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Clinical Significance of Intravenous Acetaminophen-Induced Hypotension in the Pediatric Cardiac Critical Care Population: A Retrospective Cohort Study

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Introduction: Acetaminophen is one of the most used over-the-counter medications in the pediatric population for pain and fever management. The intravenous (IV) formulation is favorable in acute scenarios when other enteral routes are not feasible. However, there have been recent concerns in the literature regarding the significance of IV acetaminophen-induced hypotension in critically ill patients, including in the pediatric cardiac population. This study seeks to determine the clinical significance of this hypotensive occurrence in pediatric cardiac surgery patients and determine if it results in compensatory increases in vasopressor or inotropic requirements. Based on recent studies, we hypothesize that there will be a difference in hemodynamic stability within 60 minutes of IV acetaminophen administration, requiring vasoactive medication titration.

Methods: This retrospective study was conducted in a large tertiary care facility and is IRB-exempt by Mayo Clinic's Institutional Review Board. Data were collected on postoperative pediatric cardiac surgery patients less than 18 years old admitted to the cardiovascular ICU (CVICU) between January 1, 2014 and May 4, 2018. Patients who received 10-15 mg/kg of IV acetaminophen within 4 hours of ICU admission were matched using the Greedy Method with similar acuity patients who did not receive IV acetaminophen. Arterial blood pressures and vasoactive-inotropic scores (VIS) were analyzed in 15-minute intervals, starting from the time of acetaminophen administration (pre-index time). For comparison, the same index times were used in the no IV acetaminophen group. For consistency with other studies, hypotension and relative hypotension were defined by a mean arterial blood pressure (MAP) drop of at least 15% and 10% from pre-index time, respectively. Linear regression was used for continuous data outcomes and logistic regression for binary outcomes.

Results: One-hundred nineteen patients who received IV acetaminophen were matched (1:1) with patients who did not receive IV acetaminophen upon admission to the CVICU. The group that received acetaminophen had 30% higher odds (P = 0.384) of having hypotension and 15% higher odds (P = 0.622) of having relative hypotension at 60-minutes post-index time compared to the group that did not receive acetaminophen. The estimated difference in lowest MAP within 60-minutes post-index time between the two matched groups was 0.8mmHg (P = 0.383). The group that received acetaminophen also had 70% higher odds (P = 0.254) of having an increase in VIS at 60-minutes post-index time compared to the group that did not receive acetaminophen. The estimated difference in highest VIS within the first 60-minutes post-index time between the two matched groups was 0.27 (P = 0.307). The mean±SD change in VIS from pre-index to 60-minutes post-index time was +0.3±1.6 and +0.1±0.7 for those who did and did not receive IV acetaminophen, respectively.

Discussion/Conclusion: The purpose of this study was to expand on the limited pediatric data regarding IV acetaminophen-induced hypotension and include higher acuity patients on vasoactive infusions. Though hypotension was seen within 60-minutes of IV acetaminophen administration in the pediatric cardiac critical care population, there was no statistically significant difference in the hypotensive

incidence or VIS increase compared to the group that did not receive IV acetaminophen. Therefore, in this population, IV acetaminophen administration was not associated with a clinically relevant decrease in MAP or compensatory increase in VIS. The limitations of this retrospective study include a smaller sample size, lack of more specific subgroup analysis, and lack of substantial long-term outcome analysis. Though an attempt was made to match similar acuity patients, a potential confounder still includes the inability to control all medications given in the ICU that could lead to hemodynamic fluctuations, such as sedative use. Future studies should include a larger sample size to increase the level of confidence with findings and a more specific subgroup analysis to determine causality. Because recent studies highlight hemodynamic vulnerability in younger patients, future pediatric studies should also include a greater proportion of children less than 2 years old.

Effects of Humerus and Intravenous Epinephrine Administration in a Normovolemic Pediatric Cardiac Arrest Model

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Introduction: Each year 15,500 children in the United States receive epinephrine (EPI) with cardiopulmonary resuscitation (CPR). Multiple factors make intravenous (IV) catheter placement difficult in these situations in the pediatric patient. Humoral intraosseous (HIO) placement offers an alternative to IV vascular access and can be established with greater ease and less difficulty. Literature Review: No research studies have characterized the pharmacokinetics of EPI, or determined the incidence of achieving return of spontaneous circulation (ROSC) following HIO versus IV administration of EPI in a pediatric cardiac arrest model. Significance: In cases of cardiac arrest, the chances of survival are decreased by 9% for each minute that epinephrine administration is delayed. Purpose: To determine EPI pharmacokinetics and ROSC following HIO versus IV EPI administration.

Methods: In a swine model of pediatric cardiac arrest, we evaluated the pharmacokinetics of HIO versus IV administered EPI, and the effects of route of administration on the incidence of ROSC. In this prospective between groups design, Yorkshire Swine (28-38 kg) were randomly assigned to the following groups: HIO (n=7), IV (n=7), or CPR+defibrillation only (n=5). Swine were placed in arrest for 2 minutes before CPR was initiated. After 2 minutes of cardiac arrest, CPR was initiated for an additional 2 minutes. Four minutes post-arrest, EPI (0.01 mg/kg) was administered by HIO or IV route. Blood samples were then collected at 0.5, 1, 1.5, 2, 2.5, 3, 4 and 5 minutes. EPI was then administered every 4 minutes or until ROSC was achieved. The incidence of ROSC and time to ROSC were determined. Plasma EPI concentrations were measured by high performance liquid chromatography. Peak concentration (Cmax), time to maximum concentration (Tmax) and mean concentration of plasma EPI over time were determined.

Results: A multivariate analysis of variance (MANOVA) was used to determine if there were significant difference between HIO and IV groups in terms of Cmax and Tmax. A repeated measures ANOVA was used to determine statistical significance between groups in mean plasma EPI concentrations over time. There was no significant difference in Cmax (P =0.106) or Tmax (P =0.529) of plasma EPI between the HIO and IV groups. However, the mean concentration of plasma EPI was significantly greater in the IV group when compared to the HIO group at 1 minute (P =0.03). A Chi-Square Test indicated that there was no significant difference in the rate of ROSC between the IV group (4 out of 6) and the HIO group (6 out of 7) (P =0.416). The odds ratio indicated a 3 times greater chance of ROSC following HIO administered EPI compared to IV administered EPI. However, time to ROSC was not significantly different between the HIO and IV groups (P =0.601). Only 1 out of 4 subjects in the CPR+defib group achieved ROSC.

Discussion/Conclusion: The American Heart Association recommends that epinephrine be administered by IV or IO route. However, these recommendations are based primarily on expert opinion. Our data indicate that HIO administration of EPI is as effective as IV administration in achieving ROSC in this pediatric model of cardiac arrest. Plasma levels of EPI were higher in the IV group when compared to the HIO group at only one timepoint (1 minute). However, this difference did not improve the chances of survival in the IV group. Limitations: Swine may not be generalizable to humans. However, they do have similar cardiovascular systems and bone structure. Other limitations were a small sample size, and only

one IO location was used.

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Effects of Tibial IO and IV Epinephrine in a Euvolemic Pediatric Cardiac Arrest Model

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Introduction: Euvolemic cardiac arrest among children can result from numerous causes including blunt chest trauma, electrocution, and drowning. Pediatric Advanced Life Support (PALS) recommends the administration of epinephrine (0.01 mg/kg) by intravenous (IV) and then intraosseous (IO) routes. These recommendations are based on expert opinion since no studies have investigated the pharmacokinetics of epinephrine administered IO nor the rate of return of spontaneous circulation (ROSC) in a pediatric cardiac arrest model. The aims of this study were the following: Are there significant differences in ROSC between the TIO and IV groups? Are there significant differences in mean concentration (MC) over 5 minutes, concentration maximum (Cmax), time to maximum concentration (Tmax), Area under the Curve (AUC) of epinephrine between the Tibal IO (TIO) and IV groups?

Methods: Pediatric pigs were randomly assigned to each group TIO (n=7), IV (n=7); and control, cardiopulmonary resuscitation (CPR) + defibrillation (defib) (n=5). Swine were anesthetized and then were placed in arrest for 2 minutes. CPR was performed for 2 minutes. The rationale for 2 minutes was this would be the amount of time to recognize arrest and implement resuscitation measures. Epinephrine 0.01 mg/kg was administered 4 minutes post arrest by TIO or IV routes. Samples were collected over 5 minutes to determine the MC, Cmax, Tmax, and AUC. After sample collection, epinephrine was administered every 4 minutes or until ROSC. The Cmax and MC were analyzed using high-performance liquid chromatography. Defibrillation began at 3 minutes post arrest and administered every 2 minutes or until ROSC or endpoint at 20 minutes after initiation of CPR. ROSC was operationally defined as a systolic blood pressure of at least 60 mm/Hg and a palpable pulse for a period of 30 minutes.

Results: ROSC occurrences were as follows: TIO (7 out 7); IV (5 out 7) and CPR + Defibrillation (2 out of 5). Chi-Square analyses indicated there were no significant differences in ROSC between the TIO and IV groups (P >0.05). A Repeated ANOVA (RANOVA) indicated a significantly higher mean concentration in the IV group vs TIO at the 30 and 60 times ($P < 0.05$) but no other significant differences ($P > 0.05$). MANOVA indicated a significant difference between the IV vs. TIO groups ($P = 0.034$) but no other differences relative to Cmax ($P > 0.05$). The means ± SEM were TIO and IV respectively 192 ± 36l; 361± 47. MANOVA indicated that there were no significant differences in Tmax by group ($P > 0.05$). The means ± SEM were TIO and IV respectively 90 ±19; 45 ± 25. MANOVA indicated there no significant differences in the groups relative to AUC. The means ± SEM were TIO and IV respectively 21465± 3674; 30675 ± 21465.

Discussion/Conclusion: Though significantly higher serum epinephrine concentrations at 30 and 60 second time points and higher overall concentrations were detected in the IV group over the TIO group, this did not impact the ROSC rates between them. This suggests that an adequate concentration of intravascular epinephrine is achieved with TIO administered epinephrine under euvolemic conditions. These serum epinephrine data and ROSC rates substantiates the purported benefits of intraosseous access over difficult intravenous catheter placement. Before any modification to clinical practice, the limitations within the study must be considered. As always, the use of an animal model may not be generalizable to humans; however, human and swine anatomy are closely similar. In addition, the sample size is small but the effect size is large enough to detect differences on statistical analysis. To mitigate these limitations, future research needs to include clinical research to validate these findings within a human population with a larger sample. In conclusion, the establishment of a TIO catheter

should be a first line therapy to avoid any delay in epinephrine delivery among euvolemic pediatric cardiac arrest victims. In addition, it is important to emphasize that intravenous access, particularly central access, is preferred and attempts to gain access must not be abandoned after TIO catheter placement.

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Exploring the CRNAs Airway Management Technique in Anticipated and Unanticipated Difficult Airway Situations

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Introduction: The invention and widespread availability of the video laryngoscope (VL) has influenced management of difficult airways. Prior to the availability of video laryngoscopes, fiberoptic intubation (FOI) was the preferred technique in difficult airways. Following the introduction of VL, multiple studies have demonstrated that anesthesia providers are choosing VL as their first choice for the management of anticipated difficult airways. This deviates from the recommendations of some of the more prominent difficult airway management guidelines. As the most common cause of anesthesia related morbidity and mortality is difficulty securing the airway, it is important to ensure guidelines reflect practice. This study explores anesthetists choice in difficult airway situations and factors associated with choosing FOI versus other techniques.

Methods: Following Georgetown University IRB approval, a survey was deployed to a random sample of CRNAs in the AANA. This study was conducted using an exploratory quantitative descriptive design. The electronic surveys were randomly distributed via email using the Survey Monkey platform to 2,851 AANA members with a total sample of n=222. The G*Power calculator was used to conduct a power analysis to obtain the optimal sample size for this research study which was determined to be 367. Deidentified data were analyzed using the SPSS statistical analysis program. Chi Square tests were used to analyze the data collected from the research questions to discover whether years of anesthesia experience influenced the order of interventions in a difficult airway situation. Chi Square tests were also used to compare additional demographic information to the selection of management strategies in common difficult airway situations. Demographics and other factors were compared to difficult airway management techniques.

Results: This study found that anesthetists' first choice in anticipated difficult airway included VL (75.66%), DL (15.77%), and awake FOI (6.31%). Providers first choice after DL failed in an unanticipated difficult airway situation included VL (62.5%), intubating via SGA (17.41%), bougie (5.26%), and FOI (0.45%). Most providers (96%) were very comfortable with DL, 92.86% were very comfortable with VL, and only 17.57% were very comfortable with awake FOI. Demographic variables and years of experience were not significant in influencing the first choice in difficult airway scenarios. Although not statistically significant, those who chose FOI among any of their choices were somewhat more comfortable with the procedure than those who did not (M = 2.94 and 2.64, respectively; t(216) = 1.85, p = .07) Familiarity with DAS guidelines had a large effect, Cohen's d = .51, and was statistically significant (t(206) = 2.54, *P* = .01).

Discussion/Conclusion: It appears that VLs were being selected for difficult intubations as they became more available in clinical practice. According to one retrospective study (n=3723), more than half of anticipated difficult airways were intubated using the video laryngoscope (*P* <0.0001). Another retrospective study (n=1,554) also showed an increase in the number of patients intubated using the VL (*P* <0.001). Our study showed that although awake FOI was historically the standard for anticipated difficult airway, a majority of CRNAs surveyed (75.66%) chose VL. When comparing our results with previous studies, the use of a VL during any difficult airway situation is more common than choosing awake FOI. It is possible that the VL could be the new standard for anticipated difficult airways due to accessibility and provider comfort level with that technique. Limitations should be considered. The data collected were subjective and generally fallible to misinterpretation. The results in the study were not

statistically significant, and the conclusions drawn from the study cannot be fully supported for that reason. The sample size needed was also not met. Future recommendations include exploring patient factors, difficult mask ventilation, previous history of difficult airway along with many others. Comparing patient factors and outcomes of those intubated with VL versus FOI should be analyzed.

Intraoperative Methadone and Dexmedetomidine in Adult Cardiac Surgery Patients Reduces Postoperative Opioid Use

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Introduction: Nausea and vomiting are significant issues following cardiac surgery. Opioid-based analgesic regimens can exacerbate this and induce hyperalgesia. Also, the association between high postoperative opioid use and chronic opioid use provides impetus for an opioid-sparing strategy. Our original analgesic regimen utilized propofol and fentanyl perioperatively. Dexmedetomidine provides anxiolysis and analgesia while not suppressing respiratory drive. Methadone is a unique opioid that modulates pain for up to 48 hours by maintaining more constant blood serum levels compared to short-acting opioids. It is also a potent NMDA antagonist and inhibits norepinephrine and serotonin reuptake. The aim of this study was to develop, implement, and evaluate a multimodal, opioid-sparing, analgesic regimen that could be applied safely to a high-volume cardiac surgical practice.

Methods: A multimodal analgesic regimen was implemented and, after IRB approval, data was extracted for adult cardiac surgical patients at a large academic medical center. The new regimen was compared to the prior opioid-based regimen. Outcomes included oral morphine equivalents used, pain scores, incidence of postoperative nausea and vomiting (PONV), and extubation time. Intervention: The new algorithm included methadone, 0.3 mg/kg IV, at induction followed by dexmedetomidine infusion, 0.5 µg/kg/min. Anesthetic management was per provider discretion. Please see addendum for Multimodal Analgesic Regimen (intervention) and the Opioid-Based Analgesic Regimen (baseline). Analysis: Data were summarized using mean±SD or median for continuous variables and frequency counts and percentages for categorical variables. Comparisons were performed using the two-sample *t* test for continuous variables and the chi-square test for categorical variables. Two-tailed tests were performed with $P < 0.05$ used for statistical significance.

Results: The Opioid-Based Analgesic Regimen group included 2,350 patients over 14 months; the Multimodal Analgesic Regimen group included 776 patients over 5 months. The multimodal group had improved highest pain scores in the first 6 hours after surgery ($P < 0.001$), yet there was no clinically significant difference at any time point. Intraoperative opioid consumption dropped nearly 50% in the multimodal group (230.0 vs 423.5 mg OME, $P < 0.001$) and postoperative opioid consumption was lower each day for the first 4 days (40.0 vs 177.0, 37.5 vs 121.5, 15.0 vs 46.5, 3.9 vs 15.0; $P < 0.001$) compared with the opioid-based group. Opioid consumption on the day prior to discharge (surrogate for home-going requirement) was significantly reduced in the multimodal group (0 vs 7.5 mg OME, $P < 0.001$). The incidence of PONV, time to first bowel movement, time to extubation, ICU and hospital length of stay did not differ between groups. [Full analysis comparing data from 03/27/2017 to 05/05/2018 and 01/07/2019 to 06/07/2019 will be added when available.]

Discussion/Conclusion: In this study, a multimodal analgesic regimen was associated with less opioid use intra- and postoperatively after cardiac surgery when compared to an opioid-based regimen. Total intraoperative OME dose was nearly 50% less than the opioid-based regimen. Postoperative OME reduction was significant, with Day 1 decreasing from 177 mg to 40 mg. This trend continued on Days 2-4. Opioid use was analyzed through Day 4, after which the majority of patients discharged. We examined the OME used the day prior to discharge as this amount is used to determine the home going opioid prescription. Higher home going opioids are associated with a higher risk of developing chronic opioid use. The multimodal group had a median OME of 0 mg on the day prior to discharge compared with the opioid-based regimen that had a median of 7.5 mg. In summary, a multimodal analgesic

regimen including methadone, dexmedetomidine, and ketamine demonstrated improved/equivalent pain scores, no increase in adverse events, and was associated with greatly decreased opioid use postoperatively when compared to an opioid-based regimen. One limitation is the retrospective study design rather than a randomized trial. Another limitation is the assumption that opioid use the day prior to discharge would correlate with post-hospital use. Although there is support for this concept, future work will include post-hospital use.

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Neuraxial Anesthesia versus General Anesthesia in Total Hip and Total Knee Arthroplasties

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Introduction: General anesthesia (GA) or neuraxial anesthesia (NA) can be used for total hip arthroplasties (THA) and total knee arthroplasties (TKA) procedures. A thorough meta-analysis and systematic review assessing the risk of complications based on the type of anesthetic used suggests that NA is superior to GA1. NA demonstrated either a decrease in risk of many of the outcomes assessed or no difference compared to GA. This project aimed to assess if best practice is being used at our own hospitals. Given the results of the meta-analysis, the clinical question guiding this project was: what is the rate of utilization of NA and GA at our hospitals for these two orthopedic service lines? For patients that receive GA, are there reasons that can be identified based on patient characteristics? It was hypothesized that GA was used less than NA, and that the use of GA has declined over the years.

Methods: This was a retrospective multicenter observational evidence-based practice project. Project approval was and all human subjects were protected in this project. Inclusion criteria included patients > 18 years old who were undergoing elective unilateral TKAs or THAs between 2015 through 2019. Exclusion criteria included patients < 18 years old, joint revision surgeries, and emergent/urgent/trauma cases. The measured outcome in this project was the proportion of cases using GA versus NA each year from 2015 through 2019. GA was defined as the use of an inhaled anesthetic, neuromuscular blocking agent, or laryngeal mask airway or endotracheal tube placement. NA was defined as bupivacaine 0.75% or bupivacaine 0.5% documented in the surgical medication administration record (MAR), or any medication documented as given intrathecally. Univariate analyses examined patient and case characteristics and the rate of utilization of GA and NA each year. A bivariate analysis using Chi Square compared the proportion of cases using GA in 2015 to 2019.

Results: A total of 10,255 patients received an elective unilateral TKA or THA at our hospitals from 2015 through 2019. The average (standard deviation [SD]) age of patients undergoing TKA was 67 (9) years old and the average (SD) age of patients undergoing THA was 66 (11) years old. Among adult patients receiving major joint replacement surgery at our hospitals, the proportion of patients receiving GA has increased over the past five years. For TKA, the proportion of cases receiving GA increased from 21% in 2015 to 34% in 2019 ((RR=1.61, 95% CI=1.41-1.85, P <0.001). For THA, the proportion of cases receiving GA increased from 18% in 2015 to 37% in 2019 (RR=2.07, 95% CI=1.74-2.46, P <0.001).

Discussion/Conclusion: Approximately 8% of all patients undergoing either THA or TKA experience complications affecting major organ systems annually. With total joint arthroplasty being one of the most frequently performed procedures (over one million annually in the United States) and on the rise with our aging population, the burden of complications significantly impacts our healthcare system and resources. This project demonstrated that despite the latest research and consensus recommendations stating that NA is superior to GA, the use of GA is increasing at our hospitals. Assessing if there are particular patient characteristics and/or comorbidities that may be contributing to the use of GA will be important for informing practice.

Onset of Epinephrine by Humerus Intraosseous and Intravenous Administration

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Introduction: More than 6.3 million children have cardiac arrests each year. Vascular access is essential for successful recovery: The chance for survival decreases by 9 % with each minute that passes without resuscitation that includes epinephrine administration. The purpose of this study was to compare the onset of epinephrine by the Humerus Intraosseous (HIO) versus the Intravenous (IV) route in a normovolemic pediatric model. Few studies have examined the onset of any drug when comparing IO and IV routes. For example, no significance was found between the onset of IO or IV administered rocuronium. To our knowledge, no one has investigated the onset of epinephrine in a normovolemic pediatric cardiac arrest model. It is not known if a significant difference in onset exists between HIO and IV administration of epinephrine.

Methods: This was an experimental study using pigs weighing between 20-40 kg to represent pediatric-aged children. G-Power was used to determine the number of subjects. A multivariate analysis of variance (MANOVA) was used to analyze the pretest data to determine equivalence of the groups. Pigs were randomly assigned to the IV or HIO group. Swine were anesthetized, and after 15-minute stabilization, baseline systolic blood pressures and pulse were recorded for each subject. Epinephrine was then administered at a dose of 0.01 mg/kg followed with a flush of 10 mL of 0.9% normal saline. A stopwatch was started and once the pig achieved a 10% increase above the baseline pulse and/or blood pressure, we considered this to be the onset. An independent *t* test was used to analyze the differences in onset.

Results: Similar studies were used to calculate a large effect size, 0.6. Using a power of 0.80, an effect size of 0.6 and an alpha of 0.05, we calculated we needed a sample size of 7 in each of the IV and HIO groups. A MANOVA indicated that there were no significant differences between the HIO and the IV groups relative to weight, blood volume, systolic blood pressure, or pulse indicating that the groups were equivalent on these variables ($P > 0.05$). The initial systolic blood pressures and pulses by group were reported in means ± standard deviations. The systolic blood pressures were as follows: HIO: 102.2 ± 14.9; IV 104 ± 10.1. The initial pulses were as follows: HIO: 83 ± 9.8; IV pulse: 87 ± 4.4. An independent *t* test indicated that there was a significant difference in time to onset ($P = 0.005$). The means ± SD of time in seconds to increase systolic blood pressure and/or pulses by 10% were as follows: HIO: 14 ± 4; IV: 8 ± 2.

Discussion/Conclusion: Although statistically significant difference was found in time to onset, clinically this finding is negligible. However, initial placement of an IV compared to IO can be significant in the amount of time to complete administration of IV epinephrine. Studies show it may take up to 49 minutes to gain IV access. It took us less than 5 seconds to insert the HIO device. This may translate into better odds and faster time to ROSC compared to the IV route. Also, in a cardiac arrest situation, CPR does not have to be stopped to insert the IO device. Future studies should include a larger sample size and other IO sites. Measuring peak and duration as well as time for elimination (T1/2 Beta) from the body should also be investigated. It may be useful for future studies to investigate differences in peak, duration, and elimination by age and weight.

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Opioid Administration After Scheduled Cesarean Delivery Following Implementation of Enhanced Recovery After Surgery

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Introduction: Opioids are used to treat acute post-cesarean delivery pain with varied success, but also come with unwanted side effects. Enhanced Recovery after Surgery (ERAS) has become a widely adopted model of care in the effort to improve the quality of patient care during the perioperative period. The anesthesia provider plays a vital role in managing perioperative analgesia and has the potential to improve the perioperative experience in minimizing adverse effects related to opioid administration. Evidence is beginning to show the potential for adequate pain management with the implementation of ERAS and other multi-modal, opioid-sparing methods. However, this evidence is limited and varied regarding the implications of postoperative opioid administration among women undergoing scheduled cesarean delivery.

Methods: Baseline demographics of women between ages 18 to 35 undergoing scheduled cesarean delivery from 2017 to 2020 were examined. These demographics were compared between the pre- and post-ERAS implementation participants. Continuous variables demonstrating symmetry were reported in mean and standard deviation and were examined with an independent samples *t* test. Continuous variables demonstrating skewness were reported in median and interquartile range and were examined using Mann Whitney U test. Categorical variables were interpreted using Chi-Square analysis. Multivariate analysis was conducted with interrupted time series. The measured outcome of milligram morphine equivalents (MME) was reported as a median value with interquartile range. Median MME values were determined for each study period, then plotted on an interrupted time series graph to compare median MME over time. The proportion of women who did not receive postoperative MME was measured between the two groups and analyzed using Chi-Square analysis.

Results: The pre-ERAS implementation group consisted of 412 women, while the post-ERAS implementation group consisted of 268 women. Baseline group characteristics were comparable showing no statistically significant differences among the two groups with the exception of the women with gestational hypertension. Results showed Among the proportion of women who received opioids during the postoperative period, the implementation of ERAS was associated with a decrease in MME administration. Among the proportion of women who received opioids, the pre-ERAS implementation group (n=347) used a median (IQR) cumulative 48-hour of 150 total MME (75-240), while the post-implementation group (n=191) used 105 total MME (45-180) which demonstrated a difference of 45 total MME, or a 30% reduction ($P<0.01$). The results also demonstrated a higher proportion of women who did not receive opioids after ERAS implementation (Pre-ERAS: 15.8% vs post-ERAS: 28.4%, $P<0.001$).

Discussion/Conclusion: Anesthesia providers play key part in providing multimodal analgesia, an integral part of ERAS protocols, while also minimizing adverse outcomes. Decreased perioperative opioid use after ERAS implementation is an important step toward improving patient outcomes and quality care. Results from this observational study regarding post-operative opioid use following ERAS guidelines may support the emphasis in the implementation of ERAS and its interventions among other obstetric service areas. Baseline comparability between the pre- and post-implementation groups help generalize these findings to the obstetric population. However, due to the retrospective and observational nature of this project, it is subject to potential for confounding factors. It is also subject to error due to misinformation within the electronic medical record and the extraction of these data. Because this was a single-center study, further research among a larger, multicenter population would

strengthen the implication of these results.

Perioperative Fluid Administration in Microvascular Autologous Breast Reconstructions

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Introduction: Moderate quality research evidence associating perioperative fluid regimens to breast reconstruction outcomes is consistent with high-quality evidence in other surgical service lines that an optimal range of fluid administration exists but cannot be defined. ERAS Society guidelines for breast reconstruction management reflect this conundrum in recommending strongly that practitioners avoid overresuscitation and underresuscitation of fluids without providing specific targets. At this facility, intraoperative management of hypotension in microvascular breast reconstructions follows a traditional approach, which eschews vasopressors and may predispose patients to overresuscitation. Anesthesia management of these cases could benefit from knowledge about the impact this approach has on its breast reconstruction outcomes.

Methods: This observational review retrieved de-identified electronic health records of 697 microvascular breast reconstructions at a tertiary and critical access hospital in Washington State from January 1, 2014 to December 31, 2019 with departmental and institutional approval and IRB exemption in compliance with HIPAA. Incompletely or inaccurately recorded cases were excluded, and a-priori and post-hoc power analyses affirmed non-futility. Univariate and bivariate analysis determined a comparable patient cohort for statistical analysis. Independent and relative effects of perioperative fluid rates were compared to other covariates against a composite adverse outcome using bivariate and multivariable regression analysis. A composite near-term outcome was assessed if any of the following occurred during the initial hospital stay for breast reconstruction: high supplemental oxygen requirements after PACU discharge, transfer or admission to higher than floor level of acuity, length of stay greater than 144 hours, or any subsequent surgery.

Results: Among 436 DIEP flap cases, the median perioperative fluid administration rate was 235 mL/h (IQR 175-294) for the intraoperative and anesthesia recovery period. Median age was 53 (IQR 46-60), BMI was 29.5 (IQR 26.2-33.0), ASA was 2, case duration was 9.8 hours (IQR 8.7-10.8), postoperative hemoglobin was 10.8 g/dL (IQR 9.9-11.4) and length of stay was 101.5 hours (IQR 79.6-123.1). Primary contributors to the composite adverse outcome (14.2%) were high supplemental oxygen requirements (8.7%) and prolonged lengths of stay (6.7%). Independent predictors of the outcome included BMI, case duration and hypertension history. Although perioperative fluid rate was not an independent predictor of the outcome, complication rates rose sharply when perioperative fluid rates exceeded 500 mL/h (OR=12.4, $\chi 2$=6.81, *P* =0.01). In addition, inclusion of perioperative fluid rate, smoking history, postoperative hemoglobin and age in the multivariable regression model predicted the composite adverse outcome better than independent predictors alone.

