although dexmedetomidine did not ameliorate the proposed mechanism of POCD, research into other avenues may be warranted. Dexmedetomidine pre-treatment compared to post-treatment, primary cell lines, different medications, and other inflammatory mechanisms are appropriate avenues for further investigation for treatment or prevention of POCD.

Funding Source: 2022-2023 Faculty Research Grant (intramural award), Webster University (Andrew Elvington)

Abstract 73

Effects of Tibial Intraosseous (TIO) Epinephrine in a Hypovolemic, Pediatric, Cardiac Arrest Model

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Introduction: Trauma remains a leading cause of death for children (WHO, 2002), yet no study has examined the tibial intraosseous (TIO) route of epinephrine administration in a hypovolemic pediatric model. The Pediatric Advanced Life Support (PALS) guidelines recommend epinephrine administration by IV route; if not attainable, IO devices should be used (Kleinman, 2010). This study aimed to examine the rate and odds of return of spontaneous circulation (ROSC) as well as the concentration maximum (CMax), time to maximum concentration (Tmax), area under the curve (AUC), and time to ROSC in a model of pediatric hemorrhage comparing groups receiving emergency epinephrine via the IV or TIO routes.

Methods: Pediatric swine, weighing between 28 and 34 pounds, were anesthetized and exsanguinated of 35% of their blood volume. Two minutes after inducing cardiac arrest, CPR was initiated in accordance with the PALS protocol. Epinephrine (per PALS dosing) was administered by either IV or TIO routes and repeated every four minutes until ROSC was achieved. Defibrillation was initiated at three minutes and continued every two minutes until ROSC was achieved.

Results: ROSC was achieved for seven of eight in the TIO group, five of seven in the IV group, one of five in the CPR + defibrillation group (no epinephrine), and zero of five in the CPR-only group (no epinephrine or defibrillation). There was no statistical difference in achieving ROSC between the IV and TIO groups ($P = 0.569$). However, the odds of achieving ROSC for the TIO group were 2.8 times greater than the IV group, 42 times greater than the CPR + defibrillation group, and 55 times greater than the CPR-only group. As expected, there were significantly higher Cmax and AUC values in the IV group compared to the TIO group ($P = 0.01$), but there were no significant differences in Tmax ($P = 0.377$) or time to ROSC ($P = 0.336$).

Discussion/Conclusion: Placing an IV can be time-consuming and challenging in a pediatric patient, especially when the patient is in hemorrhagic shock. Placing a TIO in this population can be far more simple and rapid. Any delay in administering emergency medications like epinephrine to a child in cardiac arrest significantly decreases survivability (Hansen, 2018; Raymond, 2019). However, it is unknown whether the TIO route is effective for treating cardiac arrest in pediatric patients suffering from significant hemorrhage that may result from trauma. The results of this study indicate that while there is a significant difference in overall systemic epinephrine absorption between IV and TIO administration, there was no significant difference in time to achieve the maximum plasma concentration nor the likelihood of achieving ROSC. TIO administration of epinephrine in the hypovolemic pediatric model is effective. It should be considered a first-line option for treating pediatric patients suffering cardiac arrest, even in conditions of significant hemorrhage.

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Abstract 74

Evaluating the Relationship Between Student Registered Nurse Anesthetists' Emotional Intelligence and Clinical Performance

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Introduction: Nurse anesthesia educational programs have rigorous acceptance criteria, but these measures are imperfect indicators of student success in the clinical setting. Emotional intelligence (EI) is a noncognitive factor that can measure decision-making abilities and communication skills, both critical factors in the clinical setting. Evidence in medicine suggests that EI may have promise as a clinical performance indicator in anesthesia trainees. Talarico et al. compared the EI of anesthesia residents (*n* = 85) across five programs to their clinical performance. They determined aspects from three EI sub-scores correlated with all six measured clinical competencies. The researchers concluded that EI showed considerable promise as an independent clinical performance indicator. This study sought to determine if EI was similarly associated with early clinical performance in student registered nurse anesthetists (SRNAs).