Discussion/Conclusion: Covariates outside of anesthesia's control appeared to be stronger predictors of adverse patient outcomes than documented perioperative fluid rates, and no optimal fluid administration range could be recommended. The inability to determine that perioperative fluids exerted a significant independent effect on the composite adverse outcome (OR 2.53, 95% 0.11-58.69, *P* =0.56) precluded the correlation of any pattern of fluid administration to adverse outcomes. That high complication rates occurred at very high rates of fluid administration may be attributed to case and patient characteristics or to anesthesia management other than fluid resuscitation. Inclusion of the following covariates for which data could not be collected would strengthen comprehensiveness of findings: intraoperative vasopressor use, intraoperative hypotension, intraoperative hypoxia, intraoperative blood loss, relevant patient history (coagulopathy, recent chemotherapy, prior major abdominal surgery, vascular disease, connective tissue disease), baseline oxygen requirement,

preoperative hemoglobin, surgical laterality, timing (immediate or delayed after mastectomy) and diagnosis for postoperative complication. In addition, the inability to retrieve accurate weights necessitated reporting of fluid rates in mL/hr instead of mL/kg/hr. Causality cannot be inferred from this retrospective review.

Sevoflurane and Low Versus Moderate or High Fresh Gas Flow Rates and Renal Insufficiency in General Anesthesia Cases

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Introduction: Anesthesia providers may feel reluctant to reduce fresh gas flow rates (FGFs) with sevoflurane due to the manufacturer's recommendation to use high FGFs (>2L/min). These guidelines stem from theoretical concern of Compound A accumulation and subsequent nephrotoxicity in rodent studies. The question guiding the literature search was "among patients undergoing GA with IA, do low- versus moderate- and high FGFs worsen renal outcomes?" Literature review resulted in one recent meta-analysis and seven high quality randomized control trials. These studies demonstrated no difference in renal outcomes between patients receiving sevoflurane with low FGFs versus other standard anesthesia methods. This study aimed to review FGFs during anesthesia; no difference in FGFs with sevoflurane was hypothesized to exist between the general sample and patients with chronic kidney disease (CKD).

Methods: This retrospective, observational, evidence-based practice project reviewed 144,919 surgical cases on adults requiring GA with IA at a tertiary hospital with twenty-eight operating rooms (ORs) from 2014 to 2020. It measured the mean FGF rates during the anesthesia maintenance period (case start to ten minutes prior to incision close) and associated inhalational agent (desflurane, isoflurane or sevoflurane). It compared patients with CKD to the sample as a whole to assess if FGFs differ based on CKD presence and severity. CKD was identified by billing diagnostic codes associated with the case. This project was exempt from human subjects protection according to the Institutional Review Board and the hospital's human research protection program. An A Priori Power analysis (α=0.01, β=0.01) indicated a required 1,072 subjects within the sample. Bivariate analysis included independent sample *t* test, ANOVA and Mann Whitney U tests; multivariate analysis involved linear regression to assess average FGF change per year.

Results: The sample was typical for a large medical center. Patients had a median age of 60 (IQR 45-70); 77% were ASA 2 or 3 and 80% of cases were elective. Of the 144,919 cases, 37,052 were deleted due to inaccurate maintenance FGFs, irrelevant services lines, or inadvertent inclusion of a patient <18 years old. Multiple IAs were used in 25,151 cases; sevoflurane was used in 82,712; isoflurane, 8,555; and desflurane, 8,551. Average FGFs, measured in L/min, across all IAs, have decreased from 1.94 (2014) to 1.87 (2020) (*P* <0.001). FGFs with desflurane started at 1.40 (2014), decreased to 1.10 (2017), and then increased to 1.66 (2020) (*P* =0.03). Of note, the number of cases utilizing only desflurane in 2014 was 2,496 but in 2020, there were 50 cases. Among cases with isoflurane, FGFs decreased from 1.56 (2014) to 1.42 (2020) (*P* <0.001). Sevoflurane FGFs decreased from 2.15 (2014) to 1.91 in 2020 (*P* <0.001). No difference in FGFs existed between the general sample compared with CKD patients (3% of this sample) receiving sevoflurane (*P* =0.80).

Discussion/Conclusion: The literature reports reduced cost and minimized adverse environmental impact with lower FGFs. Further, reduced FGFs indicate no increased risk for kidney injury among patients receiving sevoflurane with low FGFs. Statistically significant decreases in FGFs at the hospitals included within the study are increasingly aligning practice with literature recommendations. Limitations of this study stem from the observational retrospective nature: risk of confounding bias, inability to assess causation. Data were pulled from an electronic health record so some aspects of the data may be incomplete, inaccurately retrieved or charted in error. CKD rates reported in the study are notably low due to identification using ICD codes alone. Strategies should be developed to address ways in which

FGFs can be furthered lowered. Future research could investigate cost and environmental impact of total intravenous anesthesia, more advanced IA scavenging systems, novel IAs (such as xenon), and the recycling and reuse of exhaled IAs.

Spinal Induced Hypotension Prophylaxis in Elective Cesarean Sections

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Introduction: More than 90% of cesarean sections (CS) are performed with neuraxial anesthesia. Spinal anesthesia (SA) is popular due to its rapid analgesic onset and dense neuroblockade. Without prophylaxis, 70%-80% of cases are accompanied by hypotension. Untreated, spinal induced hypotension (SIH) increases physiologic risks to mother and fetus. The efficacy of various prophylactic interventions has been established in high-quality studies, but no intervention alone has been shown to eliminate SIH. Current research evidence supports the combined prophylactic use of intravenous fluids, pharmacologic agents and mechanical interventions (ex. positioning) to prevent SIH in elective CS under SA. This multicenter evidence-based practice (EBP) project aimed to observe the rate at which research evidence to prevent SIH among elective CS has translated into clinical practice.

Methods: This multicenter EBP project was retrospective and observational in design. Our project was approved by hospital Nursing Inquiry and Research Council and Human Research Protection Program. Initial data extraction via electronic health record (EHR) was specific to adult women (≥18 years old) undergoing elective CS with SA between 2015-2020. Inclusion criteria was based on age 18-40 years old, ASA ≤2, BMI ≤35, baseline SBP 90-160. Exclusion criteria was based on CS cases that had combined spinal epidural or general anesthesia, had preoperative diagnoses of gestational/hypertension, pre/eclampsia, and drug or alcohol abuse. Of the initial 3,623 cases extracted, 1,587 were included in our final sample. Our project observed the prophylactic rates of crystalloid preload, ondansetron and phenylephrine infusion use for SIH among elective CS with SA. Univariate analysis was conducted to describe sample characteristics. Bivariate analysis with Chi Square was used to detect group differences in SIH prophylaxis rates between 2015 and 2020.

Results: Between 2015 and 2020, findings demonstrated that the proportion of patients receiving any of the three observed prophylactic interventions remained stable at >98%. Prophylactic crystalloids were consistently administered at a rate of >90% throughout the same time period (RR=0.97; 95%CI=0.94-0.99; *P* =0.007). However, prophylactic Ondansetron rates increased from 13% to 81% (RR=6.37; 95%CI=4.72-8.59; *P* <0.001). Similarly, the use of phenylephrine infusion increased from 14% to 81% (RR=5.89; 95%CI=4.42-7.85; *P* <0.001). Findings also showed that the proportion of patients that received the three interventions together increased from 3% in 2015 to 65% in 2020 (RR=24.63; 95%CI=12.35-49.11); *P* <0.001).

Discussion/Conclusion: The observed rates of SIH prophylaxis among elective CS with SA remained consistently high at >98% since 2015. This was primarily due to similarly high rates of preload crystalloid administration. However, the individual rates of ondansetron and phenylephrine infusion for SIH prevention increased substantially, suggesting the adoption of the research evidence into clinical practice. Despite their increased prophylactic use, only 81% of cases received either ondansetron or phenylephrine infusion. Furthermore, only 65% of cases received the three interventions together. These rates suggest the underutilization of measures known to prevent the incidence and severity of SIH in elective CS with SA. The establishment of evidence-based guidelines to prevent SIH can standardize practices and improve quality of care to this population. Despite the significance of our findings, this project was limited due to its retrospective and observational design, which can inherently introduce confounding variables affecting results. Consequently, this project's results should not be used to inform clinical decision making. However, the research evidence at the foundation of this project has demonstrated efficacy and should be used to inform clinical practice. Future research can focus on

patient attributes that may decrease the likelihood of receiving SIH prophylaxis in elective CS with SA.

Strategic, Focused Barrier Applications to the Anesthesia Workstation: A Novel Approach to Moderating the Risk of Nosocomial Infection During Surgical Anesthesia Care

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Introduction: Work from our laboratory and clinical studies as well as from others demonstrate quantifiable risks of microbial cross contamination in the anesthesia workstation (AW) due to behavioral and equipment design factors. Healthcare acquired infections (HAIs) are a significant national health concern carrying increased patient morbidity, mortality, and significant financial cost. Recent national, multidisciplinary guidance recommendation urge aggressive attention to the AW detailing the need for education, training, design changes and behavior modification by AW personnel. We recognize the challenges in achieving endpoints noted in this expert guidance document. Based on our knowledge and experience, we designed a clinical pragmatic trial assessing a novel approach to mitigate the risk of cross contamination in the AW.

Methods: With IRB approval, and a priori power analysis, 30 diverse surgical cases requiring anesthesia care over a 3-day period were matched 1:1 as control group (no intervention) or intervention group (application of sized condom-like barriers to anesthesia machine 'hot spots' defined as elements frequently touched and difficult to disinfect revealed in our previous work). These included the EMR computer mouse, the APL control valve, O2 flowmeter control, and all vaporizers. Care was provided by both nurse- and physician-providers, also matched 1:1 on case mix. Pre-procedural (baseline) and end-of-case cultures were taken of the "hot-spots" using standardized sampling procedures. Mann-Whitney analysis tested the differences in the density of colony forming units (CFU) between covered and uncovered conditions in each matched case and to establish baseline equivalency.

Results: At baseline CFU density was equivalent in both conditions. Total CFU density was significantly lower in the covered (Mean Rank = 5.81) vs uncovered condition (Mean Rank = 11.19) at $P < 0.01$, r = -0.64. The covered condition not only served as a barrier to contamination of apparatus "hot spots" but prevented subsequent downstream (next-patient) exposure as these were removed at each case end, mitigating between-case disinfection need. Post-case provider debriefings noted occasional concerns regarding device performance requiring follow-up modification. These involved devices slipping off AW components, inconsistent traction on the associated component, and impeding smooth movement of the EMR mouse. These deficiencies are currently being addressed with attention to fit and texture of device fabric.

Discussion/Conclusion: We demonstrated in previous work that use of apparatus barrier conveys significant benefit to the patient in mitigating the risk of cross-contamination, yet a full AW wrap may meet resistance by some providers due to access constraints. In this proof of concept, pragmatic trial, we demonstrated that focal barrier applications convey significant patient safety benefits by theoretically reducing the risk of AW-acquired infection, and provide evidence called-for in the recent guidance document. A growing body of research and clinical observation reveals that the anesthesia workstation poses significant risk of healthcare acquired infection due to the risk of cross-contamination of equipment and personnel. Considering previous work that we and others performed, we performed a pragmatic clinical trial involving 30 diverse surgical anesthesia cases demonstrating that the use of a novel approach (focused "condom" applications) prevented contamination of high touch/highly contaminated machine elements that are difficult to disinfect and resulted in statistically and clinically relevant reductions in bacterial burden. This approach would likely facilitate subsequent disinfection of the machine by reducing not only CFU burden, but also preventing machine inoculation by new, and potentially pathogenic species, including viral and fungal organisms.

The Effect of a Recent Graduate Certified Registered Nurse Anesthetist Alumni Mentoring Program on Stress and Academic and Clinical Preparedness in the Student Registered Nurse Anesthetist: A Pilot Study

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Introduction: Student registered nurse anesthetists (SRNAs) face significant stressors during their training, including the need to balance their personal lives with rigorous academic curriculums and long clinical hours, as well as performance pressure as they transition to advanced clinical practice. Results from a recent national survey suggest that first year SRNAs desired CRNA alumni mentorship. While previous studies support the use of alumni mentorship programs to relieve stress and increase personal and professional success, few have studied the specific effects of these programs. This study evaluated the impact of a CRNA Alumni Mentoring program on SRNAs self-reported stress levels, stress symptoms and perceived academic preparedness.

Methods: A quantitative, quasi-experimental, one-group, pre- and post-test design was utilized. Following IRB approval, and informed consent, a convenience sample of 14 first year SRNAs and 14 CRNA alumni participated. The pre-test collected baseline data from SRNAs. Participating SRNAs were then randomly matched with a mentor. A scripted introductory Zoom meeting clarified individual roles and expectations. From that point, the mentoring model was informal and allowed the mentor and mentee to communicate in the environment, medium and frequency of their choice. Approximately 2 weeks after the introductory meetings, the COVID-19 pandemic resulted in widespread lockdowns in the United States. Despite this, the mentorship program proceeded as planned. The post-intervention survey was deployed 3 months into the mentorship relationship to measure the impact of mentoring on self-reported stress levels, stress symptoms, and academic preparedness. Descriptive and inferential statistics were analyzed using SPSS 26.

Results: Data from the pre- and post-intervention survey revealed a mean stress rating of 6.14 and 6.44, respectively. A Wilcoxon signed ranks test showed no statistically significant difference in average daily academic related stress among SRNAs after implementation of a CRNA alumni program ($Z=1.08$, $P=.28$). Pre- and post-Intervention data of stress symptoms among SRNAs showed no statistically significant differences, yet symptoms of stress remained prevalent at both measurement points. To assess the impact of the program on perceived academic preparedness, SRNAs were asked frequency of communication and perception of academic support. Half of SRNAs reported they communicated with their CRNA alumni mentors less than once a month, and 28.6% of those reported they had no communication with their mentors. Only 28.6% of SRNAs perceived adequate academic support from their mentor, while 28.4% of SRNAs neither agreed nor disagreed that their mentor provided adequate support.

Discussion/Conclusion: This pilot study evaluated the impact of a CRNA alumni mentoring program on SRNA perception of stress and academic preparedness. No statistically significant differences were found indicating the program had minimal impact on the SRNAs experience. While recent research revealed SRNAs prefer a more informal mentoring model, these results suggest this structure was not conducive to consistent or effective mentor-mentee communication. In the future, a more structured CRNA alumni program should be evaluated to determine whether this facilitates productive mentorship relationships. Furthermore, mentor-mentee pairing based on similar interests and communication preferences may better promote the mentoring relationship. When interpreting these results, one must consider that the onset of a global pandemic coincided with the mentorship period. This may have

altered the participants' availability and/or willingness to devote time to the mentorship relationship. Furthermore, the background stress faced by the SRNA from the pre-test (pre-pandemic) to the post-test (approximately 3 months into the lockdowns) may have been increased by the pandemic's highly disruptive impacts on daily life. Therefore, due to this unprecedented confounding factor, the researchers recommend replication of this study to conclusively determine the effectiveness of a CRNA alumni mentoring program.

The Efficacy of Cidex, Cavicide, and Neutral Disinfectant Cleaner Disinfection on Disposable ETT's After Exposure to Staphylococcus Aureus

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Introduction: Reuse of medical supplies was a common practice throughout most of modern medical history. The advent of disposable plastics and increased concern of communicable infectious disease led to an increase of disposable medical products available. This disposable culture, increased use, and lack of resupply led to supply shortages during the COVID19 pandemic. The disinfection of supplies represents a significant capability and would lessen the burden of unreliable resupply and supply exhaustion in future pandemics or for the military. Endotracheal tubes (ETT) are single use poly vinyl chloride (PVC) tubes that are used in most surgical cases requiring anesthesia and therefore an ideal candidate for potential reuse. We hypothesized ETTs exposed to Staphylococcus aureus can be safely and effectively disinfected by cidex, cavicide, neutral disinfectant cleaner.

Methods: Endotracheal tubes were contaminated with Staphylococcus aureus broth cultures adjusted to an optical density of 0.6 for 1 hour. ETTs were then dried and disinfected according to manufacturer instructions. All ETTs were then rinsed with saline for 1 hour. The ETTs were then placed into a sterile broth solution, sonicated for 5 minutes, and vortexed for an additional 2 minutes. The broth was then serially diluted 10-fold to reach a final dilution of 10-7. All dilutions, including neat suspensions and the saline wash, were cultured on Luria broth agar. Plates were incubated for 24 hours and counted and then incubated for an additional 24 hours for a total 48 hours prior to a final colony count.

Results: After 24 hours of incubation, plate colony counts revealed significant differences between saline controls and all disinfectant treatments. ETTs treated with Cavicide for 3 minutes demonstrated a 4-log reduction (P <0.0001) in S. aureus growth, while ET tubes treated with Cidex for 12 minutes revealed approximately 3.5 log reduction (P < 0.0001) in colony growth. ETTs treated with Neutral disinfectant for 8 minutes resulted in a 2-log reduction in CFU/mL (P< 0.0001). Interestingly for all treatment groups, only 1 of the 4 experiments resulted in growth, while the 3 other experiments each resulted in a complete bactericidal result, where no growth was observed, even for the neat suspensions.

Discussion/Conclusion: These data indicate that medical hard surface disinfectants may serve as an effective strategy for decontaminating disposable medical supplies or equipment. Its application within countries with advanced medical capabilities would be generally limited to catastrophic events, however its potential would facilitate medical care in environments of limited capabilities such as combat or impoverished regions throughout the world. Another important consideration for disinfection are the environmental concepts of recycle, reuse, or reduce that are now altering medical practice within major medical communities in an effort to reduce the environmental impact of medicine. Future directions of research will include investigation on disinfectant dwell time in the solutions to see if a longer soak times results in complete kill for all experiments. In addition, future research would mitigate limitations of this study, which include low sample size and the generalization of in vitro experimentation. Overall, these data offer a positive indication that medical supply hard surface disinfectants may serve an effective strategy for decontaminating single use ETTs and enhancing supply capability and augmenting medical care.

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The Impact of the COVID-19 Pandemic on Certified Registered Nurse Anesthetist Practice

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Introduction: Significant shifts in the delivery of critical healthcare services occurred as a result of the COVID-19 pandemic. The federal government declared a national public health emergency, and a number of regulatory waivers and new rules were implemented to allow for greater flexibility in addressing healthcare needs. The impact of the federal waiver was influenced by current state regulations, the most restrictive being Supervision-Level oversight requiring physician involvement in CRNA practice. The specific aim of this study was to describe and quantify changes to CRNA practice as a result of these state and federal regulatory modifications. It was our hypothesis that Supervision-Level states would be most likely to experience the greatest movement toward full CRNA scope of practice (SOP) with removal of barriers to practice.

Methods: This exempt study was approved by the Webster University IRB. Our quantitative methodology employed an electronic survey using the Qualtrics platform. The survey was reviewed by an expert panel and piloted prior to deployment to 44,100 CRNAs with current email addresses in the AANA database. CRNAs performing clinical duties during the pandemic were targeted for inclusion. Eleven clinical practice items, stratified by supervision status, were assessed to determine if a change in performance status took place. Expanded practice was defined as performing a task without supervision if it was previously only performed supervised, or performing a task outside the operating room (OR) if it previously was only performed in the OR. Respondents were also asked about pandemic work experience related to a variety of settings and responsibilities, any type of non-OR experience, and whether they worked in any capacity taking care of COVID-19 patients. The survey was active Jul 15-Sept 1, 2020, and 2 reminders were sent to encourage completion.

Results: Data from 2,097 respondents from all 50 states and DC for an estimated 6% participation rate were analyzed. Frequency distributions were calculated for demographic and practice characteristic data. To analyze the impact of state regulation, states were grouped by their level of state regulation prior the pandemic, federal supervision opt-out status, and the corresponding impact of executive orders removing barriers to CRNA practice, and categorized as Major, Minor, or No Impact states. The largest factor predicting CRNA expansion of practice was practicing in a Major Impact state versus No Impact states (OR 1.83, P=.001) after adjusting for practice characteristics and state COVID burden. Practice expansion involving tracheal intubation (n=129), ventilator management (n=82), arterial (n=76) and central (n=49) line placement was most common. CRNAs were more likely to expand their work outside of the operating room setting in Major Impact states (OR 2.37, P<.0001), and in states that held Federal Opt-out status (OR 1.52, P <.0001).

Discussion/Conclusion: Approximately 16% of CRNAs reported practice expansion beyond their normal responsibilities, primarily outside the OR. CRNAs were more likely to experience practice expansion in states impacted by removal of regulatory barriers. In settings where CRNAs were already practicing to their fullest SOP, they were more likely to be utilized in a broader capacity outside of the OR. Our findings demonstrate that removal of barriers to practice and the expansion of the responsibilities of the CRNA to their full SOP led to contributions in the care of COVID-19 patients in much-needed areas. However, the overall low rate of practice expansion suggests underutilization of CRNAs despite the intent of executive orders to remove barriers. Several respondents indicated that despite state-granted executive orders to practice at full SOP, institutional policies and restrictions still limited optimal

utilization of CRNA expertise. Our findings support the Institute of Medicine recommendation for removal of SOP barriers to improve availability of quality care. Limitations to this study included the inability to fully assess the impact of hospital-level restrictions and the low response rate. Recommendations for future research include assessment of the long-term effects of the regulatory waivers and state executive orders on CRNA practice and the impact of hospital-specific restrictions on SOP.

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The Impact of the Disease Model of Substance Use Disorder on Evidence-Based Practice Adoption and Stigmatizing Attitudes: A Comparative Analysis

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Introduction: Evidence-based practices improve health outcomes in persons with substance use disorder, but practice adoption is often limited by stigma. Stigma leads to poor communication, missed diagnoses, and treatment avoidance. To effectively care for these patients, providers need an understanding of the types of stigma, the impact of stigma on the adoption of evidence-based treatment practices, and the discrimination faced by these patients that may affect employment, housing, relationships, and healthcare services. The purpose of this study was to survey a rural community to conceptualize knowledge and attitudes towards SUD and OUD in particular. We hypothesized that community members who accept OUD as a chronic disease would be more accepting of evidenced-based treatment strategies and would show less marginalization and stigmatization towards those suffering from OUD.

Methods: This study was deemed exempt from IRB oversight. A rural county of approximately 45,000 residents was surveyed. A 25-item electronic survey was created to assess knowledge and attitudes of the community towards substance use disorder, evidenced-based practices, and stigma. Content validity was evaluated by a team of experts consisting of the Director of a University Crime Science Institute, a DNP with expertise in harm reduction, a PhD prepared RN with public health nursing experience and expertise in naloxone programs, a chemical dependency counselor, the CEO of a regional mental health and substance use counseling center, and a MPH prepared SUD expert. Questions were grouped into five subcategories to meaningfully address high-priority areas. Descriptive statistics included frequencies and percentages. A comparative analysis was performed using Chi-square and phi to evaluate response rates from the first question, A substance use disorder is a real illness like diabetes and heart disease, to the other survey questions.

Results: A total of 173 people responded to the survey. The response to “A substance use disorder is a real illness like diabetes and heart disease” resulted in two groups of similar size, with 83 (48.5%) of the respondents agreeing with the statement. Of the 21 statements compared to this response, there was a significant difference ($P<.001$) in 15 questions between the two groups. Between groups, moderate effect size was seen in the knowledge questions, treatment related questions, and bias or stigma related questions. An effect size approaching 0.5 was seen in the naloxone questions and the following two questions: support for syringe exchange programs and medication assisted treatment services. The comparative analysis between groups showed that those who believe substance use disorder is a real illness are more likely to support evidence-based treatment practices, show less stigma towards those suffering from substance use disorder, and are more supportive of naloxone distribution and harm reduction services.

Discussion/Conclusion: Educating healthcare providers and the community about the brain disease model of SUD may increase knowledge and decrease the stigmatizing attitudes that slow or prevent the adoption of evidence-based SUD practices. Participants believing that SUD is a chronic disease also displayed less marginalization and stigmatization towards those suffering from SUD. These findings serve as an impetus for provider and community education. Educating about the brain disease model of substance use disorder may increase knowledge and decrease stigma. CRNAs must be prepared to treat patients with SUD and should be educated on Medications for Opioid Use Disorder treatment, harm reduction measures, stigma-free communication, and recommendations to prevent recidivism during

the perioperative period. Limitations: The generalizability of these results may be diminished because the findings are limited to one rural community in the United States. In addition, the sample was limited to those with internet access and some computer or smart phone skills. Further research is needed to determine the best approach for providing education given the interplay and complexity of the effect of various dimensions of stigma.

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Qualitative Research

A Qualitative Examination of Opioid Sparing Anesthesia Practices Among CRNAs

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Introduction: Anesthesia providers have historically provided quality opioid-based intraoperative analgesia, but research to date suggests these techniques may have lasting implications on patients' long term health outcomes. In contrast, opioid sparing anesthesia (OSA) can provide patients superb analgesic coverage without the noxious side effects of opioids or risk of misuse. Current literature is highly specific, detailing OSA techniques for certain surgical procedures or examining OSA facilitators and barriers. No known study to date has described anesthesia providers' qualitative experiences with OSA. The study purpose was to address this research gap and, following the descriptive phenomenological frameworks of Georgi (2012) and Sundler et al (2019), examine the expertise of CRNAs who consistently utilize OSA in their personal practice.

Methods: This qualitative descriptive study utilized a semi-structured interview protocol. Purposive snowball sampling was used to recruit nationwide participants befitting inclusion criteria (practicing CRNAs who consistently utilize OSA in their anesthesia practice) and exclusion criteria (less than two years of experience, no longer practicing, or not regularly utilizing OSA). Interview questions were developed based on gaps in literature and focused on a practitioner's personal experience and expertise with OSA. Each participant completed one telephone interview. The co-principal investigators debriefed after each interview and met regularly with the full research team to discuss findings. A total of 16 interviews were conducted, achieving robust saturation of results. Recorded audio was coded with indirect identifiers, then transcribed by a professional transcription service. Verified text files were uploaded to qualitative data analysis software for thematic analysis. Consensus and synthesis of themes evolved from identified codes.

Results: Sixteen CRNAs completed interviews. Redundancy of results was reached by the eighth interview, ensuring rigor and data saturation. Two themes emerged: (1) perioperative benefits of opioid sparing anesthesia and (2) prospective benefits of opioid sparing anesthesia. Perioperative benefits include: reduction or elimination of postoperative nausea and vomiting, superior CRNA-managed pain control (pain management in the immediate perioperative period), and improved short-term recovery (accelerated and superior immediate recovery from anesthesia in the OR and PACU, related to the sparing of opioids). Prospective benefits include: higher surgeon satisfaction, superior surgeon-managed pain control (pain management beyond the PACU, influenced by CRNAs' intraop OSA techniques), increased patient satisfaction, reduction of opioids in the community, and CRNA awareness of positive prospective benefits of opioid sparing anesthesia (being cognizant of the long-term effects of OSA and patient outcomes beyond the PACU).

Discussion: This study navigates uncharted territory, focusing on experiences of CRNAs consistently utilizing OSA. Our snowball recruitment secured saturation of results, yet limited generalizability of findings. All participants identified as White and 75% identified as male. Most worked in community or rural hospitals, limiting input from larger academic institutions. OSA is a critical step toward a paradigm

shift of perioperative pain management. Traditional opioid-based techniques only address the mu receptor and allow susceptibility to deleterious side effects. Balanced OSA yields superior pain management via control of numerous pain receptors, attenuation of the sympathetic nervous system response, improved efficacy of opioids when used on virgin mu receptors, and enhanced recovery from anesthesia and surgery. Future studies should examine the perspectives of more diverse CRNA populations and institutions. Additionally, research focusing on anesthesia and surgical team collaboration for pain management between is critical. OSA techniques embody the Advanced Practice Nurse model by providing holistic patient care. OSA positively impacts the patient beyond the PACU and combats excess opioids in the community. CRNAs are pain specialists with a unique opportunity to improve the long-term health of patients. Our findings will guide providers to adopt modern methods of pain management.

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From the Operating Room to the Front Lines: Shared Experiences of Nurse Anesthetists During the Coronavirus Pandemic

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Introduction: The COVID-19 pandemic resulted in severe health, economic, social, and political consequences while thrusting CRNAs at the forefront of the battle. On March 30, 2020, the Centers for Medicare and Medicaid (CMS) announced sweeping regulatory changes allowing healthcare systems better flexibility in delivering services to meet the surge of patients during the pandemic. The CMS requirement for physician supervision of CRNAs and other advanced practice nurses was temporarily waived to ensure that providers could perform the functions they are qualified and licensed to carry out. Several state governors also issued executive orders removing barriers to CRNA practice by waiving requirements for physician supervision. The purpose of this study was to use personal and group interviews to determine the shared experiences of CRNAs who worked during the COVID-19 pandemic.