Methods: An exploratory, descriptive correlational design evaluated the relationship between SRNAs' emotional intelligence and clinical performance within the first three months of their clinical education. Each student's clinical performance was measured by their preceptors using a standard program evaluation tool submitted electronically in the Typhon system. In addition, SRNAs' clinical evaluation scores from their first three clinical months were compared to their EI scores using the Trait Emotional Intelligence Questionnaire-Short Form (TEIQue-SF). The 30-item EI collection tool and demographic survey were deployed via the Qualtrics® platform. A link to this survey and informed consent form were emailed to SRNAs by a third party who randomly assigned each participant an identification number. All EI and clinical performance data were de-identified before being released to the researchers to preserve participant confidentiality. The data was then sent to the primary researchers and analyzed with SPSS data analysis software.

Results: Using G*Power 3.1.9.7, a minimum sample of 84 was needed to achieve a power of .80 for a correlation with alpha = .05 and a medium effect size of 0.3. The population was around 75, and after a finite population correction was applied, the resulting minimum sample was 40. A total of 54 respondents participated in the study. Using a one-way ANOVA, no significant differences in total EI (P = 0.97), Knowledge (P = 0.45), or Professionalism (P = 0.12) scores were detected when compared to participant demographic characteristics. In clinical performance areas of knowledge or professionalism, correlations were minimal (less than .20). A Pearson's correlation test revealed no statistically significant correlations between Knowledge, Professionalism, EI subscales, or total scores. The total EI score related to the Knowledge correlation was 0.13 (P = 0.35), and EI related to the Professionalism correlation was 0.15 (P = 0.28). The data showed no difference in Knowledge (P = 0.69) or Professionalism (P = 0.30) in relation to the different classes.

Discussion/Conclusion: In contrast to the study of anesthesia residents by Talarico et al., this SRNA-focused study found no significant relationship between overall EI and early clinical performance. These findings are consistent with a previous pilot study comparing the EI of 11 SRNAs to their clinical performance, where no relationship was found. However, these findings should be considered cautiously, as both SRNA-focused studies had significant limitations, including small sample sizes and participants from a single program. In the current study, the correlation between clinical performance

and subscales of EI was small; this could imply a potential weakness in the clinical performance evaluation method. Further, this study only included performance evaluations from the first three months of clinical. If the measurement period was extended, associations might be seen in the later clinical phase when preceptor expectations are higher. Finally, while standard practice for the program, the clinical evaluation method has yet to be tested for interindividual variability and reliability across multiple clinical sites. The authors encourage the refinement of a clinical evaluation tool, a more extended measurement period for clinical performance, and the application of this study across multiple nurse anesthesia programs to determine EI's role in defining the potential of an SRNA.

Abstract 75

Implementation of a Spaced Learning Program for Educating CRNAs on a Scalpel-bougie Cricothyrotomy Procedure for Emergency Front of Neck Access

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Introduction: Cannot intubate, cannot oxygenate, (CICO) events are a leading cause of morbidity and mortality in anesthesia. Certified Registered Nurse Anesthetists (CRNAs) may lack adequate continuing education for emergency front of neck access (eFONA) in a CICO event. Inadequate airway planning is a major contributor to morbidity and mortality. Appropriate use of airway management techniques are important to prevent adverse complications. Spaced educational material is repeated over time and increases knowledge attainment compared to single-dose education and has been effectively used for promoting cognitive and skill acquisition. Research question: What is the feasibility of implementation of a spaced learning education program to increase CRNA knowledge and confidence levels for performing a scalpel-bougie-cricothyrotomy for eFONA over a 3-week learning period?

Methods: Participants were CRNAs who worked in the anesthesia department at a 160-bed community hospital. Thirteen CRNAs participated in a 3-week spaced learning intervention. Week 1: Online pre-intervention survey followed by an educational video. Week 2: Video review and skills component practiced in person on an adult cricothyrotomy trainer. Week 3: Skills component practiced in person on an adult cricothyrotomy trainer followed by a post-intervention survey. Participants were provided a unique study number for pairing of pre- and post-intervention data to maintain anonymity. This study was submitted to the hospital Internal Review Board (IRB) and was granted exempt status. All participant data was de-identified and study results were kept confidential. Informed voluntary consent and a consent waiver were explained and obtained. Because this was a single-arm study, the statistical testing to monitor for change or improvement was a Wilcoxon signed-ranks test and paired t-test. Data were analyzed using IBM SPSS statistics (Version 29).