Methods: This study was deemed exempt and approved by the institutional review board of Webster University. A mixed-method study was conducted. The qualitative component of the study, a focused ethnography, employed personal and group interviews to determine the shared experiences of CRNAs who worked during the COVID-19 pandemic. Focused ethnography entails studying a specific issue with a specific culture that is familiar with the investigators. Purposeful and snowball sampling were used to recruit participants. A total of 29 participants were recruited, with six focus groups and three personal interviews scheduled. Interviews were audio recorded, transcribed verbatim, and checked for accuracy by reading the transcripts while listening to the audio recordings. Data saturation occurred when information was repeated, or no new information was revealed during interviews. Although data saturation occurred after the fourth focus group interview, all scheduled interviews were completed.

Results: Criteria used to test rigor in quantitative studies include exploring internal validity, external validity, reliability and objectivity. To address trustworthiness in qualitative research, analogs are used: credibility, transferability, confirmability, and dependability. Procedures used in this study included a process whereby data were collected by different investigators. Reliability was established by comparing responses from the six focus groups. Investigators independently analyzed transcripts for codes, patterns, and emerging themes and met weekly to discuss results and reach consensus on final themes. Trustworthiness of inferences was ensured by multiple coding and audit trail. Once final themes were established, the data and analysis were validated by an independent expert qualitative investigator. Six themes were identified: (1) CRNAs are part of the solution, (2) doing whatever it takes, (3) CRNAs are valued contributors, (4) removal of barriers promotes positive change, (5) trying times, and (6) expertise revealed.

Discussion: The roles of CRNAs were expanded during the pandemic. Many found themselves front and center of the crisis educating, developing protocols, acting as consultants and intensivists, leading incident command centers, and innovatively solving problems. The expertise, innovation, and leadership demonstrated by CRNAs was recognized and valued by interdisciplinary teams and administrative leaders across institutions. Temporary removal of scope-of-practice barriers resulted in increased patient access to care and eliminated unnecessary layers of supervision. Although it was common for the CRNAs interviewed to experience fear and anxiety while caring for countless patients infected with COVID-19, they unselfishly provided highly skilled care during a pivotal moment in our nation's history. This study revealed that CRNAs can assume expanded roles and apply their knowledge and skills to

provide expert clinical care in a multitude of settings both in and out of the operating room. The findings of this study may support permanent removal of scope-of-practice barriers. A limitation of this study is response bias. Participants may have hesitated to reveal something or may have conformed to other group participants' responses even though they may not agree. Another is purposive and snowball sampling; therefore, the study results may not be transferable to the larger population of CRNAs.

Life with Malignant Hyperthermia Susceptibility: A Qualitative Study

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Introduction: Malignant hyperthermia (MH) was originally described more than 50 years ago as a hypermetabolic, potentially lethal reaction to inhalation anesthetics and succinylcholine. Few studies have focused on chronic symptoms in persons with malignant hyperthermia susceptibility (MHS). Additional inquiry is needed to better define the symptoms of patients with MHS to inform the development of strategies for more timely detection and management. The purpose of this study was to describe the symptom experience and impact of chronic symptoms on the daily lives of persons with MHS to promote better health outcomes through more timely detection and management of chronic symptoms associated with MHS.

Methods: Subjects with MHS in the North American Malignant Hyperthermia Registry (NAMHR) that previously indicated interest in participating in research studies were contacted by a research coordinator at NAMHR to participate in this study. Inclusion criteria included, 1) a known MH causative mutation in the ryanodine receptor type one gene (RYR1) or 2) the CACNA1S gene, 2) a muscle contracture testing diagnostic of increased risk of MH, and 3) joined the NAMHR as a research subject. Contact information of subjects was provided to investigators at the University of Pittsburgh and 7 subjects were interviewed by phone. Interviews were transcribed by a second investigator and analysis was performed by coding phrases from interviews using thematic analysis. Trustworthiness of data was determined by reviewing coding and themes that emerged from the data by an investigator with expertise in qualitative methods. This study was approved by the Human Research Protection Office at the University of Pittsburgh.

Results: The following themes emerged during our thematic analysis of interviews. An example of muscle pain was identified by subjects, “Charlie horses now and then…I guess I didn’t link to exercise”. Subjects also identified thermoregulation changes that occurred with MHS. “I do sweat in a non-lady like way.” Another quote that exemplified this theme included: “When my husband was in medical school, we were dirt poor…but I had to have an air-conditioned apartment which nobody else was talking about back in the 60’s.” Fear related to MHS included the following quote: “I will do anything I can to not be put under. Like I don’t care if I have to bite a bullet, to not be put under, you know I am terrified, terrified.” Those with MHS also treat their symptoms in other ways such as: “The one thing I did try was to increase my fluid intake and my electrolyte intake.”

Discussion: It is important that this research be conducted to produce evidence that persons with MHS have symptoms and medical problems that could be treated earlier and managed more effectively. Often persons with MHS have been misdiagnosed with fibromyalgia or some other condition with no identified cause and no effective treatment, thus delaying receipt of appropriate treatments. Although dantrolene is recognized as effective when given intravenously to abort a MH crisis, many health providers are not aware that dantrolene can be useful to MHS people outside the operating room. Dantrolene has been reported to be effective at relieving muscle cramps and reducing chronically elevated creatine kinase only in case reports and a small cohort of MHS people.

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Evidence Based Practice

Acupressure Compared to Pharmacologic Intervention in Reducing Post Operative Nausea and Vomiting

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Background/Purpose/Question: Post-operative nausea and vomiting (PONV) remains a problem in the surgical environment despite availability of multiple antiemetic medications. The incidence of PONV is one of great patient concern prior to surgery. In addition, PONV can increase cost, increase the length of hospital stay, contribute to patient dissatisfaction, and reduce productivity, especially in the ambulatory surgery setting. Acupressure has been found to be effective in the prevention of PONV and offers a cost-effective alternative to pharmacologic intervention with less side effects and little required training. Question: In Post-Operative Adult Surgical Patients Acupressure Compared to Pharmacologic Management More Effectively Reduces the Incidence of Post-Operative Nausea and Vomiting.

Methods/Evidence Search: The purpose of this project is to answer the clinical question: In post-operative adult surgical patients, does acupressure compared to pharmacologic management more effectively reduce the incidence of PONV? Three databases, PubMed, CINAHL and Embase, were searched using the keywords PONV, pharmacologic, and acupressure. This yielded 33 articles after duplicates were removed. Articles were then excluded based on their connection with either specific populations, specific surgeries, or specific anesthesia techniques. Inclusion criteria included the adult population and English language. Ten articles remained, which included two randomized control trials and eight literature reviews.

Synthesis of Literature/Results/Discussion: Four of the studies show that acupressure does decrease PONV. Two studies show that acupressure is more effective than placebo. Compared to pharmacologic interventions acupressure is just as effective, as shown by four of the studies. Acupressure has been studied with and found as effective as ondansetron, cyclizine, and metoclopramide. However, in patients that have a high risk of PONV, multiple studies have found that pharmacologic management and acupressure combined yield better results than acupressure alone. There are different acupressure points, such as P6. There are also various options available (finger pressure, SeaBand, and ReliefBand) to provide relief of PONV. These bands and acupressure points can be used to decrease PONV.

Conclusion/Recommendations for Practice: PONV is a problem for patients, healthcare professionals, and institutions. CRNAs are encouraged to assess their current practice of preventing PONV and consider the incorporation of acupressure into their practice. For high-risk individuals, medical management from different subclasses should be combined with acupressure. Hospitals can incorporate acupressure bands into practice since they are cost effective and require little training. Additional studies need to be conducted to better understand its effect in different populations, such as those with prior PONV, and in specific procedures.

An Evidence-Based Comparison of Decontamination Strategies for Safe Utilization of Post Decontaminated N95 Filtering Facepiece Respirators in Anesthesia Providers

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Background/Purpose/Question: Considering the current pandemic threatening a limited supply of N95 FFR, many anesthesia providers have resorted to decontamination and reuse of single-use FFR. There is limited evidence on the relative safety and efficacy of the different decontamination methods.The lack of concrete evidence and guidance regarding the reuse of FFR is a cause for concern for anesthesia providers, who are at constant risk of exposure to airborne diseases. The purpose of this evidence-based review is to answer the proposed question "In anesthesia providers, does the reuse of post-decontaminated N95-type filtering facepiece respirators (FFRs) increase the risk of airborne diseases compared to anesthesia providers who use disposable one-time use N95-type filtering facepiece respirators (FFRs)?"

Methods/Evidence Search: An electronic search was conducted using the Cumulative Nursing and Allied Health Literature (CINAHL), PubMed, MEDLINE, and Cochrane library. The search limit included the English language and articles between the years 2014-2021. The following search terms were applied in the electronic search "anesthesia providers," "reuse," "post decontaminate," "N95 FFR," and "risk of airborne disease." The search initially resulted in 140 articles. Duplicate articles and titles with abstracts not deemed relevant were then eliminated from review. Inclusion criteria for research articles was based on the article's ability to answer the questions: "The comfort level of N95 FFR wearer after decontamination, concerns of N95 FFR wearers after decontamination, and determining which decontamination methods would be most practical and safe in terms of available resources."

Synthesis of Literature/Results/Discussion: Thirteen sources met the inclusion criteria for the evidence-based review. The literature revealed that solution-based methods such as hydrogen peroxide and bleach in decontamination should be avoided because it degrades the integrity and efficiency of the masks. Heat minimally alters the integrity of the mask however after 20-50 cycles, there was evidence of decrease efficiency and mask degradation of the FFR. Other factors such as multiple donning also impacted the integrity of the FFR. A statistical analysis showed that the fit gradually decreased after donning the FFR 5 times. The most effective methods noted within this evidence-based review is gravity steam processing along with ultraviolet irradiation, moist heat microwave generated steam and hydrogen peroxide vapor. Due to the pandemic, which continues to occur as a result of different strains, mask integrity should continue to be researched to assist anesthesia providers and employers in making educational decisions in personal protective equipment for anesthesia providers.

Conclusion/Recommendations for Practice: Anesthesia providers are at increased risk of acquiring airborne pathogens. If reuse of post-decontaminated N95 FFRs is to remain a method to conserve supply in the middle of a pandemic, then appropriate information regarding the potential risk associated with reuse and decontamination should be available. Studies seem to indicate that the reuse of N95 FFR can be a feasible way to conserve the supply of N95 FFR in times of short supply. This method of conservation, however, should be studied to a greater extent to determine the risk to anesthesia providers. Many unknowns remain which can pose an increased risk to providers who have no choice but to adopt these practices. It is also important to consider the feasibility of the selected decontamination method and its cost-effectiveness. Organizations should consider the models of N95 FFR they provide when instructing providers to conserve supplies by decontaminating and reusing FFR.

Buprenorphine Prolongs Duration of Analgesia in Peripheral Nerve Blocks: A Systematic Review and Meta-analysis of Randomized Controlled Trials

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Background/Purpose/Question: Peripheral nerve blocks (PNBs) are routinely performed to prevent postoperative pain. However, the duration of analgesia is not adequate to provide pain relief through the period of time when the pain is still severe. One method to address this issue is to add adjuvants to the local anesthetic (LA) to increase the duration of analgesia in the postoperative period. The purpose of this project was to evaluate the literature on the addition of buprenorphine to the LA in PNBs for increased duration of postop pain relief and propose guidelines for use. This project addresses the question: In patients undergoing regional anesthesia, how do regional blocks administered with buprenorphine combined with LA compared to LA alone, affect duration of pain relief?

Methods/Evidence Search: Databases utilized in the literature search included PubMed, Cochrane, Google Scholar, and CINAHL. Key words used to search all databases were: buprenorphine, "regional anesthesia", and peripheral. Search was limited to orthopedic surgeries involving upper and lower extremities. Additional articles were identified by a manual search of references and database suggestions. Peripheral nerve blocks with catheters and continuous infusions of local anesthetics, as well as IV regional and neuraxial anesthesia techniques were excluded. Studies with adjuncts other than buprenorphine or in addition to buprenorphine as well as studies performed on animals were excluded as well. A total of 624 articles resulted from all searches. Inclusion criteria was adults > 16 years of age, single-shot peripheral nerve blocks using ultrasound guidance or peripheral nerve stimulator, local anesthetic with and without buprenorphine. Fifteen randomized controlled trials were identified that met the criteria.

Synthesis of Literature/Results/Discussion: The purpose of this review was to evaluate the literature to ascertain if the addition of buprenorphine to local anesthetic in peripheral nerve blocks lengthens the duration of analgesia significantly postoperatively and to propose a guideline for anesthesia providers to use when adding buprenorphine to peripheral nerve blocks. An additional goal was to determine if there were any secondary outcomes such as adverse effects (nausea, vomiting, pruritis, sedation, respiratory depression, or prolonged motor block) that might increase length of stay, lead to re-admission, or result in injury due to a fall. In all 15 RCTs, the addition of buprenorphine to local anesthetic in peripheral nerve blocks produced a significant increase in duration of motor and sensory block and analgesia postoperatively compared to peripheral nerve block with local anesthetic alone. Postoperative pain scores, the number of patients who required rescue analgesia, as well as the number of supplemental analgesics required were significant.

Conclusion/Recommendations for Practice: Postop pain is a major concern for patients undergoing orthopedic surgeries. Peripheral nerve blocks are routinely performed for postop pain for these patients. The addition of buprenorphine to the local anesthetic in peripheral nerve blocks significantly increases the duration of sensory and motor block and analgesia provided by these blocks with minimal side effects. The proposed guidelines will assist providers to administer buprenorphine safely. Due to its high lipophilicity, buprenorphine has a rapid onset. It can be used as an adjunct in spinal, epidural, and IV regional anesthesia. It has the longest duration of action of any opioid. It can be used as an alternative for methadone in opioid addicts and has been shown to be effective in the treatment of pain caused by cancer. When added to spinal anesthesia for cesarean sections, it has some of the same side effects as morphine (nausea, vomiting, pruritis), but to a lesser degree. Buprenorphine has a low side effect profile and works well for the majority of patients.

Comparison of Alternative Brachial Plexus Blocks for Shoulder Surgery

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Background/Purpose/Question: Interscalene brachial plexus block (ISB) remains the gold standard for surgical anesthesia and postoperative pain management in patients undergoing shoulder surgery. However, undesirable respiratory side effects related to phrenic nerve block leading to hemidiaphragmatic paralysis (HDP) are significant concerns. The undesirable respiratory side effects of ISB have led to the search for alternative brachial plexus blocks to provide equivalent analgesia without causing HDP.

Methods/Evidence Search: The purpose of this literature review was to answer the PICOT question: In respiratory compromised patients undergoing shoulder surgery, do alternative brachial plexus block techniques compared to ISB provide non-inferior analgesia and decreased respiratory complications associated with phrenic nerve blockade 24 hours postoperatively? Cochrane Library, CINAHL, PubMed, and Google Scholar electronic databases were searched for peer-reviewed literature addressing alternative brachial plexus blocks for shoulder surgery. The search terms: alternative brachial plexus block, brachial plexus block, cervical plexus block, shoulder surgery, and complications were used. Twenty-nine full-text articles published between 2010 to present were critically appraised.

Synthesis of Literature/Results/Discussion: The literature revealed several alternative brachial plexus block techniques, including Suprascapular brachial plexus block (anterior vs. posterior approach) with an axillary nerve block, supraclavicular plexus block, superior trunk block, infraclavicular subomohyoid block, and costoclavicular brachial plexus block. However, literature was divided on whether these alternative techniques provided equivalent postoperative analgesia and avoided HDP. Some studies demonstrated equivalent analgesia as ISB but still had HDP. Some studies demonstrated inferior analgesia but had a lower incidence of HDP, and one study demonstrated equivalent analgesia without HDP. Still, the study was too small to make a recommendation. Given the various conclusions, no recommendation for one specific technique can be made. Nevertheless, the alternative brachial plexus block techniques provided adequate postoperative analgesia with decreased incidence of HDP. All the alternative techniques were significantly superior to no block.

Conclusion/Recommendations for Practice: The demand for shoulder arthroscopies is projected to increase by 600%. Patients with respiratory compromise such as obstructive sleep apnea, COPD, and morbid obesity who are not safe candidates for an ISB and are most susceptible to opioid-induced respiratory depression, would benefit significantly from the multimodal analgesia, which includes alternative brachial plexus block. CRNAs can learn and increase their skills on the alternative brachial plexus techniques by attending lectures, seminars, workshops, cadaveric courses and enroll in pain fellowship programs. CRNAs can then master one of the alternative brachial plexus block techniques and provide the safest and highest quality care for their patients.

Comparison of Quadratus Lumborum and Erector Spinae Plane Blocks for Lumbar Spine Surgery

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Background/Purpose/Question: Postoperative pain is difficult to manage in patients undergoing lumbar surgery. The use of opioids is the main therapy for treating patients' postoperative pain. However, the analgesic effect of opioids is limited and is associated with significant side effects. In addition, the use of opioids may limit the ability of patients to participate in physical therapy at an early stage, which affects their recovery. Recently, the erector spinae plane block and quadratus lumborum block have been used in lumbar spine surgery to improve postoperative pain and reduce opioid usage. These two blocks are relatively new in the field of lumbar surgery and many anesthesia providers may not be familiar with the application of these two blocks, such as pros and cons of each block. This project will compare and contrast the two regional blocks used in the lumbar surgery.

Methods/Evidence Search: A literature review was performed to compare the regional techniques of the quadratus lumborum (QL) and erector spinae plane (ESP) blocks for lumbar spine surgery. EBSCO host, ScienceDirect, Academic Search Premier, and Gale Academic were searched using "QL block for lumbar spine surgery" and "ESP block for lumbar spine surgery". From the 4 databases, 37 nonduplicate citations were screened. Search criteria was limited to full-text articles between the years of 2016 to 2021, peer reviewed, and English language for all databases, which excluded 8 articles after a title and abstract screen. Twenty-nine articles were then retrieved and 5 articles were excluded after a full text screen, leaving 13 articles that were retrieved and utilized for this evidence-based practice comparison.

Synthesis of Literature/Results/Discussion: Current studies have found that nearly 86% of patients undergoing surgery report moderate to severe postoperative pain. Recently, a multimodal anesthetic technique with regional anesthesia modalities, such as the QL or ESP block, has been successfully used in lumbar surgeries. The use of these two nerve blocks has shown to improve patient satisfaction, decrease opioid consumption, and reduce hospital length of stay. Patients who received the QL block for lumbar spine surgery required less postoperative opioids ($P = 0.012$) and had a lower length of stay in the hospital ($P = 0.522$). Similarly, patients who received an ESP block for lumbar spine surgery required less postoperative opioids ($P < 0.001$), pain scores were lower immediately after surgery ($P = 0.002$) and at 6 hours after surgery ($P = 0.040$), and patient satisfaction was more favorable ($P < 0.0001$). Both blocks provide visceral and somatic coverage, however they vary in their level of difficulty, technique, patient positioning, volume of local anesthetic, and ability to leave a catheter in place throughout the surgical procedure. The use of QL and ESP blocks are relatively new treatment modalities, but despite limitations with each block, both QL and ESP have demonstrated effectiveness in the reduction of postoperative pain in lumbar spine surgery.

Conclusion/Recommendations for Practice: There are two emerging regional nerve blocks, QL and ESP, being used in lumbar spine surgery to decrease postoperative pain. However, the techniques of these two blocks are quite different and certain limitations may apply for performing these two blocks, despite the similar somatic and visceral pain coverage. Each regional block has some advantages and disadvantages, eg position of the patient and catheter placement. Based on the information presented in this study, anesthesia providers will be able to choose the appropriate regional block for their patients, in order to improve the outcomes for patients in their clinical practice.

Do Patients Undergoing Thoracic Surgery Have Better Postoperative Pain Control with an Erector Spinae Block Versus a Thoracic Epidural?

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Background/Purpose/Question: A thoracic epidural in conjunction with opioids is the gold standard for postoperative pain control in patients undergoing thoracic procedures. Thoracic epidurals are invasive and not technically easy to perform. Emerging evidence suggests that the Erector Spinae block (ESB) may be an equal or superior alternative to the thoracic epidural, in both its effectiveness and ease of administration. This block may be a safe alternative to the thoracic epidural and could be more efficacious.

Methods/Evidence Search: The databases utilized in this review of the literature were PubMed, EBSCO , and EMBASE. The Search terms utilized included, Thoracic Epidural, Erector Spinae Block, and Thoracic Surgery. Articles published between 2015 and 2020 were considered for inclusion. After initial review 14 articles were excluded and 21 were included for further review. Inclusion and exclusion criteria were applied, and an additional 12 articles were removed from the review. Articles were excluded based on the following: not block of interest, not outcome of interest, not population of interest. Inclusion criteria consisted of thoracic epidural vs erector spinae, pain control, and thoracic surgery. Final analysis was conducted with 8 articles.

Synthesis of Literature/Results/Discussion: Of the 8 articles included notable themes emerged. Four of the included studies found that ESB more effectively controlled pain by measure of postoperative narcotic consumption. Additionally, numeric pain score analysis demonstrated better pain control profile in ESB vs thoracic epidural in four of the included articles. The literature suggests that the ESB may be less challenging technically and therefore a good alternative to thoracic epidural. Moreover, the ESB can be an effective outpatient treatment for patients with prolonged surgical pain even after hospital discharge.

Conclusion/Recommendations for Practice: Ongoing research evaluating superiority of ESB vs thoracic epidural is warranted, as the use of this technique is relatively new in thoracic surgery. Synthesized evidence suggests that the ESB can be an excellent choice for post-operative pain control for those undergoing thoracic surgery. Mastering this regional technique is a valuable technique in any anesthesia provider's armamentarium. The ESB may be a safer , more effective replacement for the thoracic epidural, and anesthesia providers should work to advance and normalize the use of the ESB for thoracic surgery.

Does Higher Emotional Intelligence Improve Clinical Performance: A Literature Review

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Background/Purpose/Question: Despite rigorous selection of student registered nurse anesthetist (SRNA) applicants with traditional admission criteria, admission GPA and science GPA, there is still a variance in student clinical performance and academic progression through nurse anesthesia school. To decrease attrition, a noncognitive factor, emotional intelligence (EI), may explain this variance. EI encompasses the ability to recognize, assess, understand, and manage one's own emotions as well as others. The aim of this literature review is to determine if there is a correlation with higher EI and clinical performance of SRNAs.

Methods/Evidence Search: A literature search was performed to answer the PICO question: Among student registered nurse anesthetists (SRNAs), does the use of emotional intelligence evaluation upon admission to nurse anesthesia school in combination with GPA criteria, compared to GPA criteria alone, improve clinical performance? PubMed, CINAHL, and MEDLINE were searched for English publications from 2010 to present. Twenty-six articles were found and after title, abstract and full text screen, nine articles met criteria. Keywords included emotional intelligence, academic success, clinical performance, anesthesia student, student registered nurse anesthetist, and nursing student. Exclusions included anesthesia residents and associate nurse.

Synthesis of Literature/Results/Discussion: The literature shows there is significant correlation with GPA and science GPA with academic progression of SRNAs. It also links higher EI to increased academic performance, clinical performance, and one study, increased NCE scores. It is noted that higher EI scores do not correlate with high admission GPAs, and therefore EI evaluation should not be used alone in evaluation for admission. Eight studies support adding EI evaluation to admission criteria with traditional criteria, and three support adding EI to the curriculum. This may reduce the variance in attrition.

Conclusion/Recommendations for Practice: EI evaluation is recommended to be added to traditional admission criteria via the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) Version 2, a 141-question survey. SRNAs must work under high stress situations, think critically, make clinical decisions, and interact with multiple health professions daily. Higher EI is correlated with the ability to better deal with these situations. Failure in clinical training is rarely solely related to intelligence but rather noncognitive skills. Further research is needed to explore EI evaluation at admission and clinical performance of SRNAs.

Does the Administration of Magnesium Sulfate as an Adjunct in Patients Receiving Regional Anesthesia Improve Perioperative Analgesia when Compared to Traditional Regional Anesthesia Regimens?

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Background/Purpose/Question: In anesthesia practice, providers are always seeking to improve the patients experience and improve patient outcomes, both of which can be achieved by enhancing perioperative analgesia. For this reason, many adjunct medications have been studied for their role in improving block characteristics during the administration of regional anesthesia. Magnesium sulfate offers pain modulating and anesthetic sparing effects. The purpose of this review was to evaluate whether magnesium sulfate improves perioperative analgesia when compared to traditional regional anesthesia regimens. The question this review sought to answer was "Does the administration of Magnesium sulfate as an adjunct in patients receiving regional anesthesia improve perioperative analgesia when compared to traditional regional anesthesia regimens?"

Methods/Evidence Search: A literature review was conducted to answer the following clinical question: "Does the administration of magnesium sulfate as an adjunct in patients receiving regional anesthesia improve perioperative analgesia when compared to traditional regional anesthesia regimens?" The search utilized the databases PubMED, CINAHL, and MEDLINE. The key terms used were "magnesium sulfate" and "analgesia", limiting the search to full-text articles published between 2015 to 2020. The exclusion criteria included studies that were comparing magnesium sulfate to other adjunct medications instead of traditional anesthesia regimens, pediatric population, animal studies, intravenous or intraarticular use and studies that lacked relevance. Ninety-four non-duplicate articles were generated. After a full text screen, 11 articles were included for analysis in this review.

Synthesis of Literature/Results/Discussion: The articles examined demonstrate that the addition of magnesium sulfate to regional anesthesia regimens has beneficial effects on perioperative analgesia. The studies analyzed found that magnesium sulfate hastens the onset of the block and prolongs the block duration. The addition of magnesium sulfate prolonged the duration of analgesia and resulted in lower post-operative pain scores. Patients who received magnesium sulfate had prolonged time to first analgesic request and reduced total analgesic consumption. The doses used in the studies ranged from 50-200 mg of magnesium sulfate. Further studies may be warranted to examine the adverse effect profile of magnesium sulfate when used in regional anesthesia versus effects of traditional regimens.

Conclusion/Recommendations for Practice: The incorporation of magnesium sulfate as an adjunct to regional anesthesia can improve perioperative analgesia. The evidence suggests administration of magnesium sulfate in doses of 50-200 milligrams can result in prolonged duration of anesthesia and analgesia, resulting in reduced analgesic requirements for patients. This enhancement of perioperative analgesia can lead to increased patient satisfaction and reduced opioid consumption.

Efficacy of Gabapentin on Acute Postoperative Pain and Opioid Consumption

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Background/Purpose/Question: Gabapentin has risen in popularity with 70 million prescriptions, becoming the tenth most dispensed prescription in the United States. Overlooked side effects involve substance abuse and respiratory depression when given alongside opioids. In 2016, gabapentin was detected in 168 postmortem reports and confirmed primary cause of death in 23 of those fatalities. Due to publication bias, the opioid epidemic, and manufacturer misinformation, clinicians should weigh benefits and risks and avoid the common practice of standardized gabapentin. This project promotes patient safety by informing providers of current, evidence-based research on perioperative gabapentin. In adults undergoing general anesthesia, does administration of gabapentin, compared to placebo, decrease pain scores and opioid consumption in the first 24 hours after surgery?

Methods/Evidence Search: To provide focus, article selection included administration of gabapentin only and excluding pregabalin, timing of administration 1 to 2 hours before surgery, outcome measures that assess both postoperative pain and opioid consumption, and use of general anesthesia as the primary type of anesthesia. The Texas Medical Center Library Health Sciences Research Center Portal was used to access the following databases: Cochrane Library, EMBASE, and PubMed. Medical Subject Heading (MeSH) terms were used to identify articles pertinent to the subject. Key MeSH terms used were “gabapentin,” “gabapentinoids,” “pain,” and “opioids.” The Boolean operators ‘AND’ and ‘OR’ were used to narrow and expand the search, respectively. This yielded a total of 8 articles. Using strength of evidence grades and guidelines dispersed by the Agency for Healthcare Research and Quality, no randomized controlled trial received a letter grade of “A.” Three studies received the letter grade “B,” three studies received “C,” and two studies received “D.”

Synthesis of Literature/Results/Discussion: Results were highly varied amongst studies. Only 2 randomized controlled trial observed a statistically significant reduction in both pain scores and opioid consumption in the study group. One study observed no statistical difference in pain and significantly lower opioid consumption, whereas another study detected the opposite effect, observing decreased pain scores and no change in opioid consumption. Lastly, 2 adequately powered studies found no statistical significance in either postoperative pain scores or cumulative opioid consumption. To validate the inconsistent evidence, a meta-analysis of 281 randomized controlled trials and 24,682 participants evaluated gabapentinoids for postoperative pain and opioid consumption. The results failed to meet the minimum threshold, indicating no meaningful effect or clinical significance. To strengthen future research, publication of both positive and negative outcomes should be encouraged. Also, inclusion of ASA Class 3 and 4 populations is necessary to reflect the patient population and growing trend of multiple comorbidities, patient acuity, and aging.