Results: Knowledge was measured on a 5-point Likert scale. A Wilcoxon signed-ranks test indicated that the median post-test ranks, Mdn = 5.0, were statistically higher than the median pre-test ranks, Mdn = 3.0, Z = 3.12, $P < .002$. Results supported our hypothesis that spaced learning can increase knowledge of eFONA. Confidence was measured on a 5-point Likert scale. A Wilcoxon signed-ranks test indicated that the median post-test ranks, Mdn = 4.0, were statistically higher than the median pre-test ranks, Mdn = 1.0, Z = 3.24, $P < .001$. Results supported our hypothesis that spaced learning can increase confidence for performing eFONA. Skill for eFONA was measured during two consecutive weeks. A paired sample t-test result showed a significant decrease in the skill times from week 2 (M = 74.40, SD = 15.73) to week 3 (M = 49.81, SD = 9.54) and $t(12) = 4.62$, $P < 0.001$. Results supported our hypothesis that spaced learning can improve participant skill with eFONA. Note, data from this t-test were not generalizable secondary to small sample size.

Discussion/Conclusion: CICO events are a leading cause of morbidity and mortality, yet CRNAs often lack adequate or consistent continuing education for eFONA. Spaced learning had been successfully utilized for healthcare continuing education; however, this is the first study to investigate spaced learning for CRNAs for eFONA for CICO events. Our results indicate that spaced learning may be an excellent method to reinforce knowledge, confidence, and skills in these infrequently occurring, high-risk, emergency events. This has the potential to improve patient outcomes, decrease patient morbidity and mortality, and decrease institutional costs related to adverse CICO event outcomes. Several limitations were

present in this study including small sample size, three-week study requirement, and voluntary participation. Additional studies are needed to evaluate the program's effectiveness on a larger scale, validate the effectiveness of the three-week spaced education program, and investigate CRNAs' long-term retention of knowledge, skills, and confidence. Future research should also be conducted to determine the optimal spacing of education interventions for maximizing CRNA skills. Studies like these have the potential to revolutionize learning for CRNA education specifically for high-risk yet low-yield events, empowering providers to act with confidence and skill during life-threatening situations.

Abstract 76

Not Just a Lumpectomy. The Relationships between Distress, Pain and Coping Strategies following Breast-conserving Surgery: A Repeated-measures Study

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Introduction: Breast cancer is the most common cancer diagnosis for women and one-in-eight women in the United States will be diagnosed with breast cancer in their lifetime. Most women with breast cancer are diagnosed at an early stage when surgery remains the primary treatment. In addition to the stress of the entire experience of breast cancer diagnosis and treatment, the surgical removal of cancer and additional diagnostic procedures require anesthesia which leads to physical tissue damage that frequently causes pain, nausea, and additional sources of stress. However, a gap in the literature remains regarding the patients at highest risk for pain and distress and the point during treatment when women experience the highest severity of symptoms. The purpose of this repeated-measures, descriptive-correlational study was to explore these relationships.

Methods: The study was a repeated-measures, descriptive-correlational study with data collection at three standard time points based on the typical course of surgical treatment at relevant transition points before, immediately following, and two weeks after breast-conserving surgery. Aligning the data collection points with routine treatment intervals reduced respondent burden, improved the feasibility of data collection, and enhanced relevance to clinical practice. The primary measurement instrument consisted of validated questionnaires: the Ways of Coping (WAYS) and the NCCN Distress Thermometer (DT). The univariate analysis described the sample characteristics and study variables. Next, bivariate analysis was used to assess the association between the scores of the total coping score and the eight subscales of the WAYS questionnaire and pain and distress. Finally, a structural equation model was created to assess mediation between the antecedents and distress. Statistical analysis was performed using IBM SPSS Statistics (Version 25).

Results: The final sample included 75 women diagnosed with breast cancer undergoing breast-conserving surgery between August 15 and October 15, 2020. Of 123 potential participants, 75 (61%) responded and agreed to participate. The average age of the sample was 58.7. At 24 hours following surgery, 38.7% of the patients experienced moderate to severe pain, and 84% described moderate levels of distress. Pain and distress scores were highest at 24 hours after surgery, and 34% of the patients reported moderate pain two weeks following surgery. The most frequently used coping strategies sought social support and planful problem solving. The escape-avoidance coping strategy was the strongest factor in predicting distress, followed by seeking social support, history of nausea, total coping score, and age. The results of the Structural Equation Model demonstrated that coping strategy did not significantly mediate the relationship between the antecedents and distress at 24 hours following surgery.

Discussion/Conclusion: Given the invasiveness of the surgery, mild levels of pain were an expected outcome; however, about one-third (38.7%, *n* = 29) experienced moderate to severe pain. Furthermore, about one-eighth of the women experienced severe pain (12%, *n* = 9). The results of this study are congruent with previously reported frequencies of postoperative pain in this population, which range from 9% to 94%, reflecting the difficulty of capturing a subjective experience such as pain with quantitative measures. Other researchers have found that patients who experience higher levels of pain during the postoperative period are at higher risk of persistent and chronic pain, which supports the

importance of identifying this higher risk population and providing effective interventions to treat their pain to help reduce long-term sequelae. The vast majority (over 80%) of the sample experienced moderate or clinically significant levels of distress. In addition, the NCCN Distress Thermometer Problem List identified problems outside cancer affecting distress in this population that nurses can address. The results also indicated that 34% of participants continued to identify pain as a problem two weeks following surgery. Finally, the study should serve as a strong foundation for exploring effective interventions targeting the most severe symptoms at the highest risk time points.

Abstract 77

Nurse Anesthesiology Faculty Survey on POCUS Teaching Techniques

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Introduction: Point of care ultrasound (POCUS) is an increasingly important technology which can assist in procedural tasks and be used for diagnostic purposes. Recognizing this, in November 2020 the American Association of Nurse Anesthesiologists (AANA) released the practice considerations document "Point-of-Care Ultrasound in Anesthesia Care." In it, the AANA declared that POCUS is a "critical and core skill" that every CRNA should possess. This document describes uses and practice considerations for POCUS, and also outlines strategies to facilitate the adoption of this technology. The topic of how to best implement POCUS education is one that continues to be studied. However, a literature review showed that no study aimed at understanding the state of POCUS education in CRNA residency programs exists. This survey aimed to address this knowledge deficit.

Methods: A 24-question survey comprised of multiple-choice, write-in and Likert-style questions was created. The questions were reviewed by two content experts to determine whether they fit the purpose of the study. The survey was administered in person to attendees of the AANA's Assembly of Didactic and Clinical Educators held February 24-26, 2023. Participants scanned a QR code to access the survey. To encourage involvement, participation was incentivized with a $5 gift card. All information collected was anonymous and stored on secured servers. The data were exported to MS Excel and analyzed for emerging trends. A statistician will be employed to further scrutinize the data and perform the appropriate statistical analysis.

Results: A total of 116 responses were obtained from 32 states; distribution was proportional to the number of programs by state. Among educators, competency and comfort teaching were low across the eight POCUS studies surveyed, except for vascular access (52%). Across all studies, most educators preferred a two-day course with live scanning as the method to acquire skills with POCUS. The vast majority of educators indicated the importance of POCUS competency. Ranked by importance: Vascular access 98.3%, TTE 86.9%, IVC 84.1%, airway 80.2%, gastric 79.5%, lung 79.5%, abdominal 61.4%, and optic nerve sheath diameter 50.5%. These perceived levels of importance contrasted with the low number of didactic hours and scanning opportunities offered by training programs. Almost unanimously, participants believed POCUS training could be improved at their institution. Educators perceived the lack of a dedicated POCUS rotation, qualified instructors, standardized curriculum, and lack of time during clinical as major barriers. Lack of interest from residents was not seen as a barrier.