Conclusion/Recommendations for Practice: The body of literature provides evidence to recommend against routine use of gabapentin for decreasing acute postoperative pain and cumulative opioid consumption. With a high level of certainty, the recommendations discussed here exhibit a moderate amount of strength and magnitude of net benefit. Routine use of gabapentin for the purpose of decreasing acute postoperative pain is not recommended. Prior to administration of gabapentin, skilled clinicians should screen potential recipients of this treatment, especially patients with high risk of polypharmacy. Despite the high safety profile of gabapentinoids, providers must perform a risk-benefit analysis individualized to each patient prior to administering gabapentin.

Evidence-Based Approaches to Facilitate Successful Placement of the Supraglottic Mask Airway in the Anesthetized Patient

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Background/Purpose/Question: LMAs are increasingly selected as the airway management tool of choice. During insertion, malposition can occur potentially resulting in insufficient ventilation, airway obstruction, gastric insufflation, and aspiration. The researchers noted significant variability in placement approaches and observed that anesthesia providers often base insertion technique on training and experience, rather than suggested best practice. In an effort to optimize device performance and reduce complications associated with malpositioning, placement methods supported by the available evidence should be employed. By following the recommended placement guidelines, a provider could reduce the rate of malposition, increase the incidence of first-time placement success, and reduce airway complications, ultimately improving patient safety.

Methods/Evidence Search: The PICO question was: In adult and pediatric patients undergoing LMA insertion during routine surgical procedures (P), does an inflated device (I) compared to a deflated one (C) improve placement success as evidenced by fiberoptic evaluation or positive capnography, while resulting in fewer oropharyngeal complications (O)? The search included PubMed, Embase, CINAHL, Cochrane, and Google Scholar. The selected date range of 1983-2020 paralleled LMA invention and the subsequent design modification. A combination of the following keywords and strings were used to search the literature: laryngeal mask airway, LMA, insertion, LMA technique, LMA insertion technique, supraglottic airway device and surgery, deflate or inflate insertion, and deflated and inflated insertion. The search approach sought randomized control trials, non-randomized control trials, and systematic reviews, with and without meta-analysis. Applicable evidence was evaluated using the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal Tool.

Synthesis of Literature/Results/Discussion: Throughout the evidence, LMA placement success rates and insertion times were shown to be similar across all degrees of inflation. However, the evidence revealed other relevant outcomes to consider, including: validation of fiberoptic scoring, the impact of LMA placement technique on airway complications, and the role of neuromuscular blockade during placement. Fiberoptic evaluation of placement using each technique revealed equally successful anatomic placement. However, no studies correlated anatomical position to LMA performance. When airway complications were considered, any degree of inflation was found to soften the LMA, lowering incidence of oropharyngeal trauma. Furthermore, the evidence suggests that a fully deflated device was associated with an increased incidence of oropharyngeal trauma and complications. When neuromuscular blockade was administered for placement, no difference in the rate of success or time to placement was demonstrated in respect to inflation status. This finding is most pertinent to the “cannot intubate, cannot oxygenate” scenario where an LMA can be life-saving in the difficult airway algorithm. In this critical situation, these findings suggest inserting the device directly from the package and not to spend life-saving seconds on altering mask cuff volume.

Conclusion/Recommendations for Practice: The usage and indications for an LMA have continuously expanded. Resultantly, LMAs are increasingly selected as the airway management tool of choice. It is important to consider quick, successful, and evidence-based placement techniques for the anesthesia provider. Using the LMA as packaged will reduce time to placement and rapidly restore oxygenation. Should anesthesia providers deviate from the recommended technique, the evidence suggests similar rates of success; however, more time may be required for insertion due to the time required to alter the

device. When postoperative complications are considered as an additional factor in this decision, the evidence suggests using an inflated LMA to reduce the incidence of oropharyngeal trauma. Recommendations for future research studies include the validity and clinical relevance of a fiberoptic grading scale for visual confirmation of placement, investigations into insertion technique, and methods to consistently prevent unfavorable oropharyngeal complications.

Evidence-Based Practice Guidelines for Organ Procurement

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Background/Purpose/Question: There is a perceived need by the anesthesia department in an academic, urban medical center to create a multidisciplinary, evidence-based practice (EBP) guideline that details anesthetic care for organ donors during organ procurement. This facility is a major center for organ transplantation. The question for this project is: "In anesthesia providers, how does a guideline for anesthesia care during organ procurement of the brain-dead donor influence anesthesia provider knowledge levels of the organ procurement process?" Due to the high volume of organ procurements and transplantations at this facility, a primary outcome of this project is to increase the knowledge base of anesthesia providers who care for organ donors. Another goal is to ensure an optimal level of care of the transplanted organs which could translate into better outcomes for organ recipients.

Methods/Evidence Search: A literature review revealed much of the evidence focused on care of donors in intensive care units rather than intraoperatively. Literature on the care of organ donors in the operating room comes mostly from expert opinion. A total of 8 references met inclusion criteria and were used to create the guideline, along with a multidisciplinary team of anesthesia providers, the regional organ donation network, critical care physicians, and transplant surgeons. To evaluate knowledge an anonymous pretest was administered to CRNAs and student registered nurse anesthetists (SRNAs). A presentation of the guideline was given followed by a posttest. Descriptive statistics showed that average scores increased in both the CRNA and SRNA groups after the presentation. The CRNA group average increased from 75.7% to 95.6%, and the SRNA group average increased from 63.5% to 97.4%. The increase in average scores is evidence that the guideline improved CRNA and SRNA knowledge at this particular facility.

Synthesis of Literature/Results/Discussion: Consensus after literature review demonstrated a need for EBP guidelines for anesthetic care of organ donors during the intraoperative phase of procurement. Perez-Protto et al. conducted a retrospective study to determine whether or not inhalational agents improved graft survival of organ recipients noting the lack of guidelines in donor care during the intraoperative phase, which emphasized a need to optimize the intraoperative management of donors. Champigneulle et al conducted a survey amongst anesthesia providers regarding anesthetic care of donors, noting a lack of specific recommendations for intraoperative management which led to varying levels of care during procurement. Anderson et al noted the scarce amount of publications on the anesthetic care of organ donors and discussed how available literature lacked detail on how to provide anesthetic care during the intraoperative phase. Elkins conducted a literature review on effects of inhalational anesthetics during the intraoperative phase of organ procurement and noted a lack of clear recommendations for intraoperative management, concluding that there is a need for more research on intraoperative care of donors. Souter et al mentioned that improving the intraoperative care of donors by having EBP guidelines could increase the number of organs available for transplantation.

Conclusion/Recommendations for Practice: Organ procurement is a unique surgical procedure that differs from any other case. The anesthesia care provided to donors intraoperatively has a profound impact on the outcome of the recipient who will receive the donated organ. These two elements heighten the importance of creating an EBP guideline in order to bring understanding and support to anesthesia providers during these cases.

First Time's A Charm: Video Laryngoscopy vs. Fiberoptic Bronchoscopy For Awake Intubations in Difficult Airways

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Background/Purpose/Question: Among anesthesia clinicians, the gold standard for a known difficult airway is to perform an awake fiberoptic intubation. With the introduction of the video laryngoscope in the clinical setting, providers have used this technique frequently for difficult airway scenarios. Recent research has shown that video laryngoscopy may be an alternative choice. The purpose of this systematic search was to answer this PICO question: Does the use of video laryngoscopy for anticipated or known difficult airway intubations have similar first-attempt success rates to the use of fiberoptic bronchoscopy in patients undergoing surgery? A systematic review was performed, and data were synthesized to see comparison on first-attempt success rates.

Methods/Evidence Search: Peer-reviewed articles were extracted from 2015-2020 from the databases of PubMed, Web Science, and the Cochrane library database from 2010-2020. Key terms used in the search included difficult airway, intubation, and success rates. Broad MeSH terms used were airway and intubation. One-hundred twenty abstracts were screened. Inclusion criteria of intubations nasal or oral, specific to procedural areas with expected or known difficult airways was applied. Exclusion criteria included non-human studies, the pediatric population, and case reports describing difficult airways. After criteria met, 21 articles were fully reviewed. After full-text screen and data extraction, 10 articles were included in final synthesis.

Synthesis of Literature/Results/Discussion: Results showed no significant difference in the first-time intubation success rates of video laryngoscopy compared to fiberoptic bronchoscopy, with some articles showing better success rates with video laryngoscopy. Results also showed a decreased time to intubation, more user friendliness, and increased overall use of video laryngoscopy in difficult airway populations. These difficult airway populations included cervical spine immobility, obese, and oral/maxillofacial surgeries with nasal intubation. The cost of a video laryngoscope and its maintenance are lower compared to a fiberoptic bronchoscope, with easier availability of video laryngoscopy devices in remote places requiring anesthesia and intubations. Further research in this area of difficult airway intubations may explore comparison of secondary outcomes of hypoxia time, patient satisfaction, or throat soreness between the two methods. Practice guidelines for the use of a video laryngoscope in an awake intubation may be beneficial for clinicians to use as a reference for this specific technique.

Conclusion/Recommendations for Practice: Evidence suggests that providers that are proficient and comfortable in their method for intubation contribute to high first-attempt success rates. Difficult airway scenarios must be carefully considered for the appropriate method of an awake fiberoptic intubation versus an asleep video laryngoscopy intubation. Video laryngoscopy is a safe alternative for a difficult airway, with a caveat for certain specific facial and anatomical anomalies better suited for a smaller scope. Cost, availability, and time to intubation are secondary factors that may be considered for the most optimal method.

Implementation of an Intraosseous Device Task Trainer to Improve Performance

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Background/Purpose/Question: Lack of training, inexperience, and equipment failure can lead to delays in establishing vascular access in adult patients in an emergency. This can cause untimely interruptions to the delivery of emergent interventions. Intraosseous (IO) access has been shown to be easier and faster to perform than peripheral or central venous access during emergencies. However, many providers lack confidence and training placing IOs. The purpose of the project was to improve student registered nurse anesthetist (SRNA) efficiency in emergency vascular access scenarios utilizing an EBP (evidence-based project) training program for IO placement. The clinical question of this project was: In Uniformed Services University of the Health Sciences (USUHS) SRNAs what is the most effective way to improve the comfort and skill level of IO placement of SRNAs at USUHS?

Methods/Evidence Search: A literature review was completed using the databases Pubmed and CINAHL. All database searches included the same search terms. The literature review was limited to peer-reviewed journals in English published from January 2007-2020. The following medical subject heading terms were used: Infusions, Intraosseous, IO access, training, education, workshop, learning, Emergency Medical Services, Emergency Treatment, OR, Hospitals, prehospital, emergency. Exclusion criteria were Non-adult, Non-Nurse, Non-physician. The Johns Hopkins Nursing Evidence-based Practice Rating Scale was used to evaluate the literature. When appraising the literature, the authors adhered to Level 1A and Level 1B strength evidence. Initially, 172 articles were identified. After the removal of duplicates, 135 articles were left. One-hundred twenty six articles were excluded because they lacked relevance to the project. Nine articles were included after the evidence review. Non-parametric tests were used to compare nominal and ordinal pre and post implementation data.

Synthesis of Literature/Results/Discussion: The study utilized a pre/post education intervention. SRNAs filled out a pre-intervention confidence survey and performed a simulated, graded IO placement. The SRNAs were given hands-on training and shown educational videos. Students then performed a simulated IO placement. They were graded on performance a second time and filled out a post-intervention survey. The results of the project support the best practice literature, which indicates that simulation-based training is effective in improving performance and confidence. The evidence-based simulation training increased comfort and performance among the SRNA cohort. The median Likert scale score (0 to 4) related to comfort with locating the placement of an IO needle insertion site increased from pre-training (Md = 2) to post-training (Md = 3.5). The median Likert scale score (0 to 4) related to comfort with placement increased from pre-training (Md = 2) to post-training (Md = 4). The median skills checklist score (max score 15) related to comfort with placement increased from pre-training (Md = 12) to post-training (Md = 15). Following the training program, participants stated they were either extremely (n = 10) or very likely (n=6) to place an IO in an emergency setting. Though the number of participants is small, they showed consistent improvement after the training in all areas measured.

Conclusion/Recommendations for Practice: Competency and familiarity with IO access is not only critical in the hospital setting; it can also provide significant benefits in the military trauma setting. From 2006 to 2013, over 1,000 IOs were inserted during combat operations in Afghanistan. In order to ensure successful IO placement, providers need practice. The authors recommend that USUHS Graduate School of Nursing (GSN) implement an IO device task trainer as part of the SRNA curriculum. By utilizing a standardized, evidence-based training, future CRNAs will have the confidence to utilize IOs in the hospital and the forward setting. The project successfully improved the confidence and performance of

SRNAs placing IOs through simulation and video training. It was supported by the literature and was relatively quick and easy to execute. If the project were to be repeated in the future, a greater number of participants should be used. It would also be beneficial to repeat the project to assess for retention of skills.

Implementation of The Perioperative Quadratus Lumborum Block to Improve Postoperative Cesarean Section Pain: A Systematic Review

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Background/Purpose/Question: Cesarean section (CS) is a common practice and represents 31.9% of all deliveries however, undertreating postoperative pain is a persistent problem. Categorized as major abdominal surgery, CS is very painful. The American College of Obstetricians and Gynecologists (ACOG) suggest a multimodal approach to managing CS pain yet many providers are hesitant to prescribe opioids because of the growing opioid crisis that plagues the United States for which healthcare providers are a substantial contributor. Neuraxial opioids provide effective analgesia but overtime additional analgesia is needed. The transversus abdominis plane (TAP) block is limited to somatic anesthesia of the abdominal wall and dependent on interfascial spread. The QL block demonstrates consistent efficacy with a wider and longer sensory blockade compared to the TAP block.

Methods/Evidence Search: The purpose of this project was to answer the clinical question: In patients undergoing cesarean section, does the use of an ultrasound-guided perioperative quadratus lumborum block compared to an ultrasound-guided perioperative transversus abdominus plane block improve postoperative pain management? A systematic review of the literature utilizing EMBASE, Medline, PubMed, and CINHAL yielded 351 studies. Inclusion criteria consisted of RCTs in English, published 2015 to present, abdominal surgeries with patients who received QL or TAP blocks, and outcomes that gauged opioid consumption. Utilization of the Johns Hopkins Tool resulted in selecting 10 randomized controlled trials.

Synthesis of Literature/Results/Discussion: Six RCTs compared QL to the TAP block, the remaining 4 studies examined TAP or QL solely. All studies concluded that both blocks considerably reduced opioid consumption and comparative studies suggested that the QL block provided superior pain relief to the TAP block. Each study evaluated overall narcotic consumption and utilized a standardized pain scale. All six RCTs that directly compared the QL to the TAP block identified a statistically significant decrease in opioid consumption in those patients who received the QL block compared to the TAP block.

Conclusion/Recommendations for Practice: The QL block is a new regional anesthesia technique with RCTs beginning as recent as 2015. The goal of the QL block is to improve upon the TAP block to provider a faster onset, better analgesic, and denser block. The literature clearly demonstrates that providing patients with either the TAP block or the QL block is better than providing the patient with no block in both reducing postoperative pain and opioid consumption. Additional research is needed to provide further support for the utilization of the QL block to better manage postoperative CS pain. Larger scale studies will benefit the generalizability of the results and ultimately provide inclusivity for all obstetric patients. The six RCTs provide conclusive results that the QL block provides superior analgesia to the TAP block with a significant reduction in opioid consumption.

In Ambulatory Laparoscopic Patients, Does the Use of Sugammadex Compared to the Use of Neostigmine and Glycopyrrolate More Effectively Decrease Operating Costs of Medications and Patient Length of Stay?: A Systematic Review

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Background/Purpose/Question: Neostigmine, an acetylcholinesterase inhibitor, has typically been used for the reversal of non-depolarizing neuromuscular blocking drugs. Historically being the reversal workhorse, neostigmine also has substantial limitations due to its mechanism of action, unpredictability, and muscarinic side effects. Sugammadex is a new selective relaxant-binding agent for rapid reversal of aminosteroid-muscle relaxants. It has a fast and predictable reversal of all degrees of blockade, increased patient safety, may translate to efficient use of healthcare resources. This can decrease healthcare costs and OR time.

Methods/Evidence Search: A review of the literature was performed using a PubMed, Embase, and Google Scholar search in December 2020. Articles were limited to those from 2016 due to the first use of sugammadex. MeSH terms used in the search included: “Sugammadex vs neostigmine cost”, “operating room time cost”, “paralytic reversal cost”, and “Sugammadex vs Neostigmine efficacy”. International articles were used but only articles written in English were utilized for this study. The search was directed at comparing the costs of reversal agents with the cost of operating room time and increased length of stay to determine if the use of sugammadex decreased overall costs in laparoscopic procedures. Seventy-four studies were examined but only ten met the inclusion criteria.

Synthesis of Literature/Results/Discussion: The literature shows a lower reversal time (13.1 vs 2.1 mins), post-op to PACU recovery, and length of stay with sugammadex. Sugammadex is more reliable and efficient due to its mechanism of action. While it’s important to note the literature showing the cost of a sugammadex dose being higher than a dose of neostigmine and glycopyrrolate, it’s important to highlight the calculated cost of operating room time (~$36-$37 per minute), which factors into the overall cost. In laparoscopic procedures, sugammadex decreased overall costs with decreased complications and time spent waiting for reversal.

Conclusion/Recommendations for Practice: As expected, more research is needed due to the relative novelty of sugammadex. The results suggest that it is safe to use sugammadex for non-steroidal neuromuscular blockade and results in an overall decrease in healthcare costs. If there are no limitations on the use of sugammadex within one’s organization, the use of sugammadex (barring any contraindications) should be the preferred agent to decrease cost and length of stay. When given the option to choose, anesthesia providers chose sugammadex over neostigmine/glycopyrrolate regardless of patient risk factors or comorbidities.

In Patients with Cancer Undergoing General Anesthesia, Does the Use of an Epidural Compared to No Epidural Reduce the Risk of Cancer Metastasis?

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Background/Purpose/Question: Cancer is the leading cause of death for people under 65 years old and neoplasms cause about 20% of deaths in the United States. A mainstay of cancer treatment for many tumors is surgical resection using general anesthesia and IV opioids. Research has implicated inhaled anesthesia and opioid analgesia as independent risk factors for metastasis and suggests that regional anesthesia may play a protective role in patients undergoing cancer surgery. The purpose of this review is to investigate the potential benefit of decreased metastasis when combining epidural anesthesia with general anesthesia for adult cancer patients undergoing surgery.

Methods/Evidence Search: A systematic review of literature was performed utilizing the databases Embase, MEDLINE-OVID, and Pubmed through Columbia University Irving Medical Center Library. Keywords included “epidural anesthesia” and “cancer metastasis.” Full-text English language articles published between 2013 and 2020 were included. After duplicates were removed, initial search yielded 19 articles which were then screened by title and abstract. After inclusion and exclusion applied, 11 articles were excluded. Eight full-text articles were reviewed and included in the final analysis. Inclusion criteria consisted of an epidural anesthesia group, patients with cancer, and cancer surgery. Exclusion criteria consisted of results not specific to cancer metastasis, results influenced by other cancer treatments, or results influenced by medication selection. Of the articles included in this review, 4 are retrospective studies, 2 are meta-analyses, 1 is an ambispective study, and 1 is a randomized controlled trial.

Synthesis of Literature/Results/Discussion: Of the 8 included studies, 5 suggest that combined epidural and general anesthesia is superior to general anesthesia alone in decreasing metastasis for cancer patients undergoing surgery. Additional benefits of combined epidural and general anesthesia include less immunosuppression, increased cancer-free survival, better analgesic effects, fewer postoperative complications, and decreased mortality. Results from 1 study showed that combined epidural and general anesthesia improved anti-inflammatory effects, decreased postoperative complications, improved safety, and lowered the rate of metastasis and recurrence in patients with gastric cancer. Another study found that when compared to total intravenous anesthesia, some advantages of combined epidural and general anesthesia included shortened time of spontaneous breathing recovery, quicker time to eye opening and extubation, better analgesia effects, lower heart rate, lower blood pressure, lower mean arterial pressure, and higher oxygen saturation. In contrast, 2 studies concluded that benefits from epidural anesthesia were unclear, and 1 study stated that general anesthesia alone may provide better survival outcomes. Of the studies showing unclear benefits of combined epidural and general anesthesia, results did suggest decreased recurrence and decreased opioid use.

Conclusion/Recommendations for Practice: Based on this review, when planning anesthetic techniques for adult cancer patients undergoing general anesthesia, the addition of epidural anesthesia should be considered. Although epidural anesthesia is not the primary determinant for metastasis, its use may offer advantages and improve patient outcomes. Advantages include better analgesia, decreased postoperative complications, and less immunosuppression. Epidural anesthesia can help to avoid exposure to factors that support cancer progression, such as stress hormone release, poorly controlled pain, volatile anesthetics, and opioids. All of these effects aid in increasing survival and potentially saving many lives every year. Additional research is needed to confirm the effect of epidural anesthesia on cancer metastasis. Studies like these should investigate the impact of improving quality of life,

decreased reoccurrence rates, and decreased mortality.

Intraoperative Methadone Decreases Postoperative Opioid Use

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Background/Purpose/Question: Providing a balanced, patient-specific anesthetic plan that reduces opioid use is the goal of many anesthesia providers. Methadone is a unique opioid due to its long half-life and functions as a mu- and delta- opioid receptor agonist, a *N*-methyl-*D*-aspartate antagonist, and inhibits serotonin and norepinephrine reuptake. These properties may explain why methadone provides longer, adequate analgesia in the postoperative setting. The purpose of this literature review was to determine whether intraoperative methadone can lead to better postoperative analgesia and decreased administration of opioids. The following PICO question was developed to facilitate a search for evidence: In patients undergoing surgery, what is the effect of intraoperative methadone, in comparison to administration of short-acting opioids, on patients' postoperative opioid requirement?

Methods/Evidence Search: Ten primary articles from years 2010 through 2020 were chosen utilizing the electronic database PubMed through the Becker Medical Library proxy. Key search words included intraoperative, methadone, postoperative, and pain, in various combinations using Boolean operators which resulted in 55 articles. Other article filters were applied including randomized controlled trials which resulted in 16 results. Four of these articles were chosen because they are primary, randomized controlled trials that involved blinding which strengthened the level of evidence. The combination of intraoperative methadone and postoperative opioid use resulted in 37 articles. Articles were excluded if they examined methadone in combination with other opioid-sparing medications. Inclusion criteria were articles investigating the side effects, analgesic effects, and patient satisfaction of intravenously administered methadone compared to shorter-acting opioids commonly used during surgery such as sufentanil, fentanyl, and hydromorphone.

Synthesis of Literature/Results/Discussion: In three retrospective studies of pediatric patients older than 30 days undergoing cardiac procedures, postoperative opioid consumption was lower in the methadone group. Five randomized control trials investigating the effects of intraoperative methadone in adult patients undergoing various surgical procedures revealed the methadone groups required fewer opioids compared to the control groups during the 48-hour to 72-hour postoperative period. A case control study included in the literature review revealed the methadone group required 40% fewer opioids postoperatively than the control group. In conclusion, intraoperative methadone decreases cumulative postoperative opioid use, but the majority of these studies included small sample sizes and used varying doses of methadone.

Conclusion/Recommendations for Practice: The literature review provides reliable evidence of intraoperative methadone decreasing postoperative opioid use, but many of these studies included small sample sizes and used varying doses of methadone. A large sample size, multi-center, double-blinded, randomized controlled trial should be conducted to test the hypothesis that an intraoperative methadone dose of 0.2 mg/kg of actual body weight reduces postoperative opioid consumption after elective surgery in adults. The proposed study will generate results applicable to the general population across a wide variety of surgeries which could promote improved practices, better postoperative pain control, and improved patient outcomes. Providing a balanced, patient-specific anesthesia plan that reduces opioid use is the goal of many anesthesia providers, and intraoperative methadone has promising results that should be further explored.

Ketamine: an Old Drug with New Indications

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Background/Purpose/Question: Major depressive disorder (MDD) is a chronic psychiatric disorder leading to disability. Some patients do not obtain remission with medication therapy. Twenty percent of MDD patients develop treatment-resistant depression (TRD). IV Ketamine is promising in the management of TRD. The study aims to provide a guideline for CRNAs in the utilization of IV Ketamine for treating TRD.

Methods/Evidence Search: A search was performed using Cochrane, PubMed, Psycho, and OVID databases, identifying scholarly articles in English from 2010 to the present. Search terms included ketamine, treatment-resistant depression, major depressive disorder, intravenous infusion, and time interval. Based on the above criteria, 42 full-text articles were assessed for eligibility. Twenty-nine articles were excluded for not meeting ketamine infusion criteria, known psychotic features, and drug or alcohol dependency and abuse. In this review, 13 articles met inclusion criteria and were selected. Many articles in the review were rate at a level II, with a quality rating of C based on the Johns Hopkins Appraisal tool.

Synthesis of Literature/Results/Discussion: The review demonstrated a series of six IV Ketamine infusions of 0.5mg/kg over 40 minutes of ideal body weight in a 2-week period, followed by once weekly ketamine infusions to be as affective in the management of TRD/MDD as serial ECT sessions. Two studies compared multiple IV Ketamine infusions to multiple ECT sessions and found Ketamine to have a more rapid antidepressant effects and similar depression scores at one week post infusion. One study showed similar antidepressant effects when the frequency of IV Ketamine administration was given 2 or 3 times weekly. All the studies showed repeated IV ketamine infusions prolonged the antidepressant effects for patients with TRD and in MDD.

Conclusion/Recommendations for Practice: The evidence shows serial IV ketamine infusions followed by a once weekly infusion is a safe and effect alternative to ECT in the management of TRD and MDD. The recommended guideline for the management of TRD/MDD begins with a six series of low-dose IV Ketamine infusion of 0.5mg/kg over 40 minutes during a two-week period. Once the patient has responded or remitted symptoms a once weekly IV ketamine infusion is used to maintain the antidepressant effect. In the event of ketamine side effects midazolam one to two milligrams can be provided. Further studies examining the potential abuse of ketamine may be needed.

Ketamine Infusion Clinics: Best Business Practice Guide, Part I

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Background/Purpose/Question: One factor on the success and the failure rate of new businesses in the pre-startup written business plan. However, there is a debate among business researchers over the value of written business plans. There are two distinct schools of thought on the value of a written business plan. One is the planning school, which advocates for a pre-startup written business plan, and the other is the learning school, which advocates a 'learn-as-you-go' plan that relies on intuition. The primary purpose of this best business practice guide is to determine if the implementation of a well-written, pre-startup business plan would contribute to the success of a ketamine infusion clinic. Secondary goals include identifying barriers to entrepreneurship for CRNAs and determining the evidence-based business plan components that are salutary to a medical business.

Methods/Evidence Search: To provide background for the efficacy of written business plans, a systematic literature search was conducted. The following search engines were utilized for the retrieval of relevant literature: Medscape, PubMed, CINAHL, Cochrane, EconPapers, EconLit, and Google Scholar. The systematic literature search was performed with the following syntax: ((business plan) and (business success)) or ((business plan) and (business failure)). The following inclusion criteria was utilized to select studies for this systematic review: any study that measured the effects of a business plan on business success, and any study that measured the lack of a business plan on business failure. The following exclusion criteria was utilized to eliminate studies from this systematic review: studies that did not measure the effects of a business plan on business success or business failure.

Synthesis of Literature/Results/Discussion: Of the 16 studies in the review, 8 showed some correlation between a business plan and business success. The other 8 studies did not show any statistically significant association between a business plan and business success. There was a positive association found between the lack of a business plan and business failure in four studies. The study by Delmar and Shane found completing a pre-startup business plan resulted in a 60 percent reduction in business disbanding. Three studies showed a positive relationship between access to external capital and a written pre-startup business plan. The positive correlation between a business plan and success ranged from small to "the most important controllable factor to prevent business failure." Only 1 study showed any negative effects from writing a pre-startup business plan and this was around the amount of time spent on development. The process of creating a business plan increases the knowledge of the entrepreneur. A pre-startup written business plan will increase the success of a new business while reducing the risk of its failure. There are many barriers to entrepreneurship for CRNAs. These barriers include: lack of formal business education and research, scope of practice (SOP) laws, reimbursement, and hospital credentialing/privilege bylaws.

Conclusion/Recommendations for Practice: For CRNAs to become successful entrepreneurs they must engage in pre-startup planning including addressing barriers to practice and writing of a pre-startup business plan. The business plan should guide the operations of the entrepreneurship and be continually re-examined to refine the future goals of the organization. The business plan should address the essential components identified in the paper. The CRNA should consult outside experts while writing the business plan and include a cover letter with the plan. Companies with business plans that included the areas of production, marketing, finance and organizational operations, outperformed companies without these components. Following this best business practice guide should result in increased success and reduced failure of CRNA entrepreneurships.

Neuromuscular Blocking Agent Dosing and Monitoring: Evidence-Based Practice Update

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Background/Purpose/Question: There is great inconsistency in dosing and monitoring neuromuscular blocking agents (NMBA) among anesthesia providers. It has been found that 43% of anesthesia providers admit to not regularly using monitoring devices. Also, the occurrence of residual paralysis among patients receiving NMBA is greatly underestimated by anesthesia providers. The literature has shown that this incidence of residual paralysis occurs in 40% of patients receiving NMBA. The purpose of this project was to investigate the literature and identify the status of neuromuscular monitoring and dosing among anesthesia providers and provide an update to current practice guidelines on the safe use of NMBA.

Methods/Evidence Search: The literature presented in this review was selected from a comprehensive electronic search of the PubMed, CINAHL, and Cochrane library databases. Key terms used for the search included anesthesia, neuromuscular blocking agent dosing, neuromuscular monitoring, residual paralysis, neuromuscular blocking agent reversal. Broad MeSH terms included neuromuscular blocking agents and neuromuscular blockade. They were selected from each database and used to identify further relevant research. Articles published between 2005 and 2020 and in the English language were included. Initially, 21 articles were identified, but only those articles investigating adult patients were selected for inclusion; twelve articles are included in the final analysis.

Synthesis of Literature/Results/Discussion: Literature suggests that the incidence of some degree of residual paralysis in the post-operative period occurs in over half of surgical patients, and it can increase the risk of airway obstruction, hypoxia, delayed discharge, unanticipated reintubation, and ICU admission. Despite the evidence of the incidence of postoperative residual neuromuscular blockade (NMB), most anesthesia providers in the United States (US) and Europe believe it to be a rare occurrence. Anesthesia providers display overconfidence in monitoring neuromuscular blockade, placing patients at higher risk for postoperative complications. Improper monitoring is associated with significant increase in postoperative complications – including unplanned hospitalization and increased length of stay. To mitigate these risks, literature suggests best practice must incorporate intraoperative use of peripheral nerve stimulators to monitor depth of NMB and adequate reversal prior to extubation. This is ideally measured using quantitative train-of-four (TOF) monitoring at the ulnar nerve or adductor pollicis longus muscle. Postoperative residual NMB can be reduced by careful observation and documentation of TOF measurements in the operative environment. A TOF ratio ≥0.9 indicates a return of adequate neuromuscular function, predicting uncomplicated extubation devoid of residual paralysis.

Conclusion/Recommendations for Practice: Favorable reductions in the level of residual paralysis are demonstrated when TOF monitoring is consistently and effectively utilized. A reversal strategy incorporating quantitative TOF monitoring is superior to reversal strategies that do not incorporate TOF monitoring. The use of pharmacologic antagonists to reverse NMBA must always be utilized and is to be guided using TOF monitoring, ideally of the quantitative variety. Monitoring NMB should be done at the Adductor Pollicis muscle whenever possible and recovery from NMB is defined as TOF ratio ≥0.9. There is great inconsistency among anesthesia providers in the practice of dosing and monitoring NMBA and a contemporary research-based update on current best practice among anesthesia providers is essential. Future studies should be done to evaluate the overall practice impact of proper NMBA monitoring and dosing techniques. Providing continued education on the best practices of NMBA is a possible intervention that could be evaluated in the future.

Palliating Pain for Inoperable Pancreatic Cancer: Neurolytic Celiac Plexus Block as Adjuvant

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Background/Purpose/Question: Pancreatic cancer causes significant abdominal pain in 70%-80% of those diagnosed and is only operable in 15%-20% of patients. The WHO's analgesic ladder addresses cancer pain with pharmacotherapy using NSAIDs, progressing to opioids, and adding adjuvant therapy if needed. One ancillary treatment, the neurolytic celiac plexus block (NCPB), palliates abdominal pain via destruction of visceral afferent nerves using alcohol plus a local anesthetic. This literature review examines the effect of NCPB on narcotic use and pain scores for inoperable pancreatic cancer patients with refractory pain or intolerable side effects to opioid therapy.

Methods/Evidence Search: PICO Question: "For Patients with Inoperable Pancreatic Cancer, Does the Addition of Neurolytic Celiac Plexus Block Compared to Conventional Opioid Analgesia Alone Provide Superior Abdominal Pain Management in End-of-Life Care?" A comprehensive search of the literature was performed using CINAHL, MEDLINE, Cochrane, and PubMed from 2010 to present with keywords: celiac, plexus, block, pancreatic, cancer. Exclusion criteria were non-English studies, review articles, editorials, inclusion of conditions other than inoperable pancreatic cancer, and a focus other than pain reduction. Eleven studies were included in the final review: 4 quasi-experimental studies, 4 randomized control trials, and 3 retrospective analyses.

Synthesis of Literature/Results/Discussion: Included literature suggests the addition of NCPB is superior to opioid analgesia alone in treating pain for inoperable pancreatic cancer. It leads to a reduction in VAS pain score and opioid consumption for the majority of patients. Length of pain improvement was 30 days to 3 months. Five articles reported secondary outcomes based on timing of NCPB. One RCT found pain was better controlled with opioids prior to NCPB, while 4 studies (2 quasi-experimental, 1 retrospective, 1 RCT) showed improved pain management when NCBP was performed early in disease progression with opioid-naïve patients.

Conclusion/Recommendations for Practice: Based on this review, anesthesia providers should consider NCPB as an adjuvant to standard opioid therapy for inoperable pancreatic cancer because it may relieve pain for up to 3 months and reduce overall opioid consumption. Further study is needed to compare the efficacy of various NCPB techniques — MRI-guided, CT-guided, percutaneous, and endoscopic ultrasound. Future research can also examine whether early administration of NCBP in disease progression is of greater benefit than utilization of NCPB as salvage therapy.

Perioperative Intravenous Dexamethasone Use to Decrease Postoperative Pain

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Background/Purpose/Question: The primary purpose of this literature review is to determine if there is a significant difference in postoperative pain outcomes when intravenous (IV) dexamethasone is administered intraoperatively to patients undergoing TKA and THA. Multimodal pain management strategies have recently become popular as a modality in treating postoperative pain. These strategies demonstrate improvement in patient satisfaction, early mobilization, and reduced complications associated with opioid monotherapy. With the use of multimodal pain management, patients have presented with reduced readmission rates and reduced risk of complications such as myocardial infarction, pneumonia, venous thromboembolic disease, and chronic pain syndrome. Adding glucocorticoids to this multimodal pain management strategy has recently been explored, specifically the use of dexamethasone.

Methods/Evidence Search: A comprehensive electronic search in PubMed was completed through the Schaffer Library of Health Sciences at Albany Medical College to find the articles utilized in this literature review. Multiple searches were completed using the following search terms: dexamethasone, decadron, knee surgery, knee replacement, arthroplasty, analgesia, administration. Filters applied were last ten years and randomized controlled trial. Articles were chosen if they were designed as randomized controlled trials, published in the past 10 years, peer-reviewed, and conveyed information about IV dexamethasone used to reduce postoperative pain.

Synthesis of Literature/Results/Discussion: In all studies reviewed, when IV dexamethasone was added to a multimodal analgesic plan, patients used less postoperative pain medication and had decreased pain levels. It was also found that IV dexamethasone use decreased both CRP and IL-6. Increased levels of these inflammatory markers have been proven to result in increased pain, nausea, and fatigue, as well as reduced muscle strength. Specifically, high levels of IL-6 may lead to perioperative tissue inflammation, fat embolism syndrome, postoperative fever, mental status changes, and are correlated with increased morbidity and mortality. All of these results can, in turn, increase length of stay and decrease patient satisfaction postoperatively. Therefore, the decrease in inflammatory markers may play a significant role in the postoperative period. These studies also revealed a decrease in PONV, postoperative antiemetic use, fatigue levels, and length of stay, as well as an increase in patient satisfaction. Further research is necessary to determine the most effective dosage of IV dexamethasone use, its safety when used short-term, and to determine if it would be useful in other patient populations.

Conclusion/Recommendations for Practice: The combined results of these studies support the use of IV dexamethasone to reduce pain postoperatively. Doses of 8-10 mg can be administered perioperatively to help with patient recovery in the postoperative period. When patient's have less pain they ambulate at a faster rate and ambulate farther. They also will have shorter lengths of stay and fewer postoperative complications if their pain is controlled. Overall, adding dexamethasone to a multimodal pain regimen after total knee and total hip arthroplasty will create a higher level of patient satisfaction as well as help them heal at a faster rate.

Perioperative Opioid Stewardship: The Implementation of an Opioid Disposal Program

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Background/Purpose/Question: The opioid epidemic in the United States is a major cause of concern for CRNAs involved in surgical patients' perioperative care. Although opioids play a role in managing acute surgical pain, leftover, undisposed opioid medications after a surgical procedure contribute to the ongoing opioid epidemic. A recent study showed that nearly 70% of prescribed opioid medications remain unused after a surgical procedure. These leftover medications are the primary source for misuse and diversion for non-medical use. A lack of knowledge exists among healthcare providers and patients regarding safe use, storage, and disposal of opioids. The incorporation of an opioid disposal program is a preventative solution for this issue.

Methods/Evidence Search: The purpose of this comprehensive literature search was to examine the effectiveness of an educational intervention and the provision of an in-home opioid disposal product on opioid disposal. The electronic databases utilized in the search strategy include the Cumulative Index of Nursing and Allied Health Literature, OVID, and PubMed. Inclusion criteria were pediatric, adolescent, adult, surgical patients, ambulatory surgery centers, hospitals, outpatient office-based procedures, prescribed opioids at discharge, in-home opioid disposal, opioid education, peer-reviewed journals, peer-reviewed studies, English language, and publication dates 2000-2021. Additional articles were identified from the references of relevant articles and a Google Scholar search. In total, 487 articles were identified. The screening process, excluded 316 articles, leaving 23 articles to undergo a full-text review. Finally, 14 articles met the inclusion criteria consisting of 6 randomized control trials and 8 quasi-experimental studies.

Synthesis of Literature/Results/Discussion: Findings in the studies showed that 38%-96% of patients had leftover opioids after their surgical procedures. All studies reviewed provided patients with educational material related to opioid disposal. In 4 of the 14 studies, patient education alone demonstrated a meaningful association with opioid disposal. In 9 of the 14 studies, patients provided with both education and an in-home opioid disposal product were more likely to dispose of leftover opioids. In evaluating the mode of education, it appeared that education describing the safe use, storage and disposal of leftover opioids was associated with higher rates of disposal. The timing associated with the education and provision of the in-home opioid disposal product mattered. Providing these interventions in the preoperative period in contrast to postoperatively, appeared to lead to higher rates of opioid disposal. In the studies that provided an in-home opioid disposal method, the use of a disposal product versus a mail-back envelope produced higher rates of disposal. Barriers to opioid disposal were reported in 8 of the 14 studies. Fear of future pain, keeping for future use, future plans to dispose, future family needs, paid for the drug, and still taking the opioids for pain management were described. The response "plans to keep for future use" was the highest reported with ranges of 36%-77%.

Conclusion/Recommendations for Practice: The use of prescribed opioid medications during the perioperative period enhances surgical pain management yet, introduces the potential for excess opioid medications to remain in communities for misuse and diversion. As leaders in healthcare, CRNAs are positioned to implement change related to leftover prescribed opioids. Recommendations focus on providing both preoperative education about the safe use, storage, and disposal of leftover opioids along with the provision of an in-home opioid product. These practice enhancements will provide needed education for patients along with the in-home disposal product which will serve as a physical

reminder to disposal of opioids once the surgical pain has resolved. Future studies should investigate reasons why patients retain opioids and target enhanced patient education with this knowledge to further increase disposal. The long-term outcome of an opioid disposal program could lead to opioid disposal becoming an expected behavior in society, much like wearing a seat belt while in a vehicle.

Pitocin Education for Anesthesia Providers

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Background/Purpose/Question: Pitocin administration following fetal delivery in cesarean section is the single most important approach to preventing postpartum hemorrhage. Excessive Pitocin administration may cause subsequent hemodynamic instability from vasodilation and tachycardia. These effects are dose and rate dependent, but there are no set standard administration guidelines in our hospital. Because of this the rate of administration varies greatly between providers. The purpose of this project is to educate anesthesia providers on the side effects and mechanism of action of Pitocin, and to provide an evidence- based protocol detailing optimal Pitocin administration in cesarean delivery.

Methods/Evidence Search: A literature review was conducted to determine recommended rate and dose of Pitocin administration in cesarean delivery. The following databases were searched: PubMed, CINAHL Plus, and Embase. Keywords used were Pitocin, oxytocin, cesarean delivery, cesarean section, dose, side effects, hemodynamics, oxytocin receptors, and effective dose. Articles were excluded if they were studied in women with vaginal deliveries or using Carbetocin, a shelf stable oxytocin analogue. Articles greater than 15 years old were excluded. This time frame was chosen due to the limited amount of primary research on this topic. Education for this protocol was delivered to nurse anesthetist and anesthesiologist practicing in obstetrics, as well as student nurse anesthetist and anesthesia residents who will complete an obstetric rotation this year. The education for the new evidence-based protocol was delivered in a 15-minute-long web-based module. Evaluation of the module was done using a paired *t* test from identical pretest and posttest scores.

Synthesis of Literature/Results/Discussion: Pitocin works on oxytocin receptors throughout the body such as the uterus, brain, vasculature, and heart. Significant effects can be seen when the vasculature receptors are stimulated. Substantial hemodynamic compromise may occur when the rate of administration exceeds one unit per minute. Because of these effects, administration should be limited to the effective amount. Heesen et al produced a consensus statement showing the vast differences in practice but a general trend toward lowering Pitocin doses. A review of the literature found in a healthy mother undergoing elective cesarean delivery, the ED90 of Pitocin was 0.29 IU per minute. This study excluded women who were induced with Pitocin previously or who had underlying health conditions. A protocol implemented in 2013 by the University of Chicago Birthing Center reflected these recommendations to increase the dose on a need basis. In 2018 an update was published that recognized women who have been induced with Pitocin prior to cesarean have desensitized uterine oxytocin receptors. The research suggest that lower rates of Pitocin may achieve adequate uterine tone. Additional protocols do exist using a bolus dose technique. Further research is needed to determine the duration of administration and cumulative dose.

Conclusion/Recommendations for Practice: Pitocin is a lifesaving medication that may induce tachycardia and vasodilation during a critical time of autotransfusion during the cesarean delivery. These compounding effects can lead to cardiac stress and a massive increase in cardiac output at this time. Current evidence suggest that women may receive lower infusion rate of Pitocin to minimize hemodynamic compromise without increasing the risk of postpartum hemorrhage. The University of Chicago Birthing Center has outlined a reference point for appropriate dose, and we have modified this protocol with the input of pharmacists and obstetricians to define the length of infusion. We recommend that institutions implement an evidence-based Pitocin administration protocol in all cesarean deliveries, as well as provide continuing education to their anesthesia providers to review side effects of Pitocin.

Playing Music Perioperatively During General Anesthesia May Reduce Opioid and Versed Use and Boost Patient Satisfaction Scores

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Background/Purpose/Question: The utility of music as a perioperative intervention is well documented during regional anesthesia during which music has been shown to reduce sedative medication requirements. There is less research on music during general anesthesia, specifically investigating its impact on anesthetic requirements and medication doses. Music is inexpensive, easily accessible, and widely enjoyed. Understanding the current consensus on the usefulness of music during general anesthesia is beneficial because its implementation into practice could be impactful without many impediments. PICO question: For patients undergoing general anesthesia, does playing music, compared to playing no music, more effectively reduce patient's intraoperative anesthetic requirements as measured by lower doses of premedication, opioids, propofol, and/or volatile agent?

Methods/Evidence Search: The following databases were used to search the literature: PubMed, Cochrane, CINAHL, and Web Of Science. Each database was searched with the following terms: music, general anesthesia, propofol, opioids, premedication, sevoflurane, desflurane, isoflurane, versed, and pain. The titles and abstracts of the initial results were scanned. Articles were excluded if the measured outcomes were not medication requirements, not general anesthesia, or if focused on the postoperative period. Full-text articles were reviewed. Nine articles were included in the final review since they offered meaningful insight into music's effect perioperatively for general anesthesia cases.

Synthesis of Literature/Results/Discussion: Five studies concluded that music has no effect on the overall dose of anesthetic during general anesthesia. Two studies demonstrated no effect of music on hemodynamic parameters, implying there were no changes in the doses of delivered medications. Five studies showed a reduction in intraoperative doses of opioids and three studies demonstrated a reduction in the dose of or need for premedication preoperatively. Four studies measured patient satisfaction and three of them reported significantly improved patient satisfaction scores as a result of the music intervention.

Conclusion/Recommendations for Practice: Based on this review, no compelling evidence exists to support music as an intervention to reduce anesthetic requirements during general anesthesia. However, data support its use to reduce the doses of premedication and opioids perioperatively. Both midazolam and opioids have undesirable side effects and a reduction in both can improve patient outcomes. The evidence does suggest that music may improve the patient's overall perioperative experience translating into better patient satisfaction scores. Positive patient satisfaction scores on official surveys may improve reimbursement rates and improve hospital brand reputation. Both effects can increase the institution's financial revenue. Though this was an incidental finding of the review, its potential impact is extremely compelling. More research is needed in this area.

Preoperative Administration of Erythropoietin and Iron in Anemic Patients

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Background/Purpose/Question: The purpose of this project is to evaluate and disseminate the use, efficacy, and side effects of iron and erythropoietin administration in patients who are anemic preoperatively. Anemia can lead to poor outcomes as it is independently associated with congestive heart failure, decreased glomerular filtration rate, and myocardial infarction. It also places patients at an increased risk of blood transfusions, which itself is associated with adverse outcomes and increased costs. To evaluate different treatment options for anemia, the following PICO question was developed: In adults undergoing non-cardiac surgery with hemoglobin values less than 14 g/dL, how does the preoperative administration of erythropoietin and iron compared to iron administration affect hemoglobin values and transfusion requirements?

Methods/Evidence Search: The Texas Medical Center Library website was utilized to obtain access to PubMed, The Cochrane Library, Medline (Ovid), and Embase. The key terms "erythropoietin," "iron," "preoperative" and "anemia" were used to search the database. The Boolean operative "AND" was used to narrow the search. To further refine the search, the key terms "surgery," "hemoglobin" and "blood transfusions" were added. The Boolean operative "NOT" was added and proceeded by "cardiac" to eliminate the inclusion of cardiac surgeries. The snowballing technique was also used to find other articles related to the topic. After conducting the literature search, a total of 14 articles were found. Based on the John Hopkins Nursing Evidence Based Practice scale, 13 articles were categorized as Level I evidence, and one article was categorized as Level III evidence. Based on the US Preventative Services Task Force (USPSTF) grading scale, 11 articles received the letter grade B, and three articles received the letter grade C.

Synthesis of Literature/Results/Discussion: The administration of erythropoietin and iron resulted in a significant (P <0.05) increase in hemoglobin levels in all studies that evaluated this variable except for the one study. Iron and erythropoietin administration significantly (P < 0.05) reduced blood transfusion requirements in several studies. In contrast, four studies did not show a significant reduction in blood transfusion requirements. Most studies showed that the use of erythropoietin and iron were beneficial in reducing blood transfusions and increasing hemoglobin levels. This is important because these findings can be applied clinically to help reduce morbidity and mortality since the prevalence of preoperative anemia can be as high as 75%. Furthermore, there is currently a clinical trial that is in the recruitment phase and is evaluating the preoperative use of erythropoietin and iron in anemic patients. This study is called the Hemoglobin Optimization to Prevent Transfusion and Adverse Events in Perioperative Patients with Iron Restricted Anemia (HOPE-Hb). The study is projected to be completed in December 2021 and the findings of this study will add current knowledge about the efficacy and safety of these medications.

Conclusion/Recommendations for Practice: The findings from this literature search do support the use of erythropoietin and iron when optimizing the anemic patient preoperatively. Beginning 21 days before surgery, the anemic patient can receive 600 IU/kg of erythropoietin subcutaneously. This dose should be repeated on preoperative days 14, 7, and on the day of surgery. The anemic patient can also receive 200 mg of iron daily beginning three weeks before surgery. Until more current research is conducted, the use of these two medications should only be used in select patient populations such as those who have renal insufficiency, anemia of chronic disease, and those who refuse blood transfusions. Before administering these medications, the patient's past medical history should be thoroughly evaluated because erythropoietin increases the risk of strokes, clots, and heart attacks (Food and Drug

Administration, n.d.). If used, erythropoietin and iron can aid the anesthesia provider in modifying a risk factor and achieving optimal patient outcomes.

Racial and Ethnic Disparities in Acute Perioperative Pain Management

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Background/Purpose/Question: Question: In African American surgical patients experiencing acute perioperative pain in hospital settings, is there decreased opioid administration for pain management compared to Non-Hispanic Whites yielding racial and ethnic disparities? Purpose: To increase awareness among practitioners regarding healthcare gaps in perioperative pain through an education module promoting patient specific care. Background: Pain control is vital to the achievement of positive clinical outcomes and patient satisfaction. All individuals are affected by poorly managed post-operative pain. Race and ethnicity remain among the leading factors affecting those bearing the burden of pain. There is a significant healthcare gap in perioperative pain management placing minorities at risk for increased physiological and psychological implications, resulting in healthcare disparities.

Methods/Evidence Search: Scientific literature was selectively reviewed from the database search utilizing CINHAL, PubMed (Medline), and the Cochrane Library. Key terms used for this search included African American, Black American, Non-Hispanic White, opioid, analgesia, bias, racial, ethnic disparities, and pain. A total of 91 articles resulted from the 3 searches. Inclusion and exclusion criteria narrowed the search. The inclusion criteria noted articles published in the English language, retrospective cohort studies, secondary data analysis, African American / Black American post-operative patient comparing the Non-Hispanic White post-operative patient population, articles on pain perception and pain treatment, and studies on opioid distribution for post-operative pain. Several studies were excluded for various reasons including patients experiencing pain not related to post-surgical procedure, incomplete trials, and duplicate publications.

Synthesis of Literature/Results/Discussion: Eight articles were included in the final analysis. Studies agreed, while experiencing acute perioperative pain, the Non- Hispanic White patient received increased total doses of analgesia in opioid form. No significant difference was found in non-opioid administration for racial/ ethnic groups. These inequities were noted in all settings (ER, ED) throughout the lifespan of the patient (pediatric, adolescent, adult). Five of the eight studies suggested interventions needed to reduce racial disparities in perioperative pain management required integration of diverse and culturally competent education to the provider as well as the patient. Two of the three virtual studies agreed that false beliefs and racial bias continue to shape the perception and treatment of black patients lending to racial disparities in pain assessment and treatment recommendations. Future studies should focus on implementation of research that captures the true essence of the patient population. The ED specifically endorsed prospective studies with adequate sample sizes of broad geographic and ethnic representation.

Conclusion/Recommendations for Practice: Five of the eight studies reviewed suggested interventions needed to reduce the racial disparities in perioperative pain management required integration of diverse and culturally competent education to the provider as well as the patient. Future medical training should be focused on assessment and treatment of each patient in a holistic fashion, which requires the eradication of standardized care. Multidisciplinary approaches were proposed which included, implementation of patient-focused pain treatment protocols and guidelines, and implementation of research that captures the true essence of patient populations. The emergency department specifically endorsed prospective studies with adequate sample sizes of broad geographic and ethnic representation in diverse types of emergency medicine settings necessary to study factors that contribute to pain disparities. The goal is to avoid unconscious incompetence, thereby decreasing

racial and ethnic disparities leading to catastrophic and costly outcomes.

Reducing Intraoperative Hypothermia with Pre-warming

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Background/Purpose/Question: Perioperative hypothermia leads to postoperative complications such as prolonged anesthetic effects, delayed emergence, surgical site wound infection, myocardial ischemia, cardiac dysrhythmias, and excessive blood loss resulting in increased post anesthesia care unit time, hospital time and cost of care. This project attempts to address: Do patients undergoing general anesthesia (P) who have preoperative warming (I) compared to similar patients with no preoperative warming (C) have lower incidence of hypothermia (O) intraoperatively (T)?

Methods/Evidence Search: To answer the question, keywords were used to search databases: Cochrane Library, PubMed, MEDLINE and CINAHL. For temperature management therapies, the terms preoperative, perioperative, temperature, warming, pre-warming, and forced-air warming were used; the terms hypothermia and normothermia were also searched, to determine the setting of temperature management therapies. These terms were searched in different varieties of combinations, separated using the word "AND", in order to capture more specific results.

Synthesis of Literature/Results/Discussion: Six randomized controlled trials (RCTs) were critically appraised. All RCTs used an intervention and a control group. Three studies found patients receiving forced air warming preoperatively demonstrated a lower drop in core temperature after induction of anesthesia than patients who were not prewarmed. Three studie showed a higher core body temperature in the intervention group than the control group. Not only did patients receiving preoperative forced air warming achieve higher temperatures, but five studies found intervention patients spent more time in normothermia intraoperatively. While one study only showed an increase in core body temperature in the intervention group postoperatively for the first thirty minutes, another found an increase in core body temperature two hours postoperatively. Evidence from these RCTs consistently found preoperative warming led to lower incidence of intraoperative and postoperative hypothermia, higher core body temperature, and maintained normothermia intraoperatively and up to two hours postoperatively.

Conclusion/Recommendations for Practice: The effects of hypothermia lead to deleterious complications for the patient and institution from postoperative complications, prolonged time in PACU and increased, preventable costs to the facility. Preoperative forced warming was more successful opposed to no preoperative warming in maintaining normothermia. Therefore, it is recommended that forced air warming devices routinely be used preoperatively. Education to the preoperative hospital staff on preoperative warming was instituted in order to increase compliance of wearing the warming gown, connecting the device, and turning to the "on" position. Visual aides were placed in the rooms to encourage and remind staff to utilize the device. Information tags were placed on remotes to encourage and educate patients on the preoperative warming device. Data were collected through a pre- and post-implementation survey including whether the preoperative warming device was connected to the patient and turned on, intraoperative temperature range, and initial temperature on arrival to PACU.

Statistical Versus Clinical Significance of Dexamethasone Administration Among Diabetic Patients

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Background/Purpose/Question: Dexamethasone is used to alleviate inflammation and it possesses both antiemetic and analgesic properties, making it an appealing drug to administer to patients undergoing general anesthesia. Dexamethasone, however, is known to cause hyperglycemia which may lead to increased infection rates. The purpose of this project was to evaluate the statistical significance of postoperative hyperglycemia when 4 mg versus 8 mg of dexamethasone was administered, and if this contributed to postoperative infection rates among diabetic patients. PICOT: In adult diabetic patients aged 18-85 undergoing general anesthesia (P), is the administration of dexamethasone in 4 mg or 8 mg doses (I) compared to no dexamethasone administration (C) associated with the clinically significant effect of postoperative infections (O) during the first 24 hours of the postoperative period (T)?
Methods/Evidence Search: A search was conducted on the Texas Medical Center Library website, and the databases searched included PubMed, EMBASE, Ovid, and ClinicalKey. Keywords and Medical Subject Heading terms included "dexamethasone," "corticosteroids," diabetes," "hyperglycemia," and "postoperative nausea and vomiting." The Boolean operators "AND" and "OR" were used to narrow and widen the search, respectively. The snowballing technique was also utilized, yielding a total of 16 articles. The evidence-based practice (EBP) model chosen to implement the research findings was the Stetler Model. The research findings will be summarized to meet a total of six objectives. To assess whether these objectives will be met after dissemination of the literature, inferential statistics will be used. A pre-test and posttest will be administered prior to and after dissemination of the research findings, and those results will be analyzed utilizing the following tests: Chi-square test, paired-sample *t* tests, correlations, and the general linear model.
Synthesis of Literature/Results/Discussion: All 16 articles were analyzed and the primary outcomes measured were postoperative hyperglycemia levels and the incidence of infection rates. Patients receiving dexamethasone were significantly more likely to develop postoperative hyperglycemia in comparison to a placebo ($P < 0.001$). Non-diabetic patients who received dexamethasone had no statistically significant greater increase in the occurrence of hyperglycemia; alternatively, diabetic patients who received dexamethasone had a statistically significant higher blood glucose level postoperatively ($P = 0.0018$). Specifically, there was a greater percentage of hyperglycemia among diabetic patients who received 8 mg versus 4 mg of dexamethasone ($P < 0.001$), and the administration of 8 mg of dexamethasone was associated with a 25 mg/dL increase in glucose levels compared with a 9 mg/dL increase in glucose levels after a 4 mg dose. Patients who had significantly elevated glucose levels did have postoperative infections, with the risk of infection being higher for pneumonia ($P = 0.05$) and surgical site infections ($P = 0.03$). However, the utilization of steroids within the perioperative setting was not an independent predictor of postoperative infections ($P = 0.2$), and when dexamethasone was used as an antiemetic, there was no association found between the use of intraoperative dexamethasone and postoperative infections ($P = 0.977$).
Conclusion/Recommendations for Practice: Based on the literature, a statistically significant greater increase in postoperative blood glucose levels was found when an 8 to 10 mg dose versus a 4 mg dose of dexamethasone was given. Based on this statistical significance, it is preferred to administer 4 mg of dexamethasone to diabetic patients undergoing general anesthesia, as this dose offers the benefit of PONV prophylaxis and mitigates the risk for postoperative wound infections. A majority of the studies omitted study participants with a blood glucose level greater than 200 mg/dL, so it is further preferred to withhold the administration of dexamethasone to these patients. The relevance of this project topic is

to standardize the administration of dexamethasone among diabetic patients, which will be accomplished through the creation of an algorithm that depicts which dose of dexamethasone should be administered to diabetic patients based on preoperative glucose levels.