Discussion/Conclusion: This survey demonstrates that educators are eager to implement POCUS training in their programs. However, due to a perceived lack of clinical opportunity, qualified instructors, and guidance in the form of a standardized curriculum, POCUS implementation beyond vascular access remains minimal. Only eight respondents indicated they had a dedicated POCUS rotation. Increasing scanning opportunities beyond simulations will be crucial if POCUS is to be widely adopted. Efforts are needed to better understand the educational needs of program faculty and better equip them with the skills needed to teach POCUS. Guidance and uniformity on how to best implement POCUS education are lacking. A standardized curriculum could help provide both and accelerate the spread of POCUS education. Future efforts should be aimed at better understanding strategies to circumvent these barriers and work toward the goal of a standardized POCUS curriculum.

Funding Source: Funding was provided in part by the Middle Tennessee School of Anesthesia Alumni Association Grant Assistance Fund

Abstract 78

Retrospective Cohort Analysis of Platelet Inhibitor Therapy in Children and Adults Supported On Extracorporeal Membrane Oxygenation

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Introduction: Long-term extracorporeal membrane oxygenation (ECMO) therapy requires systemic anticoagulation to avoid thromboembolic and hemorrhagic complications. Long-term mechanical circulatory support targets secondary hemostatic cascades with platelet inhibitor (PI) medications demonstrating improved device longevity while reducing embolic complications. This retrospective analysis explored PI's impact during ECMO therapy on circuit interventions, hemolysis, thrombotic complications, and blood product administration. We hypothesized that PI medications in the adult and pediatric populations are safe with no increase in bleeding or adverse events and may offer an advantage regarding circuit longevity and survival. Currently no other studies analyze the role of PIs on circuit interventions, hemolysis, thrombotic complications, and blood product administration during ECMO therapy.

Methods: A single center retrospective cohort study of adult and pediatric ECMO patients between January 2015 and May 2021 assessed the association between PI and hazard for circuit interventions, hemolysis, and thrombotic complications for the first 30 days of ECMO therapy with univariable Cox proportional hazards model. Multivariable Poisson regression models assessed the association between PI and transfusion outcomes.

Results: A total of 338 ECMO patients were analyzed of which 136 participants were in the PI therapy group. ECMO configurations were 82% venous-arterial and 15% veno-venous. Males constituted 63% of patients with a median age of 55.1 years. The majority (74%) of cannulations were initiated in the OR and 63% were central configurations. Adult RBC, platelet, and plasma transfusions were reduced with PI therapy ($P < .001$). Pediatric patients with PI therapy required less RBC (Day 0) and plasma (Day 0 and 1-4) transfusions. No differences in outcomes with regard to circuit interventions ($P = 0.201$), hemolysis ($P = 0.433$), or thrombotic complications ($P = 0.407$).

Discussion/Conclusion: In adult and pediatric ECMO populations, PI administration reduced blood product transfusions without increasing complications. Future studies are necessary to further elucidate the role of and better characterize optimal strategies for administration of PIs during ECMO support.

Funding Source: Mayo Clinic small grant

Abstract 79

Sternal Intraosseous Epinephrine Administration in a Hypovolemic Pediatric Cardiac Arrest Model

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Introduction: Trauma is one of the leading causes of death in children. In cases of cardiac arrest, the chances of survival are decreased by 9% for each minute that epinephrine administration is delayed. Multiple factors make intravenous (IV) catheter placement difficult in these situations and in the pediatric patient. Sternal intraosseous (SIO) placement establishes rapid vascular access and offers an alternative to IV. The purpose of this study was to compare the incidence of achieving return of spontaneous circulation (ROSC) with SIO epinephrine administration verses IV epinephrine administration in the pediatric hypovolemic cardiac arrest model. We evaluated the pharmacokinetics of SIO versus IV administered epinephrine, and the effects of route of epinephrine administration on ROSC.

Methods: In an experimental prospective-between-groups design, Yorkshire swine (28 to 38 kg) were anesthetized and randomly assigned to the following groups: SIO (n = 8); IV (n = 7); CPR+defibrillation (n = 7); CPR only (n = 4). The swine were anesthetized and 35% of each swine's estimated blood volume was exsanguinated. The swine were in arrest for two minutes and CPR was then performed for two minutes. Epinephrine 0.01 mg/kg was administered four minutes post-arrest by either SIO or IV route. Blood samples were then collected at 0.5, 1, 1.5, 2, 2.5, 3, 4, and 5 minutes. Epinephrine was then administered every four minutes or until ROSC was achieved. ROSC was operationally defined as a systolic blood pressure of at least 60 mm/Hg and a palpable pulse. The incidence of ROSC and time to ROSC were determined. Plasma epinephrine concentrations were measured by high-performance liquid chromatography. Peak concentration (Cmax), time to maximum concentration (Tmax), and mean concentration (MC) of plasma epinephrine were determined.

Results: A multivariate analysis of variance showed no significant difference in Cmax between the SIO and IV groups (P = 0.95). However, the time courses were significantly different. The mean concentration of epinephrine was significantly greater in the IV group at the 1.5, 2, 2.5, and 3 minute time points (P < 0.05) while the mean concentration of epinephrine was significantly greater in the SIO group at the 0.5 minute time point (P < 0.05). The difference in time to maximum concentration (Tmax) of plasma epinephrine between the SIO and IV groups did not reach statistical significance (P = 0.07). There was no significant difference in the rate of ROSC between the IV group (5 out of 7) and the SIO group (8 out of 8) (P = 0.20). One out of seven subjects in the CPR+defibrillation group achieved ROSC. None of the CPR only group achieved ROSC. Odds ratio from the ROSC data found a 5x greater chance of ROSC with the SIO route of administration vs. IV and a 10x greater chance of ROSC with the SIO compared to CPR+defibrillation only.

Discussion/Conclusion: Our data indicate that SIO administration of epinephrine is as effective as IV administration in achieving ROSC in a pediatric hypovolemic cardiac arrest model. While traditionally considered a contingency plan, these findings indicate that the SIO could be utilized as a first-line administration route for the hypovolemic, pediatric patient in cardiac arrest, especially in situations where IV catheterization is difficult or time-consuming. Previous research has additionally shown that the SIO route has higher flow rates and larger flow volumes compared to the humeral intraosseous (HIO) and tibial intraosseous (TIO) routes. Additionally, the sternum contains a large amount of red marrow and a more uniform cortex, making fracture less likely compared to the HIO and TIO sites. Our findings,

alongside previous research data, strengthen the concept that the SIO could serve not only as a contingency plan for rapid establishment of access, but may actually pose as a contender for first-line access, especially in areas of austere medicine. For future research, we hypothesize that if the experiment was repeated and 1.5x the dose of epinephrine was given via HIO compared to the standard IV dose, then the Cmax would approach the IV Cmax and there would be an increase in ROSC comparable to the IV route.

Funding Source: The study was funded by the TriService Nursing Research Program (TSNRP)

Abstract 80

The Effect of Video Simulation on Novice Nurse Anesthesia Student Learning and Ultrasound-guided Central Line Insertion

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Introduction: Literature suggests advances can be made to simulation education through the use of video vs. the traditional in-person approach because video simulation allows students to learn independently and obtain repeated skill exposure. However, a knowledge gap was identified regarding the effects of video simulation on the learning outcomes of first-year resident registered nurse anesthetists (RRNAs). The researchers aimed to assess video-simulated learning compared to traditional classroom learning and its impact on knowledge retention in first-year RRNAs when performing ultrasound (US)-guided central venous catheter (CVC) insertions. The study aimed to answer the question: How does video simulation impact the skills performance of first-year RRNAs on US-guided CVC insertion compared to traditional in-person simulation? The null hypothesis was that video simulation would have no effect on US-guided CVC insertion performance in first-year RRNAs.