The Administration of Lower FiO_2 Intraoperatively to Minimize Postoperative Adverse Outcomes

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Background/Purpose/Question: There is no consensus about the most effective and least detrimental percent of inspired oxygen (FiO_2) during general anesthesia. In 2016, the World Health Organization (WHO) recommended the use of 80% FiO_2 for surgical patients during general anesthesia to decrease the incidence of surgical site infections. In 2019, the evidence upon which recommendation was based was retracted from the literature due to compromised data integrity. Since then, several studies have shown that excessive FiO_2 may be detrimental. The purpose of this work is to describe the evidence on the adverse effects of high intraoperative FiO_2 during general anesthesia and to describe a change in anesthesia practice based on this evidence.

Methods/Evidence Search: The Cochrane, PubMed, CINAHL, and Web of Science databases were searched using keywords from the following PICOT question: Do surgical patients under general anesthesia (P) administered high inspired oxygen (I) compared to similar patients administered lower inspired oxygen (C) have a higher incidence of complications (O) postoperatively (T)? Several synonyms were used to expand the search results. For high inspired oxygen fractions, the terms hyperoxia, hyperoxemia, and oxygen toxicity were used. For complications, the terms adverse outcomes were used. These keywords were separated with the word OR. The same technique was used for the search terms intraoperative and perioperative; both were separated using the word OR. The term AND was also used to combine the term anesthesia with other search terms.

Synthesis of Literature/Results/Discussion: Three randomized controlled trials (RCTs), one systematic review and one large cohort study were critically appraised. One study found that a FiO_2 of 0.80 or greater increased patient mortality on postoperative days 30 and 180 and did not reduce the incidence of surgical site infections (SSIs). Two studies found that intraoperative FiO_2 0.80 or greater increased oxidative stress markers and decreased the strength of the antioxidant barrier. Researchers in one study found that intraoperative FiO_2 0.80 or greater increased the alveolar-arterial O2 gradient and atelectasis postoperatively, compared to intraoperative FiO_2 less than 0.5. One study also found an FiO_2 0.60-0.80 was associated with increased 30-day patient mortality and a higher incidence of re-intubation, respiratory failure, pulmonary edema, and pneumonia. These five studies demonstrate that intraoperative FiO_2 0.60 or greater is associated with increased patient mortality, oxidative stress markers, pulmonary complications, and does not decrease the incidence of surgical site infections.

Conclusion/Recommendations for Practice: Based on these findings it is recommended that the inspired concentration of oxygen during general anesthesia for greater than one hour be at an FiO_2 of 30-40%. Lowering the FiO_2 is a feasible and cost-free practice change that could reduce adverse patient outcomes up to 30 days postoperatively.

The Effect of High Positive End-Expiratory Pressure vs. Standard Positive End-Expiratory Pressure on Perioperative Oxygenation in the Obese Surgical Patient

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Background/Purpose/Question: The rising prevalence of obesity is a concern for anesthesia providers due to increased perioperative complications. During general anesthesia and dynamic surgical conditions, obese patients experience pronounced derangements in ventilation and oxygenation. The use of PEEP and alveolar recruitment maneuvers (ARM) can mitigate the effects of alveolar collapse and improve perioperative oxygenation.

Methods/Evidence Search: The PICO question was: In obese patients undergoing anesthesia (P), does the use of high PEEP(> 8 cm H_2O) with or without ARM (I) compared to standard PEEP (0 to 5 cm H_2O) (C) improve perioperative oxygenation status (O)? The search for evidence was performed using the electronic databases PubMed, CINAHL, and Google Scholar with the search terms "obes*", "PEEP", "positive end expiratory pressure", "anesth*", "perioperative", and "oxygen*". These terms were used alone and in combination with "obes* AND PEEP OR positive end-expiratory pressure AND anesth* OR perioperative AND oxygen*." This resulted in 73 potential evidence sources. Six randomized controlled trials and two meta-analyses (3,202 subjects) met the inclusion criteria of being conducted within the past 10 years (2010-2020), adult population, peer reviewed, and available in the English language. All studies were conducted in an operative setting.

Synthesis of Literature/Results/Discussion: In the obese patient during general anesthesia, the evidence suggests the greatest improvement in intraoperative oxygenation and lung compliance occurred with the application of an ARM followed by PEEP > 8 cm H_2O. There was no long-term reduction in the incidence of postoperative atelectasis. Increasing levels of PEEP was associated with a higher risk of hemodynamic consequences, such as intraoperative hypotension, bradycardia, and higher vasopressor support requirements. Overall pulmonary complications were not more likely in high PEEP groups. The evidence recommends that levels of PEEP 8-15 cm H_2O can be used to improve oxygenation with consideration for each patient's hemodynamic status. Further research on the use of non-invasive positive pressure after extubation, such as CPAP or BiPAP, would be beneficial as it may prolong the effects of high PEEP into the postoperative period, particularly for the obese population.

Conclusion/Recommendations for Practice: The findings of this review can be implemented during anesthesia care to improve intraoperative pulmonary function in obese patients undergoing general anesthesia. High PEEP (> 8 cm H_2O) can be used to improve intraoperative oxygenation and pulmonary compliance without compromising hemodynamic stability in the majority of patients. Based on the evidence, we recommend delivering an alveolar recruitment maneuver followed by a modest increase in PEEP for any obese patient who is unable to maintain satisfactory oxygenation at a standard level of PEEP 5 cm H_2O.While the optimal amount of PEEP has not yet been determined, high PEEP (> 8 cm H_2O) has been utilized without significant negative consequences in the range of 8 to 15 cm H2O. The use of PEEP > 8 cm H_2O was not associated with barotrauma or a significant decline in mean arterial pressure or heart rate, but did report an increase in vasopressor support requirement. Individualized PEEP did not demonstrate evidence of intraoperative or postoperative improvement in oxygenation.

The Effectiveness of Dexmedetomidine in Preventing Airway Obstruction in Adult Patients with Obstructive Sleep Apnea During Deep Sedation

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Background/Purpose/Question: Adult surgical patients with obstructive sleep apnea (OSA) are at risk for upper airway obstruction during sedation and general anesthesia. Propofol is the most frequently used anesthetic drug for deep sedation and can cause upper airway obstruction. In surgical patients with OSA, dexmedetomidine may reduce the incidence of upper airway obstruction. The purpose of this work is to describe the evidence of the effectiveness of dexmedetomidine compared to propofol in decreasing the incidence of the airway obstruction in surgical patients with OSA.

Methods/Evidence Search: Four databases (Cochrane Library, PubMed, CINAHL, and Web of Science) were searched using keywords from the following PICOT question: Do patients with obstructive sleep apnea requiring deep sedation (P) who receive dexmedetomidine (I) compared to similar patients who do not receive dexmedetomidine (C) have a lower incidence of airway obstruction (O) during anesthesia (T)? Synonyms such as "native airway, "natural airway," and "Precedex" were used to expand the search results. Propofol and etomidate were also searched in every database as they are alternative anesthetics to dexmedetomidine. Search terms included obstructive sleep apnea, dexmedetomidine, deep sedation, propofol, etomidate, native airway, and natural airway.

Synthesis of Literature/Results/Discussion: Three randomized controlled trials and one case study were critically appraised. All studies compared propofol use to dexmedetomidine use in adult obstructive sleep apnea patients. Three studies examined sedation in OSA patients specifically during DISE. Shin et al. (2018) studied sedation in OSA patients receiving spinal anesthesia. In the three RCTs the anesthesia provider was aware of which anesthetic was being administered. Two studies investigated upper airway obstruction in patients receiving propofol compared to dexmedetomidine. Patients receiving propofol had a statistically significant increase in upper airway obstruction in both studies. One study examined oxygen desaturation in patients who received propofol, dexmedetomidine, or ketamine/propofol. Another found a statistically significant increase in hypoxia and frequency of mask-assisted ventilation in the propofol group compared to the dexmedetomidine group. Each study investigated airway obstruction or hemodynamic changes with propofol compared to dexmedetomidine infusions. Despite the variation in upper airway obstruction detection, all studies consistently found significant increases in obstruction with propofol use compared to dexmedetomidine use.

Conclusion/Recommendations for Practice: Dexmedetomidine use in patients with sleep apnea decreases the severity of upper airway obstruction in comparison to propofol. Based on these findings, it is recommended that dexmedetomidine be used for deep sedation of patients with obstructive sleep apnea.

The Effectiveness of Intravenous Ketamine for Major Depressive Disorder

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Background/Purpose/Question: Major depressive disorder (MDD) can be caused by genetics, traumatic events, environmental stress, medical conditions, drugs, and hormonal changes. Treatment for MDD include antidepressants, anxiolytics, antipsychotic drugs and electric shock therapy, which may not be effective. Low-dose ketamine intravenous infusions is a potential therapy for MDD.

Methods/Evidence Search: The purpose of the literature search was to answer the following clinical question: Do patients with depression who have not responded to antidepressant therapy treated with low-dose IV ketamine compared to similar patients not treated with IV ketamine have improved symptoms of depression after 6 weeks of ketamine treatment? The search used PubMed, CINAHL, ProQuest, and the Cochrane Library of Systematic Reviews. Inclusion criteria were ketamine and depression with a time limit of 2010-2020. One hundred seventy articles were found that related to the PICOT with five articles selected that consisted of two randomized controlled trials, one prospective study, and one systematic review and meta analysis. IRB exemption was obtained and a change in practice was implemented in middle Georgia.

Synthesis of Literature/Results/Discussion: The literature review of these studies consistently found patients receiving low-dose ketamine IV infusions had a rapid and persistent antidepressant effect. A reduction in depression scores were consistently shown at 1 month after the first infusion. An evidence-based project was conducted to educate and inform mental health providers of the use of ketamine for MDD. With the use of pamphlets, postcards, and presentation of research, the ketamine clinic received four referrals for treatment of MDD.

Conclusion/Recommendations for Practice: The use of intravenous ketamine has been shown to reduce depressive scores in patients with MDD. The goal of this project was to educate mental health providers on the use of ketamine for MDD and increase knowledge about local options for ketamine therapy. The project was successful in educating providers, shown by the referrals for patients to receive the treatment. Further education would be useful to support this progress. This project can easily be replicated in other communities to allow patients more treatment options for MDD.

The Effectiveness of Non-Invasive Goal-Directed Fluid Therapy on Abdominal Surgery Outcomes

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Background/Purpose/Question: Intravascular fluid replacement during surgery is an important element in the management of the surgical patients. The goal of fluid replacement is to maintain adequate cardiovascular volume and function. It was unclear if the use of non-invasive monitors for goal-directed fluid therapy improved postoperative patient outcomes. The purpose of this project was to describe the evidence from the literature on the effectiveness of non-invasive goal-directed fluid therapy monitoring.
Methods/Evidence Search: Keywords from the following PICOT question were used to search four literature databases: Do patients undergoing abdominal surgery (P) with the use of non-invasive goal-directed fluid therapy (I) compared to patients who do not use goal-directed fluid therapy (C) have better outcomes (O) postoperatively (T)? Cochrane Library, PubMed, Medline (ProQuest), and Cumulative Index of Nursing and Allied Health Literature (CINAHL) were utilized to conduct this literature search. The keywords non-invasive, goal-directed fluid therapy, and abdominal surgery were typed into the database and searched using the keyword AND to narrow the search and ensure all of the search terms are present in the text. Two randomized clinical trials, one meta-analysis, and one systematic review were critically appraised.
Synthesis of Literature/Results/Discussion: One study demonstrated evidence perioperative goal-directed fluid therapy reduces mortality, morbidity, rates of arrhythmia, respiratory failure, prolonged mechanical ventilation, pneumonia and intra-abdominal wound infections, and improves postoperative outcomes in adult surgical patients. One study demonstrated evidence using stroke volume variation for guiding fluid therapy in major abdominal surgery directly correlated with better oxygenation and lower extravascular lung water. Another study demonstrated evidence the use of non-invasive goal-directed fluid therapy reduced surgically related complications, hospitalization length of stay, and cardiopulmonary and cardiovascular complications. Another found the use of goal-directed fluid therapy reduced the number of postoperative complications, wound infection, abdominal complications, postoperative hypotension, and the number of complications were significantly less in abdominal surgical patients. These studies consistently demonstrated the use of non-invasive gold-directed fluid therapy and its associated parameters have a positive influence on postoperative outcomes. Evidence from these studies demonstrates the efficacy of utilizing GDFT for improving patient outcomes among patients undergoing abdominal surgery.
Conclusion/Recommendations for Practice: There is strong evidence that the use of non-invasive goal-directed fluid therapy monitoring improved both intraoperative and postoperative hemodynamic stability and decreased postoperative pulmonary and cardiovascular complications and wound infections. It is recommended from this evidence that the use of non-invasive goal directed fluid therapy monitoring be incorporated into anesthesia practice for patients undergoing abdominal surgery to improve patient outcomes and decrease patient complications.

The Effectiveness of the Head-up Position During Preoxygenation of General Anesthesia

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Background/Purpose/Question: Preoxygenation during induction is vital for optimizing oxygen stores for patients prior to establishing an airway. In the majority of current practice, preoxygenation has been performed in the supine position. This has proven to be sub-optimal when compared to a head-up preoxygenation approach. The purpose of this work is to describe the evidence on the efficacy of head-up preoxygenation during induction. The project seeks to answer the PICOT question: Do surgical patient undergoing general anesthesia who are preoxygenation in a head-up position compared to similar patients who are not preoxygenated in a head-up position have higher levels of oxygen during induction?

Methods/Evidence Search: Keywords from the following PICOT question were used to search four literature databases: Do surgical patients undergoing general anesthesia (P) who are preoxygenated in a head-up position (I) compared to similar patients who are not preoxygenated in a head-up position (C) have better oxygenation (O) during induction (T)? A combination of these search terms was used to search the CINAHL, Cochrane Library, PubMed, and Medline databases. The search terms for positioning and synonyms used in the databases included: head-up, supine and reverse Trendelenburg and were separated by the word AND to acquire specific results together. Preoxygenation, oxygenation, and oxygen were entered into the database and separated using the term OR. To acquire specific search results together in the database the term AND was used. Other search terms that were also included to decrease the number of articles found were induction and anesthesia, which were also separated by the term AND.

Synthesis of Literature/Results/Discussion: Five randomized controlled trials (RCT) were critically appraised. One found that obese patients preoxygenated while in the sitting position had longer apnea times when compared to patients that were preoxygenated in the supine position (216 seconds vs. 164 seconds, respectively) Another found that safe apnea time averages in seconds were 178 (Reverse Trendelenburg), 153 (Semi-Fowlers) and 123 (Supine). One study found that safe apnea times were on average 56 seconds longer in the group preoxygenated in the 25-degree head-up position vs. the group preoxygenated in the supine position. In another study researchers conducted a prospective, RCT comparing the efficacy of preoxygenation in the 20° head-up vs supine position. The patients in the 20-degree head-up position head a mean apnea time of 386 seconds with a range of 343-429 seconds vs. a mean apnea time of 283 seconds, with a range of 243-322 seconds in the supine group. In another study researchers conducted a randomized comparative study and found that preoxygenation with 20º head-up tilt provides longer duration of non-hypoxic apnea than conventional preoxygenation in non-obese healthy adults. Patient in the 20-degree head-up position, had longer apnea times compared to the control group of supine preoxygenation with a mean time of 452 to 364 seconds, respectively.

Conclusion/Recommendations for Practice: It was recommended from this evidence, head-up preoxygenation can be employed to allow greater levels of oxygen during induction for patients undergoing general anesthesia. The simplicity of raising the head of the bed up to allow high levels of oxygen during preoxygenation should be the gold standard moving forward based on the evidence. The overall goal for this implementation is to prevent patients from desaturating before the airway can be established. This is especially crucial in patients that have difficult airways that warrant more time and multiple attempts for intubation.

The Equivalency of Oral Acetaminophen Compared to Intravenous Acetaminophen on Reducing Postoperative Pain

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Background/Purpose/Question: Due to the increased incidence of opioid drug abuse, there has been a new focus on non-opioid analgesics and other alternatives for the treatment of postoperative pain. Preoperative oral and intravenous (IV) acetaminophen have been used as an alternative to opioid drugs. It was unclear if preoperative oral acetaminophen was as effective at reducing postoperative pain as IV acetaminophen. The purpose of this evidence-based practice project is to describe the evidence on the effectiveness of oral acetaminophen compared to IV acetaminophen to reduce postoperative pain. Based on this evidence a change in clinical anesthesia practice is described.

Methods/Evidence Search: Keywords from the following PICOT question were used to search the Cochrane Library, PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and the Medline databases: Do surgical patients (P) who receive preoperative oral acetaminophen (I) compared with similar patients who receive intravenous acetaminophen (C) have an equal reduction in pain (O) post-operatively (T)? Two RCTs, two systematic reviews, and one systematic review and meta-analysis that answered the PICOT question were critically appraised.

Synthesis of Literature/Results/Discussion: One study found that preemptive oral acetaminophen is not inferior to IV acetaminophen for postoperative analgesia in patients undergoing third molar extraction during general anesthesia. Another study found no difference in the efficacy of preemptive oral acetaminophen and IV acetaminophen for postoperative pain in patients undergoing laparoscopic robotic-assisted hysterectomy. One study found oral acetaminophen given preoperatively was equivalent to intraoperative IV acetaminophen at reducing immediate postoperative pain in patients undergoing total hip or knee arthroplasty. Researchers in another study found preemptive oral acetaminophen was as effective as IV acetaminophen for postoperative pain. Still another found preemptive oral acetaminophen was equivalent to IV acetaminophen in reducing postoperative pain. These studies consistently found preemptive oral acetaminophen as effective as IV acetaminophen at reducing postoperative pain.

Conclusion/Recommendations for Practice: At Habersham Medical Center an effort to increase the use of preoperative oral acetaminophen was made. Prior to implementation a presentation was given to anesthesia and postoperative care unit (PACU) nurses discussing the evidence on the effectiveness of oral acetaminophen at reducing postoperative pain and the practice change based on this evidence. Anesthesia providers and PACU nurses received weekly emails regarding the benefits of oral acetaminophen and posters were placed in high visibility areas. Using the electronic medical record system, the frequency of use of oral acetaminophen preoperatively was determined before and after implementation of this practice change.

The Implementation of a Peer-support Program in a Nurse Anesthesiology Educational Program

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Background/Purpose/Question: Second victims are healthcare providers such as nurse anesthetists who are involved in an unanticipated adverse patient event, anesthesia mishap, medical error or patient-related injury and become victimized themselves by the trauma of the event. Anesthesia providers in training have double the risk of making a drug error alone. Social support measures for nurse anesthesia students involved in a negative patient event may prevent untoward reactions and help them become a better provider from the experience. The purpose of this project was to describe the evidence on the effectiveness of a second victim peer support program on reducing psychological stress resulting from experiencing an adverse patient event.

Methods/Evidence Search: Terms from the following PICOT question were used to search four literature databases: Do clinicians (P) with a second victim peer support program (I) compared to clinicians without a second victim peer support program (C) have better outcomes from the second victim phenomenon (O)? Synonyms were used to search the Cochrane Library, PubMed, CINAHL, and the Johanna Briggs Institute EBP literature databases. In replacement of clinicians, the terms nurse, health care providers, student nurse, resident, and nurse anesthetist were used. The same strategy was used for search terms second victim, healthcare errors, second victim training, and support program. Within the four databases, the word AND was used to delineate subjects and the word OR was used to create synonyms. Three qualitative studies and one randomized control trial were selected for critical appraisal.

Synthesis of Literature/Results/Discussion: Four studies were critically appraised. One found that participants that reported having peer support after a patient adverse event, rated themselves as having less physical distress, psychological distress, and had less job turnover intentions. Another study found that second victims preferred unit specific peer support and after enrolling in a second victim care team. The majority of second victims that were supported by their department and unit peers did not seek further assistance. Another study found that most second victims, with peer supporters from the same specialty, reported the program had a positive impact on the department's "safety and support" culture and would recommend the program to a colleague. Researchers in another study provided evidence that a structured peer support program was an effective and practicable intervention for supporting healthcare providers involved in an adverse patient outcome. These studies consistently found that second victims with peer support programs experienced less psychological distress and increased institutional support leading to enhanced recognition of second victims, constructive changes in practice, and a more positive work environment.

Conclusion/Recommendations for Practice: There is strong consistent evidence that shows the positive impact of social support measures for healthcare providers involved in a negative patient event. Short and long-term effects of the second victim phenomenon are improved when second victims have social support measures in place. From this evidence it is recommended that peer-support programs be included in the curriculum of nurse anesthesia programs to improve student support, increase awareness of the second victim phenomenon and break the silence of anesthesia mishaps that student nurse anesthetists may encounter. These social support programs prepare students for anesthesia mishaps events resulting in better coping mechanisms and can provide psychological healing.

The Prophylactic Use of Ondansetron to Attenuate Post-Spinal Hypotension in Parturients Undergoing Cesarean Section

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Background/Purpose/Question: Spinal anesthesia is the preferred method of anesthesia for the parturient patient undergoing cesarean section. A consequence of spinal anesthesia is hypotension requiring vasopressor drug administration, which is undesirable for both the mother and fetus. It was unclear if the prophylactic administration of ondansetron prior to spinal anesthesia in parturients undergoing cesarean section decreased the incidence of post-spinal hypotension. The purpose of this work is to describe the evidence on the effectiveness of the prophylactic use of ondansetron prior to spinal anesthesia in the parturient undergoing cesarean section at decreasing the incidence of hypotensive episodes in this patient population.

Methods/Evidence Search: Keywords from the following PICOT question were used to search four literature databases: Do parturients undergoing cesarean section (P) who receive prophylactic ondansetron prior to spinal anesthesia (I) compared to similar parturients who do not receive ondansetron (C) have a lower incidence of hypotension (O) following spinal anesthesia (T)? Two systematic reviews and three randomized controlled trials were critically appraised. A practice change based on this evidence is described.

Synthesis of Literature/Results/Discussion: Two systematic reviews and three randomized controlled trials were critically appraised. Researchers in one study found intravenous (IV) ondansetron in parturient women undergoing elective cesarean section significantly decreases hypotension, bradycardia, nausea, vomiting, and the dose of vasopressor used. Another study found IV ondansetron given prior to spinal anesthesia can attenuate a fall in SBP, MAP, and DBP in parturients undergoing spinal anesthesia. In another, researchers found IV ondansetron reduced the incidence of spinal anesthesia-induced hypotension in both obstetric and non-obstetric patients, and reduced vasopressor consumption as well as the incidence of bradycardia and nausea. In another researchers found 5-HT3 antagonists effectively reduced the incidence of hypotension and bradycardia in patients undergoing cesarean section, and significantly reduced the amount of vasopressor needed for the treatment of hypotension. Another study found IV ondansetron given prior to spinal anesthesia can attenuate decreases in blood pressure and decrease amount of vasopressor requirements in parturients undergoing spinal anesthesia. The results of these studies found, prophylactic ondansetron administered prior to spinal anesthesia reduced the incidence of hypotension in parturients and reduced the use of vasopressors in parturients undergoing cesarean section.

Conclusion/Recommendations for Practice: It is recommended from this evidence that 4 mg of ondansetron be administered intravenously prior to spinal administration in patients undergoing cesarean section. An education presentation of this evidence was given to obstetrical anesthesia providers at UF Health Jacksonville, a 695-bed university hospital in Jacksonville, Florida, with the goal of increasing the use of ondansetron prior to spinal anesthesia for patients undergoing cesarean section.

The Role of the Sphenopalatine Ganglion Block for Treating Postdural Puncture Headaches

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Background/Purpose/Question: Postdural puncture headaches (PDPHs) occur in up to 40% of patients following a neuraxial procedure. They can be debilitating during the symptomatic period and delay recovery and discharge. Initial management strategies have included encouraging fluids, caffeine, and bedrest, but the gold standard treatment modality depending on severity and duration of symptoms has been an epidural blood patch. This project aims to determine if the sphenopalatine ganglion block (SPGB) warrants a place in the treatment guidelines as a less-invasive alternative to an epidural blood patch. In adult patients experiencing PDPHs resulting from neuraxial procedures, does a transnasal SPGB compared to conventional treatment offer effective pain relief and avoidance of an epidural blood patch?

Methods/Evidence Search: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2009 Checklist was utilized to guide study selection. The Cochrane Library, CINAHL, PubMed, and Google Scholar were searched. Articles were not restricted based on language. Inclusion criteria were treatment technique of a SPGB as sole regional anesthesia technique, and treatment population of adults with a PDPH following a neuraxial procedure. Peer reviewed qualitative and quantitative reports and research were included. Exclusion criteria included wrong intervention and wrong patient population. Educational conference presentations were excluded. Search terms were: (postdural OR post-dural) AND (sphenopalatine ganglion OR pterygopalatine ganglion) AND headache AND epidural blood patch. The Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) Evidence Level and Quality Guide was utilized to systematically assess the literature for strengths and weaknesses. Evidence levels (Level I-V) were assigned.

Synthesis of Literature/Results/Discussion: Twenty-three articles were included in this review: 1 meta-analysis (JHNEBP Level I), 2 randomized controlled trials (RCTs) (JHNEBP Level I), 16 non-experimental, observational case reports (JHNEBP Level III), 2 narrative reviews (JHNEBP Level IV), and 2 retrospective chart reviews (JHNEBP Level V). Although the meta-analysis and one RCT found no therapeutic advantage of the SPGB over conventional approaches, another RCT had a statistically significant effect on discharge readiness. Some studies have indicated that SPGB may provide rapid PDPH relief. A retrospective review found there to be less risk and undesirable side effects from SPGB than an epidural blood patch, but the meta-analysis reported no significant difference in the incidence of adverse events when comparing SPGB to other treatments. Case studies/series have presented instances of successful use of SPGB and some have shown unique patient populations that may benefit from having alternatives to blood patch as a treatment modality due to patient preferences, a difficult initial neuraxial procedure, or contraindications. SPGBs have been successful in providing pain relief for some patients with PDPH, but additional research would help to determine the overall effectiveness, the optimal time to offer SPGB treatment, and the impact of the SPGB on patient satisfaction and healthcare costs.

Conclusion/Recommendations for Practice: The broad range of SPGB treatment techniques, local anesthetic drugs/dosages, patient populations, and assessment modalities in the literature shed light on the need for large-scale prospective, randomized studies to determine what is most efficacious and safe. SPGB may be a warranted option as a PDPH treatment modality, particularly in patients who request or require alternatives to a blood patch. When comparing the documented risks of SPGB against those of a blood patch, it seems like a reasonable first-line treatment option that may offer improved patient satisfaction, especially with the possibility of patients being taught self-administration. A blood patch

could remain a rescue therapy when indicated or preferred.

The Use of a Standardized PACU Handoff Checklist to Improve Transfer of Care

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Background/Purpose/Question: Lack of a standardized handoff can lead to inconsistent report, errors of omission and miscommunication between patient care providers, which directly affects patient outcomes. It was unclear whether checklists used during handoff report between providers in the PACU are effective at reducing errors of omission, improving communication, and improving patient outcomes. The purpose of this project is to describe the evidence on the effectiveness of a standardized handoff checklist in the PACU on improving patient outcomes in the postoperative period. A change in practice was also made based on this evidence.