Methods: This randomized, single-blind, experimental research study evaluated the impact of video-simulated learning vs. traditional classroom learning on knowledge retention in first-year RNNAs performing US-guided CVC insertions. A convenience sample included first-year RRNAs enrolled in an accredited Doctorate of Nurse Anesthesia Practice program. The participants were randomly assigned to two groups: the traditional group (TG) and the video group (VG). Both received the same content from their professor either in person or via four recorded videos. The participants were evaluated for knowledge retention and skills performance nine weeks after exposure with a skills checkoff. Participants were awarded a pass if 12 steps were successfully completed from a validated checklist. A Fishers-exact statistical analysis was used to compare pass/fail scores. A student two-sample t-test was utilized to compare mean checkoff scores.

Results: There was a total of 24 participants (N = 24) divided into two groups: the TG (n = 12) and the VG (n = 12). Eight participants received a passing score and four received a failing score in the TG. Seven participants received a passing score and five received a failing score in the VG (P = 1.0). The mean score for the TG was 12 out of 23, and for the VG it was 11.75 out of 23 (P = 0.904).

Discussion/Conclusion: In conclusion, there was no statistically significant difference between traditional and video simulation learning methods when evaluating knowledge retention for US-guided central line insertion. This study suggests video simulation is as effective as traditional classroom simulation when learning hands-on skills. Video simulation could allow RRNAs to improve learning outcomes on advanced skills and impact their confidence when presented with the need to perform such skills in clinical. Increased knowledge of and practice with advanced skills may enable RRNAs to provide higher quality and safer care in the future as Certified Registered Nurse Anesthetists. Educational programs could utilize these results to augment their simulation teaching and incorporate video learning to improve outcomes and increase resident's access to educational resources. Several limitations were encountered during this study, including small sample size, lack of researcher experience, inability to maintain absolute certainty that no collaboration occurred between groups, and mannequins that inadequately represented human CVC insertion. Future research can examine the benefit of using video simulation as an adjunct to traditional simulation. Also, it would be beneficial for additional research to be conducted to assess how video simulation applies to other nurse anesthesia skills.

Abstract 81

The Effectiveness of Teaching Peripheral Nerve Block Placements to Nurse Anesthetists in Cameroon, Africa via Virtual Education

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Introduction: Safe and accessible anesthesia care is critically limited in Cameroon. Nurse anesthetists lack resources and access to education. Studies of anesthesia care in Sub-Saharan Africa have highlighted the gap in education and resources with excessively high mortality rates. The mortality rates are signifacntly lower with regional anesthesia when compared to general anesthesia. The purpose of this study was to determine the efficacy of virtual education on the knowledge of axillary, femoral, and sciatic nerve block placement among nurse anesthetists in Cameroon. The primary goal of this study was to close the educational gap with virtual education of regional anesthesia techniques to decrease the anesthesia-related mortality rate.

Methods: Virtual education modules were created by combining PowerPoint presentations, recorded visual media, and podcast presentations in English and French. WhatsApp and the Webster Nurse Anesthesia Podcast (WeNAP) via a YouTube channel were the platforms utilized for communication and distribution of the educational modules. Practicing nurse anesthetists in Cameroon were the subjects for this study. A total of 51 participants were included in the study. Participants were given a pre-test to assess their baseline knowledge prior to having access to the educational modules. After completing the 24-day education period, a post-test was administered. A paired samples t-test was used to analyze the results of the tests. A point biserial correlation was used to assess the correlation between post-test scores and the time spent studying.

Results: Two hundred Cameroonian nurse anesthetists were invited to participate and out of that 51 practicing Cameroon-based nurse anesthetists participated. The paired samples t-test revealed a statistically significant difference in mean test scores before virtual education intervention (47.87%) and after instruction (60.72%) with a P value < 0.01. A point biserial correlation analysis revealed no significant difference between hours spent and post-test scores ($P = 0.757$). Pre-test score averages were 47.87% and posttest score averages were 60.72%. The 26.84% increase in the post-test scores did have statistical significance ($P < 0.01$) after completing the virtual education program. There were no statistical difference noted with the biserial correlation analysis between the hours spent and post-test scores ($P = 0.757$).

Discussion/Conclusion: The study was significant because the P value was < 0.01. There was an increase of 26.84% in test scores and more than 80% of participants stated they had increased their knowledge in anesthesia as a result of the study; however, the average score of 60.72% did not meet the standard for competence. Further education programs are needed to increase scores. After didactic instruction, in-person hands-on education can further enhance learning. Because international distance and time differences create a lag in communication and troubleshooting, distance learning is becoming more prevalent in closing educational gaps and improving technology. However, there is inconsistent internet access in Cameroon, so it was difficult to recognize if participants were able to access the educational information. Future researchers should choose matching IDs for the participants to ensure accountability. An online pre-test with a post-test conducted after in-person hands-on demonstration would be beneficial. Virtual education did statistically improve scores yet they were still quite low. The development of virtual with biannual in-person with hands-on workshops is planned to further improve scores and competency and address the educational and resource gap. During these in-person sessions,

valuable airway-related equipment is donated to the anesthesia providers after proper education and hands-on practice.

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Abstract 82

Urinary Retention Following Video-assisted Thoracoscopic Surgery: Role of Neuromuscular Blockade Reversal

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Introduction: Postoperative urinary retention (POUR) complicates approximately 10% of video-assisted thoracoscopic surgeries (VATS). Anticholinergic medications decrease bladder detrusor muscle contraction and can increase POUR risk. Sugammadex, an amino-steroidal neuromuscular blocking agent (NMBA) reversal drug, is devoid of cholinergic activity. In patients who underwent inguinal herniorrhaphy and received NMBA reversal with neostigmine/glycopyrrolate rather than with Sugammadex, there were higher rates of POUR. Avoiding the use of cholinergic medications and using Sugammadex to reverse NNMBs in VATS could decrease incidences of POUR.

Methods: A retrospective study was conducted on adult patients undergoing VATS at a major tertiary academic center. Patients were selected from the following two intervals: January 1 through June 30, 2016 (before Sugammadex became available) and January 1 through May 4, 2018 (after Sugammadex was available). All VATS procedures were conducted with the patient under general anesthesia with one-lung ventilation, and the choice of reversal technique (neostigmine/glycopyrrolate or Sugammadex) was left to the discretion of the attending anesthesiologist. The perioperative course was reviewed for surgical duration, opioid dose, intraoperative fluids, use of intraoperative urinary catheter, reversal technique, hospital length of stay, and need for hospital readmission. POUR was defined as the need for urinary catheterization due to urinary retention and was the primary outcome variable. A propensity-adjusted analysis was performed to assess POUR in neostigmine/glycopyrrolate vs. Sugammadex using inverse probability of treatment weighting (IPTW) to adjust for potential confounding.

Results: We identified 168 VATS patients who were reversed with neostigmine/glycopyrrolate in 2016 and 108 who were reversed with Sugammadex in 2018.. POUR was observed in 24 (14.3%) of neostigmine/glycopyrrolate and four (3.7%) of Sugammadex-reversed patients (unadjusted odds ratio = 0.23 [95% C.I. 0.08 to 0.69], *P* = 0.008; IPTW adjusted odds ratio = 0.24 [95% C.I. 0.06 to 0.91], *P* = 0.036). For both groups, the median hospital length of stay was 2 [1, 3] days, *P* = 0.447. The frequency of hospital readmission was 13/168 (7.7%) for neostigmine/glycopyrrolate patients and 10/108 (9.3%) for Sugammadex patients, *P* = 0.662. Comparisons between patients who developed or did not develop POUR found no difference in median hospital length of stay (2 [1, 5] vs. 2 [1, 3] days, *P* = 0.298) or frequency of hospital readmission (4 [14.3%] vs. 19 [7.7%], *P* = 0.269).

Discussion/Conclusion: Following a retrospective analysis utilizing IPTW of 276 adult patients undergoing VATS surgery, the incidence of POUR was lower in patients who received NMBA reversal with Sugammadex compared to neostigmine/glycopyrrolate. Results appeared to be independent of typical risk factors: surgical duration, intraoperative fluids, opioid dose, and gender. The magnitude of difference and rates of POUR observed in this study were similar to the results of previous studies. We speculate that this finding can be attributed to avoidance of anticholinergic medications. This study has limitations inherent to a retrospective design. It would be beneficial for future studies to confirm these results with prospective randomized clinical trials.

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