Methods/Evidence Search: Keywords for the following PICOT question were used to search four literature databases: Do anesthesia providers (P) who use a standardized handoff checklist in PACU (I) compared to similar anesthesia providers who do NOT use a standardized handoff checklist in PACU (C) have better patient outcomes (O) postoperatively (T)? Synonyms and related terms were used to expand the search results within the Cochrane Library, PubMed, CINAHL, and UpToDate literature databases. The term anesthesia providers, anesthesia, PACU, and teamwork were used to search the databases. Similar related terms were used for handoff to include checklist, communication, handoff OR checklist, as well as handoff AND checklist. Specific terms were combined such as PACU AND handoff, handoff AND checklist AND teamwork, anesthesia AND handoff, PACU AND communication. One randomized clinical trial, one systematic review and two quality improvement projects were selected for critical appraisal.

Synthesis of Literature/Results/Discussion: The randomized control trial (RCT) results demonstrate positive evidence to the use of a checklist for medical handovers between operating rooms and intensive care units to increase quantity and quality of information transmitted. A systematic review shows positive results using proformas or checklists for handover with less handover errors and improved accuracy of information transfer. The quality improvement project concluded that a department-specific handoff checklist can reduce the number of omission errors which may occur during patient handoff. Another quality improvement (QI) project concluded that the use of a PACU handoff checklist can improve transfer of care. The QI project demonstrated the use of the checklist by anesthesia providers decreased the rate of callback for information clarification to a degree which was statistically significant.

Conclusion/Recommendations for Practice: There is strong consistent evidence that shows a standardized handoff checklist used by the anesthesia provider during PACU report, improved communication and decreased provider call-backs. This is a reflection that patient care and outcomes were improved. From this evidence it is recommended that a standardized handoff checklist be provided to anesthesia providers to use while giving report in PACU.

The Use of Aprepitant versus Ondansetron in the Prevention of Postoperative Nausea and Vomiting in Adult Patients Undergoing General Anesthesia

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Background/Purpose/Question: In the United States, over 40 million people each year will undergo surgery. At least 30% of those people will experience postoperative nausea and vomiting (PONV) if no intervention is instituted. The incidence of PONV following general anesthesia remains high despite the increasing number of healthcare advances. Surgical patients consistently reported nausea and vomiting as the top 3 most concerning possible complications of anesthesia. Aprepitant has demonstrated promising effectiveness in the prevention of PONV and can add value to current healthcare practices. The purpose of this evidence-based project was to answer the following clinical question: In adult patients undergoing general anesthesia, does the administration of aprepitant, including in combination with ondansetron, compared to ondansetron alone, reduce incidence rates of PONV?

Methods/Evidence Search: The three databases used to complete the search for this review were PubMed, Excerpta Medica Database (EMBASE), and Cumulated Index to Nursing and Allied Health Literature (CINAHL). Boolean operators were used to specify the limits of the search and truncation was used to catch all variations of search terms. The included search terms were selected based on the chosen PICO question. Search terms used in also three searches include “aprepitant,” “comparison,” “ondansetron OR zofran,” and “PONV.” A total of 193 articles were retrieved, duplicates were eliminated, and titles were appraised for applicability. Exclusion criteria included patients less than 18 years old, patients receiving chemotherapy, patients receiving medications known to cause nausea and/or vomiting, or those that involved any other antiemetic combination other than ondansetron with aprepitant. A total of 10 studies were included for this review including randomized controlled trials, 5 randomized double blind controlled trials, systematic reviews, and meta-analyses.

Synthesis of Literature/Results/Discussion: Aprepitant alone, in most studies, was found to be superior to ondansetron alone in prevention of postoperative nausea and vomiting. All studies that measured aprepitant as combination therapy with ondansetron found it to be more effective than ondansetron alone. Two studies found aprepitant to be superior to ondansetron in both postoperative nausea and vomiting, whereas another study found aprepitant superior only in the prevention of postoperative vomiting. Overall, patients that were given aprepitant preoperatively had lower nausea scores than those who received ondansetron alone. One study found that patients who received aprepitant were half as likely to suffer episodes of vomiting in comparison to those that only received ondansetron. Additionally, time to first vomiting episode was delayed in those who received aprepitant. Two studies both found that the time to first vomiting was prolonged in the patients who received aprepitant with ondansetron. According to another study, nausea scores generally peak at 4 hours after emergence from anesthesia. However, the group that received aprepitant had no episodes of vomiting during this time period, and up until 6 hours postoperatively, supporting the hypothesis that aprepitant delays time to first vomiting.

Conclusion/Recommendations for Practice: It is clear that postoperative nausea and vomiting is an ongoing with PONV rates remaining high despite the availability of multiple antiemetic agents, short-acting anesthetic agents, and minimally invasive surgical techniques. Based on the evidence obtained from 10 different research articles, aprepitant administered alone or with ondansetron is more effective than ondansetron alone in reducing PONV rates. The dose of aprepitant administered seemed to have no statistically significant difference in the efficacy, therefore, it was concluded that a dose of 40 mg of aprepitant is sufficient for PONV prophylaxis. Administration of aprepitant preoperatively was

particularly effective in prevention of postoperative vomiting and time to first vomiting episode. While aprepitant may be too costly for the very low risk patient, it has the potential to be extremely beneficial in patients at high risk for PONV and in preventing serious adverse postoperative serious adverse of PONV.

The Use of Evidenced Based Clinical Guidelines for Advancement in Preceptor Training and Improvement of the Clinical Learning Environment for Student Registered Nurse Anesthetists

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Background/Purpose/Question: The preceptorship model has been widely accepted in many disciplines to enhance student learning, provide opportunities to demonstrate competence and critical thinking, and build confidence. The role of a preceptor involves many challenges. Nursing preceptors must balance their usual workload in addition to being educators. Studies report that preceptors find the lack of support from leadership most difficult. Consequently, the lack of support from leadership makes nursing preceptors less inclined to precepting. The question that will be used in this review, is "In graduate-level nurse anesthesia students, would the implementation of formal training of the preceptor and clinical guidelines compared to no formal training of the preceptor facilitate a positive learning environment clinically and student success didactically?"

Methods/Evidence Search: The electronic search of the articles was performed in the databases, such as PubMed Central, CINAHL, MEDLINE and in the literature, search sites, such as Google Scholar that could help in optimizing the search-related process. The CINAHL database yielded 1,183 results, MEDLINE database yielded 806 articles, and PUBMED yielded 541 results. A total of 2,530 results from all three searches. Duplicates were removed. The literature review has been conducted utilizing specific keywords: “student nurse anesthetists”, “preceptorship”, “mentors”, “students”, “mentorship”, “preceptorship models”, and the search of literature related to these keywords in some of the most commonly used databases or literature search sites. The literature search consisted of the search of journals, peer-reviewed articles, and empirical research-based articles. In this literature review, the articles that were not published in English language were excluded. Moreover, the articles that were more than 10 years old were also excluded.

Synthesis of Literature/Results/Discussion: According to the literature, in a good learning environment, both theory and practice merge and clinical staff and educators collaborate on intended clinical outcomes for the students. Studies show that the learning environment contributes to students’ success, health, happiness, and motivation. The clinical environment is critical to learning and correlates to the academic success of the student Student perceptions and satisfaction are indicators of the quality of learning and related to several outcomes. Studies indicate that the clinical environment perpetuates students’ perceptions and indirectly relates to academic success, student retention, and coping mechanisms. It is the ability to believe in one’s own ability to carry out an objective. Preceptors who provide timely feedback, observe skills frequently, effectively communicate, and are willing to teach contribute to a better learning environment. As a result of these findings, there is a need to ensure that the preceptor understands how to mentor appropriately and understands the impact they have on the student’s education. Most CRNAs go to work on the first day and have a student. The CRNA usually does not have time to transition into their career and learn how to be a CRNA. It is recommended, that having an educational module to teach the preceptor how to precept will increase student success.

Conclusion/Recommendations for Practice: Nurse anesthetists play a key role in the education of future nurse anesthetists. Traditionally, nurse anesthesia students gain didactic knowledge in post graduate education, however, clinical knowledge is generally gained during clinical residency. Working with experienced nurse anesthetists or nurse anesthesia faculty in the clinical setting allows the SRNA to flourish clinically prior to the completion of their didactic education. SRNAs not only gain knowledge

from their preceptors, but they could also be influenced by their work and experience within the hospital environment. Therefore, the formal training of preceptors could result in improved outcomes in terms of clinical experience for nurse anesthesia students. Training preceptors on how to mentor, clinically educate and give constructive feedback to the students is essential in improving their confidence, improving the student learning environment and making student registered nurse anesthetist education student centered.

The Use of Regional Anesthesia to Prevent Chronic Post-Surgical Pain in Breast Surgery Patients: A Literature Review

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Background/Purpose/Question: A significant number of patients experience chronic post-surgical pain (CPSP) following breast surgeries such as mastectomies. The purpose of this systematic review is to synthesize current evidence regarding the efficacy of perioperative regional anesthesia (RA) in the form of peripheral nerve blocks (PNBs) for preventing the development of CPSP in the breast surgery population. The severity of acute post-operative pain may be correlated to an increased risk of developing chronic pain. By better controlling acute post-operative pain and preventing central sensitization, can PNBs decrease the incidence of CPSP in the breast surgery population?

Methods/Evidence Search: A systematic review of the literature was performed using specific inclusion criteria: patients undergoing breast surgery receiving perioperative PNBs with general anesthesia (GA) compared to a sham block or conventional analgesia with GA. The search included the following databases: PubMed, Scopus, and Cumulative Index to Nursing and Allied Health Literature (CINAHL). This review focuses on two PNBs, specifically, the thoracic paravertebral block (TPVB) and the Pectoral Nerve Block II (PECS II). The following keywords and medical subject headings (MeSH) were used alone or in combination utilizing the appropriate Boolean phrase mechanics: nerve block AND pain, postoperative AND peripheral OR thoracic OR paravertebral OR pectoral AND breast OR mastectomy OR axillary. After applying the selection criteria, we included a total of seven articles. The included seven articles include two randomized controlled trials (RCTs), three meta-analyses, and two prospective observational studies.

Synthesis of Literature/Results/Discussion: Three studies found a statistically significant decrease in the incidence of CPSP in patients who received a perioperative PNB. Four studies included in this review did not find a decreased incidence of CPSP in the patients who received a PNB. Some studies found a decreased incidence of CPSP in the PNB groups, but the results were not considered statistically significant. However, the reduced number of patients experiencing CPSP may be considered clinically significant and warrants further investigation. In one article, the authors investigated the severity of chronic pain and health-related quality of life (HRQOL) as secondary outcome measures and found that the two groups who received a TPVB (single-injection or continuous) reported lower chronic pain scores, experienced fewer signs and symptoms of chronic pain, and experienced better physical and mental HRQOL than the group who received GA alone. Based on the results of the seven studies in this review, both TPVB and PECS II blocks offer variable results regarding the development of CPSP. Many reasons may explain the variability in results between studies including different techniques of administering PNBs and the different types of blocks administered.

Conclusion/Recommendations for Practice: The literature in this review brought forth three main points: 1) TPVB and PECS-II blocks are shown to decrease the incidence of CPSP in some but not all patients who receive them for breast surgeries, 2) PNBs have the potential to reduce the severity of chronic pain in patients following breast surgery, and 3) perioperative PNBs can lead to an improved long-term HRQoL and mental health for patients undergoing breast surgery. Even in cases that showed no decrease in the incidence of chronic pain, patients who received a PNB experienced reduced acute postoperative pain when compared to conventional systemic pain management techniques. Because the development of chronic pain is believed to be related to the severity of acute pain, the TPVB and PECS-II blocks should be considered when attempting to prevent central sensitization, wind-up, and resulting chronic pain for breast surgery patients. The body of research regarding PNBs for preventing

chronic pain in the breast surgery population remains limited.

The Use of Virtual Reality in Patients Undergoing Regional Anesthesia and its Impact on Patient Satisfaction, Anxiety, and Pain Level

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Background/Purpose/Question: New technology and advancements in regional anesthesia (RA) have led to an increase in its popularity and implementation in recent years. The RA approach presents a unique nature, which allows the patient to have varying levels of awareness throughout the procedure, leading to apprehension and push back often displayed from patients. Uncontrolled anxiety has many adverse effects on the patient throughout the perioperative period. Such physiologic effects counteract the benefits RA has to offer. The purpose of this investigation is to find the benefits virtual reality may have when used on patients undergoing regional anesthesia and present them to CRNAs and student registered nurse anesthetists as an adjunct to their practice in order to reduce patient anxiety, pain and improve patient satisfaction.

Methods/Evidence Search: The evidence-based practice project was guided directly by the PICO question: Does the use of virtual reality (VR) in patients undergoing regional anesthesia lead to improved patient satisfaction, anxiety, and pain levels? A search was conducted to synthesize data supporting the efficacy of VR to reduce anxiety, decrease pain and improve patient satisfaction and outcomes, using CINAHL, PROQUEST, and Medline databases. The keywords and Boolean operators developed for the practice question were "regional anesthesia" using quotation marks to keep this phrase together, AND "virtual reality" OR "anxiety" OR "pain." The search conducted included a filter date range from 2010 to 2020. CINAHL yielded a total of five articles, PROQUEST produced six pieces, and the majority of results were found in the MEDLINE database with a total of ten studies. Six articles remained after exclusion criteria was applied.

Synthesis of Literature/Results/Discussion: The review concluded a consistent increase in patient satisfaction scores when virtual reality was implemented. There were variances in the studies when anxiety and pain levels were measured, but overall, the majority of the research determined a decrease in anxiety and pain. There was no concrete evidence to show that VR effectively led to an increase in hemodynamic stability in none of the readings. More importantly the VR immersion experience studies reported no adverse effects and showed excellent feasibility when implemented in a busy setting. VR is still in its infancy and much more research is needed in order to establish concrete evidence of the benefits VR has to offer. The direction of future research should be aimed at setting standard patient exclusion criteria, with a greater degree of objectifiable outcome measurements, as well as higher quality evidence.

Conclusion/Recommendations for Practice: There are many modalities in use to reduce patient anxiety and pain, but they have associated side effects or have proven to be unsuccessful. VR is a pioneering adjuvant that attenuates patient anxiety and pain, allowing for the acceptance of RA for surgery and its well-documented associated benefits. It is low-cost, accessible, and non-threatening, warranting its achievable and practicable implementation in the perioperative period. It is still a novel intervention and, as such, needs further scrutinizing and application to validate its efficacy truly. Overall, the use of virtual reality and its outlook has given promising results, and its future appears optimistic. These preliminary findings give anticipation to successful outcomes and demonstrate the strengths of VR implementation. This study aims to persuade CRNA's in identifying opportunities in which the patient experience can be optimized when implementing regional anesthesia.

Thoracic Paravertebral Blocks for Post-Operative Pain Control in Breast Surgery

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Background/Purpose/Question: The American Cancer Society estimates that approximately 1 in 8 women will face a breast cancer diagnosis. Surgery is often the chosen treatment for these patients, but they provide a unique challenge from an anesthesia perspective. The purpose of this project was to determine whether thoracic paravertebral blocks are a viable option and how they affect patient outcomes. The following research question was developed in the PICOT format to provide a framework to guide the literature review regarding the hypothesis under investigation: In adult patients undergoing general anesthesia for breast surgery (P), is the administration of a thoracic paravertebral block (I) compared to general anesthesia alone (C) associated with a decrease in opioid consumption and pain scores (O) during the perioperative period (T)?

Methods/Evidence Search: A comprehensive literature search was conducted to identify and analyze current literature that addressed the above research question regarding the use of thoracic paravertebral blocks in patients undergoing breast surgery. The Texas Medical Center Library Health Sciences Resource Center was used to access the following databases: EMBASE, Scopus, PubMed, and Medline (Ovid). Medical Subject Heading (MeSH) terms were employed to discover articles related to the research question. The Boolean operator 'AND' was used to narrow the search results and the Boolean operator 'OR' was used to broaden the search results. The MeSH terms used were 'paravertebral block', 'breast surgery', and 'opioid'. The snowballing technique was also used in which the reference lists of articles found in the literature search were analyzed for additional relevant literature. Each article was assessed for level of evidence based on the Oxford Levels of Evidence and graded for relevance based on the United States Preventative Services Task Force scale.

Synthesis of Literature/Results/Discussion: The results of the literature yielded evidence to support the use of thoracic paravertebral blocks in patients undergoing breast surgery for cancer. There were statistically significant ($P<0.05$) decreases in pain scores up to 24 hours post-operatively from 1-3 points on the numeric rating scale and 0.5-3.5cm on the visual analog scale. Opioid consumption was also decreased with statistical significance ($P<0.05$) from 3-39 mg morphine equivalents, 100-150 μg fentanyl equivalents, or 3 mg oxycodone dosage. It is unclear from the literature whether there is a clinically significant difference in the type of local anesthetic used. The use of ultrasound guidance has been shown to reduce complications associated with paravertebral blocks. Thoracic paravertebral blocks should not be administered to patients with difficult thoracic anatomy such as severe scoliosis, coagulopathies, infection at the site of injection, or allergy to local anesthetics. There are only a handful of articles that directly compare thoracic paravertebral blocks to other types of regional techniques for these procedures. Future research should include comparison of local anesthetic medications, direct comparison to other regional techniques, and cost-effective analysis.

Conclusion/Recommendations for Practice: Thoracic paravertebral blocks can be used as adjuncts to general anesthetic techniques to help decrease pain scores and opioid consumption for patients undergoing breast cancer surgery. Thoracic paravertebral blocks should be used in adult females undergoing breast cancer surgery who are ASA class I-III without contraindications to regional anesthesia. Thoracic paravertebral blocks can be placed using either a loss of resistance technique or using ultrasound guidance. If the provider has the means to use ultrasound guidance, there is evidence to show that it reduces complication rates. The literature supports the use of bupivacaine and ropivacaine as the local anesthetic medication and the block can be done in a single-shot block or include placement of a continuous catheter.

Tools to Evaluate the Competency of SRNAs Learning Ultrasound Guided Regional Anesthesia in Simulation: An Integrative Review

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Background/Purpose/Question: Ultrasound-guided regional anesthesia (UGRA) requires the interaction of technical skills, manual dexterity and cognitive knowledge which many student registered nurse anesthetists (SRNAs) find difficult to learn. In a recent study, trainees committed 67% more critical errors and 161% more total errors than experts, which exposes patients to pain, repeat attempts, and potential harm. UGRA skills are ideally learned in a simulated environment where tasks can be practiced, and errors identified prior to clinical performance. Although simulation has been shown to improve clinical competency and patient safety, there is no standardized tool for objectively quantifying UGRA skill level after simulated practice. Therefore, we aimed to determine the most valid, reliable, and feasible tool to evaluate the skill level of SRNAs learning UGRA in simulation.

Methods/Evidence Search: A literature review was conducted using CINAHL, Cochrane Library, and PubMed databases. Search terms were regional anesthesia, nerve block, simulation, assessment tool, checklist, scale, evaluation, competency, rating, assessment, and proficiency. Results were filtered for peer-reviewed journal articles published since 2005, English language and adult patients. Four hundred twenty two study summaries were scanned for applicability. Exclusions were made for veterinary medicine, dentistry, pediatrics, non-UGRA placement techniques, non-novice learners, or neuraxial anesthesia techniques leaving 114 articles. Abstracts were scanned for inclusion criteria of English language, peer-reviewed, published since 2005, human, simulation assessment or clinical competency assessment, novice anesthetists, non-dental, non-neuraxial, adult patient. Full text copies of all remaining articles were further evaluated, and 42 remaining studies were sorted into systematic reviews of assessment tools (n=3), studies describing the development of a nove

Synthesis of Literature/Results/Discussion: The most common method for assessing skill level was a task specific checklist (TSC) in conjunction with a global rating scale (GRS). Eight distinct TSCs and 6 GRSs were assessed for validity, as well as four high-fidelity assessment tools. Validation testing determined if an assessment tool could accurately differentiate between novice and experienced providers either in a clinical or simulated environment, degree of agreement between multiple assessors, ability to differentiate between procedures with varied difficulty levels, internal consistency of assessors, and feasibility for use of the tool. The most promising high-fidelity tools were those which utilizing hand motion analysis and eye motion tracking. These demonstrated objectivity and high accuracy in determining skill level of providers both in simulation or clinical setting, but expense, set-up and data analysis requirements limited their feasibility. A TSC/GRS tool developed by one researcher showed validity, agreement and feasibility and is applicable.

Conclusion/Recommendations for Practice: The perfect tool for assessing an SRNA's regional anesthesia skill level would be fully tested, highly objective, applicable to both the simulated or clinical environment, able to assess all types of blocks and would be easy to use. Four tools were identified as nearing this standard. The use of a reliable, valid and accurate assessment tool of UGRA skills in simulation would result in greater success in the clinical setting. A standardized assessment protocol is able to quantify the skill level of the trainee, in order for programs to establish a standardized competency expectation for their students. A well-trained, skilled regional anesthetist increases patient safety, decreases complications from regional anesthesia, improves hospital length of stays through integration with ERAS protocols, and decreases side effects such as nausea and vomiting and persistent pain after surgery. The use of these assessment tools is an important component to training CRNAs who

are competent in regional anesthesia.

Transcutaneous Electrical Acupoint Stimulation to Decrease Opiate Utilization in Surgical Patients: An Evidence-Based Education Module

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Background/Purpose/Question: An estimated 2 million Americans are addicted to opioids. A non-pharmaceutical method of analgesia can decrease the amount of opioid analgesia required during the perioperative period. Acupuncture is a non-pharmacological analgesic technique that has been shown to increase endogenous opioid-like substances in cerebral spinal fluid. Transcutaneous electrical acupoint stimulation **(**TEAS) is noninvasive, affords no risk of infection, and is inexpensive. Disposable electrodes are placed on acupoints on the body and stimulated with an electrical current. TEAS has been shown to decrease perioperative opioid use and pain in surgical patients. The purpose of this evidence-based project was to answer the following clinical question: For surgical patients during the perioperative period, does TEAS decrease perioperative analgesia, nausea, vomiting, post-operative recovery time, pain, and increase patient satisfaction?

Methods/Evidence Search: The PICO question was used to direct the search. The investigator utilized Cumulative Index of Nursing and Allied Health Literature, PubMed, Medline, and Google Scholar. Boolean operators were used to specify the limits of the search and truncation was used to catch all variations of search terms. The articles are reproducible with the following search terms: “acupuncture”, “anesthesia”, “pain”, “analgesia, and “surgery.” A total of 2,033 articles were retrieved in the four databases, duplicates were eliminated, and titles were appraised for applicability. The inclusion criteria concentrated on date of publication within 20 years, exposure of interest, geographic location, participants, peer reviewed, setting, reported outcomes, study design and type of publication. All database searches were limited to research involving humans, the English language and decreased opiate usage and/or pain in the perioperative period or while on mechanical ventilation. A total of 15 randomized control studies were included for this systematic review.

Synthesis of Literature/Results/Discussion: All studies found TEAS useful as a non-pharmacological method to decrease perioperative pain and analgesia usage. Researchers concluded that acupoint stimulation produced superior analgesia and a decrease in postoperative opiate administration compared to stimulation of non-acupoints. One study found that TEAS decreased postoperative opiate usage in surgical patients by 350%, P=0.004. Another study found that TEAS decreased intraoperative sufentanil by 33.5%, P <0.001. Six studies found that TEAS reduced incidences of postoperative nausea and vomiting (PONV). Two studies found that TEAS decreased time in the post-anesthesia care unit (PACU). One study found that TEAS patients left the PACU an average of 12.7 minutes faster than those in the control group, P =0.01. TEAS increased patient satisfaction and quality of recovery scores. Future studies should be conducted at multiple healthcare sites with a larger and more diverse patient population to validate the existing research on TEAS. Future studies should determine its effectiveness on children and pinpoint the time during the perioperative period that yields the greatest analgesic effect. Most studies had woman as the sample population; including more men would be more representative of the general population along with studies conducted outside of Asia to test the effectiveness of TEAS.

Conclusion/Recommendations for Practice: TEAS is an economical, noninvasive, non-pharmacological adjunct to existing perioperative analgesic regimens that can be administered by healthcare providers with minimal training. The stimulation of the acupoints, Hegu (LI4) and Neiguan (PC6), decreases perioperative opioid use and PONV. Located on the hand and on the wrist, these two acupoints are easy for healthcare providers to access and identify. Hegu (LI4) and Neiguan (PC6) are the acupoints that

should be stimulated bilaterally and can be stimulated with any surgical procedure. It is recommended that TEAS be initiated 30 minutes prior to surgery and administered at a dense and disperse frequency of 2/100 Hz for a duration of 30-40 minutes. The intensity should be set above 5 mA. A TEAS protocol for specific surgeries would be beneficial for understanding which interventions produce the best patient outcomes. The empirical evidence indicates that TEAS is effective in decreasing postoperative pain, perioperative opioids, PONV, recovery time, and improves patient satisfaction.

Ultrasound Guided Transversus Abdominis Plane Block Workshop for Nurse Anesthetists

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Background/Purpose/Question: Ultrasound guided nerve blocks require knowledge and practice for proficiency. Nerve blocks are underutilized but can be an integral part of multimodal anesthesia. The purpose of this project is to provide ultrasound guided transversus abdominis plane (TAP) block education and simulation for certified registered nurse anesthetists (CRNAs). The question is, how will a TAP block workshop affect CRNA knowledge and confidence for TAP block placement? When competent in ultrasound guided TAP blocks, CRNAs can promote block administration to enhance recovery, reduce opioid consumption, and decrease overall length of stay. When TAP blocks are administered along with other multimodal pain management regimens, patients achieve excellent pain control and less opioids are required.

Methods/Evidence Search: A literature review was conducted within Embase, Scopus, and PubMed systems. Search terms included transversus abdominis plane block, pain management, analgesia, general surgery, and cesarean delivery. Results were filtered to include peer-reviewed articles. Meta-analyses, systematic reviews, and articles published before 2015 were excluded. In-person workshop sessions were provided with education via PowerPoint over 90 minutes followed by a 60-minute simulation session with 5 stations with ultrasound machines. Pretests and posttests were completed by all participants before and after the workshop. Nine true or false and multiple-choice questions pertained to knowledge. Five questions, with Likert scale answers, related to confidence levels. TAP block questions covered provider experience, confidence, and knowledge of ultrasound, basic anatomy, local anesthetics, equipment, and block administration. Paired t-test calculations were used to determine statistical differences in CRNA knowledge and confidence after workshop implementation.

Synthesis of Literature/Results/Discussion: Means of 9 knowledge and 5 confidence questions were analyzed separately with paired *t* test calculations. Both knowledge and confidence questions for 12 participants were found to have statistically significant increases with $P < 0.001$. Equal variance was assumed with a 95% confidence interval. Pretest and posttest means for knowledge questions were 3.92 (44% correct) and 8.08 (90% correct) respectively. Pretest and posttest means for confidence questions were 25 and 44.75 respectively. Many CRNA providers at the facility were inexperienced with ultrasound guided TAP blocks. After the workshop, providers were able to become adept with ultrasound needle guidance, local anesthetic management, TAP block administration, consent, and appropriate charting. With additional providers advocating for and administering TAP blocks along with a multimodal anesthesia plan, evidence shows enhanced recovery and decreased opioid consumption. Study limitations included a small sample size and participant scheduling conflicts. Thus, future participant recruitment could be promoted by providing a prerecorded voiceover PowerPoint before attending the hands-on simulation portion of the workshop. Future research in TAP block administration will be focused on perineural adjunct medications to improve the quality and duration of blocks.

Conclusion/Recommendations for Practice: This project demonstrates that CRNAs can become more knowledgeable and confident in performing TAP blocks with comprehensive didactic and hands-on simulation education. Evidence-based benefits for ultrasound guided TAP blocks illustrates excellent pain control and a reduced need for opioids, especially when utilized along with multimodal anesthesia plans. Decreasing the severity and duration of pain in the early postoperative period is key to mitigating the risk for the development of chronic post-surgical pain. This evidence and the education provided within the workshop could be used as model for future workshops for student nurse anesthetists, new

providers, or as an annual course to maintain competency. This workshop would be beneficial for anesthesia providers caring for adults within the general surgical and obstetric populations. This course could also be extended to other hospitals considering the number of adult patients eligible for TAP blocks as well as indications for multimodal anesthesia.

Ultrasound-Guidance for Peripheral Intravenous Access Education: An Evidence-Based Practice Project in the Peripartum Setting

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Background/Purpose/Question: Peripheral intravenous (PIV) cannulation is a safe, efficient way of obtaining venous access for fluid, medication, and blood product sampling and administration. However, PIV access can be challenging due to peripartum patient factors such as obesity and edema. An estimated 15%-26% of patients are affected by difficult PIV access. Using ultrasound to guide PIV catheter placement increases PIV cannulation rates, decreases procedure time, and decreases PIV cannulation attempts. Yet peripartum registered nurses are not trained to perform the procedure. The purpose of this project was to provide ultrasound-guidance for PIV access education to peripartum RNs. The PICO question was "In peripartum RNs, do focused didactic and hands-on simulation sessions about ultrasound-guidance for difficult PIV catheter placement improve knowledge and likelihood of clinical use?"

Methods/Evidence Search: A literature search was conducted in PubMed and CINAHL databases. Keywords were education, vascular access, peripheral intravenous catheterization, ultrasound guid*, and ultrasonography guid*. Nine articles were chosen, the majority of which were quasi-experimental studies of low to good quality. The education involved didactic and simulation sessions. A voice-over presentation covered support in the literature, ultrasonography, ultrasound machine and equipment, indications for use, peripheral vascular anatomy, and the procedure technique. Two simulation sessions were hosted. Each participant had 20 to 30 minutes to practice using the ultrasound machine and equipment, peripheral vessel identification and differentiation on human models, and the procedure technique on meat models. Pre- and post-tests were administered to assess participants' demographics, knowledge about ultrasound-guidance for PIV cannulation, and likelihood of clinical use. Data were analyzed using descriptive statistics and results were presented in tables.

Synthesis of Literature/Results/Discussion: Synthesis of the literature substantiated the benefits of ultrasound-guidance for PIV access education. After receiving education, healthcare providers improved PIV cannulation rates, procedure time, number of skin punctures, and incidence of invasive line placements. There were no differences in ability to perform the procedure among healthcare professionals, regardless of previous education or experience. Data analysis revealed that most of the participants held a bachelor's degree and had not been educated on and/or clinically used ultrasound-guidance for PIV catheter placement prior to the education. Participants improved knowledge about the procedure by 17% and likelihood of clinical use by 3%. These results show the value of ultrasound-guidance for PIV access education for peripartum RNs and are consistent with current literature. However, retrospective chart reviews are needed to determine the impact on PIV cannulation rates, procedure time, number of skin punctures, and incidence of invasive line placements. Other limitations of the project include small population size, non-randomized, and inability to determine whether participants viewed the didactic education. In addition, results could not be extrapolated due to lack of available data.

Conclusion/Recommendations for Practice: The ultrasound-guidance for PIV access education improved peripartum RNs knowledge and likelihood of clinical use. Peripartum Units nurse leadership observed these accomplishments and dedicated resources to sustain the education. An RN was appointed to lead continuing education efforts and funds were allocated to purchase an ultrasound machine and arm models. Although the education benefited peripartum RNs at the project institution, more data are needed to determine the clinical impact and if the project model can be implemented in

other populations.

Upper Extremity Nerve Blocks: A Review of Techniques and Pearls for Success

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Background/Purpose/Question: Students enrolled in the University of Cincinnati Nurse Anesthesia Program receive extensive training on regional anesthesia. While robust, the time from content delivery to a student's regional rotation may be 13 months. This period with little to no clinical application makes it challenging for students to fully comprehend the foundational tenets of upper extremity nerve blocks and fails to foster development of sound scanning and needle-guidance techniques. Affording nurse anesthesia students an in-person review day reinforces content previously delivered and allow hands-on skills to be revisited. For senior nurse anesthesia students, does a focused review of upper extremity nerve blocks prior to their regional rotation, as opposed to no review, improve student knowledge and confidence in performing upper extremity nerve blocks?

Methods/Evidence Search: Prior to implementation, 19 senior nurse anesthesia students completed a self-evaluation exploring knowledge and confidence in performing upper extremity nerve blocks. Following a PowerPoint presentation reviewing indications, contraindications, and risks, as well as how to best obtain images for the various blocks, students participated in a hands-on workshop allowing them to practice scanning and needle-guidance techniques. Content for the presentation was gathered through database (PubMed and EmBase) searches using terms such as "upper extremity nerve blocks", "regional anesthesia", "educational technique", and "simulation." After conclusion of the focused review, the students again completed a self-evaluation assessing their knowledge and confidence in performing upper extremity nerve blocks. The results were compiled and analyzed using a combination of summary statistics and paired *t* tests.

Synthesis of Literature/Results/Discussion: Incorporating a focused review of upper extremity nerve blocks prior to a regional rotation led to statistically significant improvements in self-reported knowledge and confidence in performing upper extremity nerve blocks when compared to no structured review. Following the focused review, knowledge-based assessment scores increased from a pre-implementation cohort mean of 5.79 to 8.63 which was statistically significant with a $P < 0.0001$. Confidence was assessed using a scale ranging from strongly disagree (assigned a value of 1) to strongly agree (assigned a value of 5) regarding the following statement, "I am confident in performing upper extremity nerve blocks." The median response was "disagree" prior to the focused review, with the median response being "agree" on the self-evaluation completed immediately following the review. This too was statistically significant, with a $P < 0.0001$. These findings suggest there is value in incorporating a focused review of upper extremity nerve blocks prior to a student's regional rotation if there are prolonged periods between the didactic course and the clinical experience. Future studies are needed to evaluate if these results are reproducible in other, possibly larger, groups and if the increase in knowledge and confidence translates to improved student success in performing upper extremity nerve blocks.

Conclusion/Recommendations for Practice: The addition of a focused regional review day prior to the regional anesthesia clinical rotation significantly increased student knowledge and confidence in performing upper extremity nerve blocks. This is theorized to improve success of the student in the clinical setting, and in turn, improve patient outcomes, though this will need to be confirmed through future research efforts. It is also recommended that this intervention be reproduced for following cohorts to determine consistency in outcomes. Being able to replicate the results of this study, especially in larger groups, will mitigate some of the inherent biases in the statistics of this small-scale

evidence-based practice project. With more robust data, further dissemination and extrapolation of these efforts to other anesthesia programs, or other specialty rotation experiences, would be more likely to gain support.

Vasopressor Use in Free Flap Transfers for Breast Reconstruction

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Background/Purpose/Question: Vasopressors are a routine part of treatment for hypotension under general anesthesia but are often avoided during free flap transfers for breast reconstruction due to a theoretical risk of vasospasm, venous congestion, thrombosis, and/or flap failure. Vasopressors are effective at increasing mean arterial pressure and therefore could be beneficial in improving flap perfusion. A dogmatic discrepancy exists between clinical avoidance of vasopressors in flap cases and the current body of literature and provides the purpose for this evidence-based project. The following question was developed to guide the literature search: in patients undergoing free flap breast reconstruction, does the intraoperative use of vasopressors compared to fluid administration alone affect the complication rate and the survival of the tissue flap in the recovery period?

Methods/Evidence Search: The Texas Medical Center Library was used to access The Cochrane Library, Embase, PubMed, and Medline (Ovid) databases. Medical Subject Heading (MeSH) terms used for the search included "vasopressor agents," "microsurgery free flaps," and "breast reconstruction." Keywords included "DIEP" and "TRAM." The search yielded 121 total articles that were screened for relevance. The snowballing technique was utilized to identify additional articles. The literature review resulted in the identification of seven relevant articles.

Synthesis of Literature/Results/Discussion: Findings from the literature show that the use of vasopressors in free flap transfer for breast reconstruction does not increase the incidence of flap failure or the rate of flap complications (thrombosis, vasospasm, and/or venous congestion). One study showed a statistically significant decrease in flap complications with ephedrine administration (P = 0.014). Another study showed a statistically significant decrease in pedicle compromise (P = 0.018) and venous congestion (P = 0.019) in patients who received vasopressors. Vasopressors utilized in the studies included norepinephrine, dobutamine, and dopamine infusions, as well as bolus administration of ephedrine and phenylephrine. Dobutamine increased arterial blood flow by 285% in the recipient arteries and by 178% in the donor arteries (P = 0.043). Vasopressor administration during critical time periods (perforator selection, dissection, and microsurgery) had no correlation with complications. The literature discussed that excessive fluid administration (> 5.4 ml/kg/hr) is associated with thrombosis formation, flap failure and the need for reoperation. Finally, there was no difference in length of operation time, time to mobilization, and/or hospital length of stay in patients who received vasopressors.

Conclusion/Recommendations for Practice: Evidence-based clinical practice recommendations were formulated based on the summary of findings. The recommendations include: (a) vasopressors may be used in ASA I and II patients undergoing free flap breast reconstruction, (b) including ephedrine, phenylephrine, norepinephrine, and dobutamine, and (c) use a balanced approach to hemodynamic management by using vasopressors and avoiding excessive fluid administration. These recommendations are of moderate strength due to the limitations of the current available literature including small sample sizes and limited number of quality randomized controlled trials.

Quality Improvement

A Comparison of Rocuronium Use for Intraoperative Paralysis Before and After the Availability of Sugammadex

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Background: In 2015, the FDA approved sugammadex as an alternative and highly effective reversal agent for rocuronium induced neuromuscular blockade (RINMB). Prior to this approval, the only way to reverse rocuronium was with an anticholinesterase. The availability of sugammadex for the reversal of RINMB has the potential to influence the amount of rocuronium used in clinical settings. Providers could be using more rocuronium than is clinically necessarily to ensure an adequate neuromuscular block for surgery knowing they can reverse any degree of blockade with sugammadex. The purpose of this quality improvement project is to determine if there has been a practice change in the utilization of rocuronium by anesthesia providers at a major southeastern academic medical center before and after the addition of sugammadex to its formulary.

Method: Quality improvement certification was obtained by the southeastern academic medical center at the outset of project implementation. An interrupted time series analysis was chosen for the study's design to analyze longitudinal data around a specified date and intervention. Sugammadex was added to the hospital formulary on March 17, 2016. Rocuronium order history was obtained for all dates between September 16, 2015 and March 16, 2017. Cancelled orders and orders of quantity zero were omitted from the data set. A negative binomial model of number of vials per week that included the natural cubic spline of time in weeks as the independent covariate was examined. Additional data analysis was performed to test the hypothesis that the curvilinear inflexion points observed in this analysis were statistically significant using interrupted time series analysis.

Results: Rocuronium order history was divided into three 6-month segments between September 16, 2015 and March 16, 2017 and analyzed for significant order differences. There was a decrease in rocuronium vials ordered per week from September 2015 to March 2016, an increase from March 2016 to September 2016, and a decrease from September 2016 to March 2017. A constrained linear model was fit to assess for significant differences in vials ordered per week in each time period. There was no statistically significant difference in the number of vials ordered per week in period 1 and period 2 (P = 0.319 and 0.096, respectively). There was a significant decrease in the vials ordered per week in time period 3 (P= 0.002). The significance of inflection points observed in the first data analysis between time periods was further analyzed using interrupted time series analysis. The results of this analysis were not significant. The significance level for the inflexion point of March 2016 was P=0.8734 and the October 2016 inflexion point showed P=0.4428.

Discussion: The addition of sugammadex to a hospital's formulary may result in anesthesia providers using more rocuronium than is clinically necessary due to the efficacy and safety of RINMB reversal with sugammadex. Increased rocuronium usage and anesthetic costs have been observed in Australian and French hospitals after the introduction of sugammadex. Data analysis determined that no statistically significant trend supports the hypothesis that providers at this institution were using more rocuronium since the addition of sugammadex to the hospital formulary. These results should be interpreted with

caution as the data consisted of archival records that were not specifically designed to assess the project's hypothesis. Confidence in the findings are strengthened by the fact that two different types of statistical approaches to the data analysis arrived at the same conclusion. The pattern of large variance within the data resulted in lack of statistical support to reject the null hypothesis. Future studies of changes in pharmaceutical practice patterns should consider an approach that allows prospective data collection at the patient level. Such an approach would avoid the problems relating to great variations of use data within the time segments, thereby increasing statistical power to identify an effect.

Airway Crisis Management: An Interdisciplinary Approach

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Background: An airway is deemed difficult when a trained anesthesia provider has difficulty with mask ventilating, laryngoscopy, intubation, or all of these skills. A provider must be able to recognize a difficult airway to avoid harm to patients resulting from hypoxia. The Difficult Airway Algorithm (DAA) was developed by the American Society of Anesthesiologists for anesthesia providers to standardize difficult airway management. This algorithm gave anesthesia providers a road map for dealing with difficult bag-mask-ventilation, direct laryngoscopy, tracheal intubation, and failed intubation in situations both expected and unexpected. This project aims to determine if teaching the DAA and application through simulation can improve knowledge and confidence for nurse practitioner students and student nurse anesthetists.

Method: A literature review using Pubmed, Ebscohost, and Embase was performed. Terms of difficult airway, interprofessional collaboration, simulation training, and airway crisis management were used to find peer-review articles published no earlier than 2015. Articles obtained for this project support the idea that simulation training has beneficial effects on knowledge retention and skill development for practitioners. A PowerPoint including voiceover covering the topics of airway assessments, airway adjuncts, laryngoscopes, video laryngoscopes, and their use was distributed to a group of 19 trainees (8 nurse anesthesia students and 11 nurse practitioner students). Groups of 4-5 participants, 2 nurse anesthesia and 2-3 nurse practitioner students, participated in simulations collaboratively managing a difficult airway using the DAA on 4 separate days at the University of Cincinnati College of Nursing Simulation lab. Data were collected from pre-intervention and post-intervention assessments covering topics included in the PowerPoint teaching

Results: The pre- and post-test scores of the participants were averaged and compared using a paired *t* test showing a statistically significant increase of scores by 0.8 from 6.3 to 7.1 out of 9 questions. With an assumed equal variance and a 95% confidence interval resulted in a p-value of 0.028. Notably, from the Nurse Practitioner group who have little to no knowledge of the DAA, scores increased from a mean of 5.71 to 6.71. Subjective responses show 100% of students from both professions support that training between professions was beneficial and voiced their improved comfort with the techniques included for managing a difficult airway. Study limitations include all participants receiving the education prior to simulation, so no comparison of effectiveness of the PowerPoint education between a study and control group was obtained for this project. Questions regarding knowledge of the DAA prior to the project were overlooked, so we were unable to assess its effect on time to establish airways between groups.

Discussion: Roughly 0.5-2.5% of intubations are considered difficult, however failure to establish an airway is a leading cause of morbidity and mortality in the field of anesthesia. Time is vital for reducing harm and improving outcomes when providing oxygenation and ventilation for patients. Research supports simulation training in aiding providers' ability to improve skills. One study discusses how skills can begin to deteriorate when not utilized regularly. This concept is important related to airway management because if a provider does not have regular experience intubating it may take longer to establish an airway, leading to significant patient harm. There is limited research assessing the effectiveness of the DAA since its inception. This project provides information to improve further research on the DAA effectiveness using simulation training and interprofessional collaboration. Future projects regarding this topic can be conducted with providers from other healthcare professions to assess effectiveness of simulation and education in their fields of expertise. Finally, this project could be a start to inclusion of the DAA and simulation training in other healthcare curriculums.

An Evaluation of CRNA Emergency Cricothyrotomy Competency: Exploring Two Techniques

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Background: Airway complications are one of the leading causes of anesthesia-related morbidity and mortality in patients. Cricothyrotomy (CRIC) can be a life-saving procedure in a cannot intubate, cannot oxygenate (CICO) situation. It is the final step in the American Society of Anesthesiologists difficult airway algorithm (ASA-DAA). CRIC is not a common procedure and can be difficult because of lack of training and skills retention amongst providers. Literature findings indicate that CRIC training is lacking amongst airway providers. No studies were found that assessed Certified Registered Nurse Anesthetist (CRNA) skill in performing the procedure. The results of an internal survey indicated that training is desired by CRNA providers in our institution. The purpose of this study was to evaluate baseline CRNA speed and skill in CRIC, and after a self-education module using low cost, high fidelity models. We also explored effectiveness of two different techniques - Scalpel-Finger-Bougie (SFB) and Seldinger technique using Melker Kits (MK).

Method: A parallel, two-arm study was developed that utilized a pretest, video education module with practice attempts, and posttest to assess our objectives. CRNA participants were randomly assigned to one of two groups (SFB or MK). During the pretest, CRNAs were instructed to perform a CRIC on a mannequin using any technique they knew with the available equipment. Following pretest, participants watched an emergency CRIC instructional video based on their assignment and conducted five practice attempts on low cost, high fidelity models. Afterwards, the participants performed a posttest identical to the pretest but were required to use the technique they had been assigned. All tests were video recorded, and recordings were graded by a blinded third party using a validated Global Rating Scale (GRS) for CRIC. Statistical analysis was performed using various tests (Wilcoxon Signed Rank, McNemar's, two-sample t-test, Rank Sum test, Chi-Square or Fisher's Exact). Two-tailed tests used a $P < 0.05$ as statistically significant.

Results: 42 CRNAs participated in the study. Speed at performing CRIC improved between tests, with a mean difference of 9 seconds, but this was not statistically significant ($P = 0.34$). The posttest skill level (GRS) for cricothyrotomy performance was statistically improved compared to pretest GRS. ($P = 0.01$). Successful cricothyrotomy (as determined by correct location and within 3 minutes) was statistically significant between pretest and posttest ($P = 0.05$). SFB technique had more successes than MK technique with respect to correct location and time ($P = 0.02$ and $P = 0.06$). Participant's confidence greatly improved post education ($P = 0.0001$). 97% of respondents were likely to use this module as a refresher for CRIC education in the future.

Discussion: Our study found that a self-education module is effective at significantly improving skill and success of cricothyrotomy within three minutes amongst CRNAs. Between the two techniques, SFB technique was statistically superior in placing an endotracheal tube in the correct location compared to MK technique. However, there was no statistical significance in speed. Improvement in skill and success of CRIC matches literature findings for other airway providers, but the lack of statistical significance in speed does not. This may be due to study design (known technique in pretest vs new technique in posttest). Furthermore, survey results indicated that a self-education model of training is desired amongst CRNAs to maintain competency and confidence on performing an emergency cricothyrotomy. Limitations in the study included its small sample size, equipment failure, and loss of data because of missed video recordings. Lastly, use of low cost, high fidelity models reconfirm literature findings demonstrating their effectiveness in skills training and education.

Funding Sources: Model tissues were self-purchased. The endotracheal tubes, bougies, expired Melker Kits, and 3D CRIC models were donated by the hospital and a relative of one of the researchers.

Assessing Barriers to Early Extubation of Adult Cardiac Surgical Patients

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Background: Adult cardiovascular surgery intensive care unit (CVICU) rapid recovery patients bypass post-anesthesia care unit and arrive directly to CVICU, most often intubated. Prolonged intubation time is associated with increased ICU length of stay, increased cost, and increased morbidity and post-operative complications. The aim of this quality improvement project was to identify barriers to early extubation to be used to improve the extubation process for adult cardiac surgical patients in the postoperative period.

Method: A survey was administered to a multidisciplinary team of CVICU providers, including registered nurses, respiratory therapists, advanced practice providers, and critical care physicians. The aim of the survey was to identify perceptions of current extubation practices at the time that the survey was administered. The survey was designed with the assistance of the Survey Research Center and administered via RedCap.

Results: Survey results revealed that extubation practices were variable in the CVICU practice. The most common perceived barriers to early extubation were postoperative sedation, inconsistent ventilator weaning methods, availability of providers, and hypothermia.

Discussion: The results of the survey demonstrated a need to for improvement in the extubation process for CVICU patients. A multidisciplinary team was comprised and revised an extubation protocol to meet the current practice needs. Literature has supported the use of protocols to standardize care and improve time to extubation in CVICU patients status post cardiac surgery. The extubation protocol will be implemented in the CVICU. Areas for further study include impact of the protocol on extubation times, ICU length of stay, and hospital length of stay.

Funding Sources: Mayo Clinic, Small Grants Program

Comprehensive Evaluation of Day of Surgery Cancellations at an Academic Outpatient Surgery Facility

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Background: Day of surgery (DOS) cancellations are multifactorial and possibly preventable through adequate preparation and communication among key members of the perioperative care experience. DOS cancellations may decrease efficiency, delay surgical care, waste resources, and negatively impact staff morale. Patients often experience re-scheduling challenges related to work, childcare, transportation, and caregiver arrangements. Surgical case preparation requires a complex interaction of multiple clinical processes and patient care activities, with inherent opportunities for performance failure and communication breakdown. Comprehensive quality assessment may be performed by evaluation of the dynamic interactions between structural features and clinical processes within a perioperative department and the observed DOS cancellation outcomes. This Donabedian approach was followed for the purpose of identifying the key drivers influencing the ability to achieve DOS cancellation aims at an academic outpatient surgery facility.

Method: We followed quality improvement recommendations from the Institute for Healthcare Improvement using flowchart, cause and effect diagram, key driver diagram, run chart, and Pareto chart evaluative tools to assess structure, process, and outcomes for the facility. We interviewed twelve key personnel across nine perioperative departments to sequentially map surgical case preparation processes, determine and classify contributing factors to DOS cancellations and aims, and to solicit suggestions for improvement. Process flowcharts and the cause and effect and key driver diagrams were analyzed through process observation, face validation with participants, and discussion among project team members. Reasons for all DOS cancellations for one year prior to the onset of the COVID-19 pandemic were collected via chart review and analyzed by Pareto chart. One-year baseline and ongoing monthly DOS cancellation rates were collected and evaluated through run chart analysis. A process measure and possible change ideas were identified.

Results: Situational and process failures were identified as failure to appropriately refer medically complex patients for preoperative anesthesia consultation, inadequate communication of preoperative instructions, and operating room environment or equipment failures. DOS cancellation measurement errors resulted when surgeons' offices failed to communicate prior cancellations to surgery schedulers. The vital few reasons contributing to the more than 80% of DOS cancellations were patient no shows, non-medically optimized patients, and failure to follow preoperative instructions. DOS cancellation rates were above the goal of 5% or less for eight of the 16 months investigated. Non-random variation was found in the monthly DOS cancellation rates related to the presence of too few runs, a downward trend, and a shift within the data. Two primary key drivers were identified as patient preparedness and patient medically optimized.

Discussion: This evaluation revealed risks for process failures to adequately prepare patients or communicate essential information preoperatively. Additionally, DOS cancellation root causes included poor process standardization across surgical departments and deficiencies in health and social needs assessment. Along with Pareto analysis resulting in primarily patient-related causes, key drivers were therefore determined to be patient preparedness and patient medically optimized as the largest contributors to achievement of the DOS cancellation aim. It was concluded that variability and deficiencies in information-driven processes were most likely to affect the occurrence of DOS cancellations at this facility. Therefore, a useful process measure to continue the quality improvement journey is the percentage of patients with a DOS cancellation reason of not medically optimized who

completed an anesthesia consultation visit. Change ideas and staff suggestions centered around educating and improving communication among perioperative providers and better coordination of preoperative health and social care needs. Workflow redesign and improved standardization of surgical case preparation processes may benefit identified deficiencies. Limitations included information bias risks, contextual factors, and measurement error related to impaired standardization in DOS cancellation reporting.

Creation and Implementation of an Intraoperative Lidocaine Infusion Protocol for Gastric Surgery

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Background: The recent opioid epidemic in the United States has damaged the country's public health system and led to devastating patient outcomes. Healthcare providers are responsible to do their part in reducing these negative consequences. The purpose of this quality improvement project was to develop and implement an evidence-based protocol for an intraoperative lidocaine infusion during gastric surgery. The project consisted of five parts: (1) development of an evidenced-based Intraoperative Lidocaine Infusion Protocol, (2) education of the anesthesia team, (3) collection of baseline data, (4) implementation of the Intraoperative Lidocaine Infusion Protocol and (5) evaluation of the results.
Method: Baseline patient outcome data were collected through chart review on 25 patients of one surgeon, undergoing gastric surgery prior to protocol implementation. Subsequently, education was provided to the anesthesia providers of Kalamazoo Anesthesiology regarding the lidocaine protocol components and associated benefits. After implementation, provider adherence to the protocol was assessed, as well as patient outcomes for those who received all components of the lidocaine protocol. Patient outcome data included intraoperative medications given, time to first bowel sound, time to first bowel movement, Post-Anesthesia Care Unit (PACU) discharge time and hospital discharge time. Pain score, opioid administration, cumulative opioid administration and antiemetic administration were assessed over the following postoperative time intervals: 0 to < 1 hour, 1 to < 4 hours, 4 to < 8 hours, 8 to < 12 hours, and 12 to < 24 hours. Intellectus Statistics was utilized for data computation.
Results: The amount of opioids administered (in morphine milligram equivalents) intraoperatively and postoperatively were lower in those who received the Intraoperative Lidocaine Infusion Protocol. Opioid administration from 12-24 hours postoperatively was 78% lower in the protocol group ($P < .001$). The Intraoperative Lidocaine Infusion Protocol led to a 46% decrease in the average amount of cumulative opioids administered in the first 24 hours postoperatively. There was no significant difference in number of antiemetics administered intraoperatively, postoperative nausea and vomiting or time to first bowel sounds. A significant difference was found in the average time to PACU discharge, measured in hours postoperatively. The pre-protocol group experienced a shorter PACU stay (M = 3.31; SD = 1.88) compared to the protocol group (M = 5.01; SD = 2.47) ($P = .040$). On average, the protocol group was discharged from the hospital approximately 13 hours sooner than the pre-protocol group ($P = .018$).
Discussion: Despite knowledge of current literature and the lidocaine protocol components, anesthesia providers had a low level of adherence to the protocol. Patients who did receive all elements of the protocol demonstrated decreased consumption of opioids in the postoperative period. These results are consistent with several studies included in the literature review. The lidocaine (protocol) group was discharged from the hospital an average of 13 hours earlier than those who did not receive lidocaine. This finding is also represented in several studies. Data findings from this project still indicate that lidocaine infusions could play a role in reducing overall healthcare costs by reducing hospital length of stay. The profession of nursing has a duty to advocate for the health of patients and communities. Nursing interventions that are safe, evidence-based, fiscally responsible, and improve patient outcomes should be adopted by the nursing profession. In the future, projects may choose to explore the efficacy of lidocaine infusions in a variety of surgeries. This could further reduce the use of postoperative opioids on a widespread scale, and thereby reduce the individual and systemic associated consequences.

Developing Airway Skills Remotely: An Innovative Take-Home Lab for SRNAs

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Background: In March of 2020, clinical and in-person education in our Nurse Anesthesia Program (NAP) abruptly stopped due to the COVID-19 pandemic. Classes, skills labs, and simulation transitioned online in three days. Pre-clinical student registered nurse anesthetists (SRNAs) anxiously awaited direction on how they would learn the foundational airway skills typically taught on campus in the weeks leading up to the start of clinical rotations. Pre-pandemic, faculty utilized airway manikins in the classroom to teach intubation, bag-mask ventilation, and placement of laryngeal mask airways (LMAs). Skill acquisition in the simulated environment has been effective in decreasing anxiety while increasing self-confidence. To teach these skills remotely, the NAP faculty designed, implemented, and evaluated an innovative take-home airway lab. This lab's purpose was to afford SRNAs unlimited opportunities to engage in the deliberate practice of airway skills before entering the clinical arena.

Method: The NAP faculty ordered supplies, packaged the airway kits, and arranged a social distancing pick-up (masks mandatory). The kits included an airway manikin, an Ambu bag with mask, laryngoscope handles, Miller 2 and Mac 3 blades, endotracheal tubes with stylets and syringes, LMAs, and endobronchial tubes. Instructional videos were uploaded to the learning management system for students to review before practicing their airway skills at home. Faculty utilized Flipgrid, a video discussion platform, for students to upload videos of themselves performing their skills. The four videos required for the virtual lab were: 1) Bag-mask ventilation and LMA insertion, 2) Basic intubation, 3) Induction scenario, and 4) Open lab- students' choice using anything in their kit. The faculty reviewed the videos and provided performance feedback for students. After IRB approval, students received an electronic evaluation survey via Qualtrics consisting of 12 items, including four open-ended questions. Survey results were reviewed by the NAP faculty.

Results: The virtual lab received over 1,500 views and 86 hours of engagement. Sixteen of the 25 (64%) surveys were returned and 100% of students reported being satisfied or extremely satisfied with their take-home lab. Eighty percent of students practiced skills between 3-7 days weekly during the five weeks they had their kits before entering the clinical arena. Seventy-five percent of students found that unlimited access to airway kits was helpful in developing airway skills and recommend incorporating this lab in non-COVID times. Students commented, "Using the airway supplies was extremely helpful in learning at my own pace. The FlipGrid assignments were great because it made me feel like I needed to practice a lot before getting on 'camera'. The airway lab was helpful in learning the induction sequence and holding/feeling the materials frequently before getting in the clinical arena. It allowed for repeat practice scenarios after clinical days. I loved this take-home lab and hope it continues in the future!"

Discussion: The students reported enjoying their airway kits as they were intubating on their kitchen counters, dining tables, and dressers. Some students even named their manikins and taught family members their newly developed skills. Sharing pictures, stories, and videos from students surprisingly served as an unanticipated connection between students and faculty that was missing as the program temporarily moved to an online format. Limitations for this novel lab included delayed performance feedback by faculty and some students didn't feel comfortable posting videos of their skills for classmates to view. While the remote take-home lab was successful, we recommend 1:1 or small group video sessions to provide real-time feedback. Additionally, implementing near-peer video sessions where experienced students could offer input and advice to the pre-clinical cohort might foster a sense of community in the program. Driven by student feedback, faculty are repurposing the airway manikins for the next cohort despite being on campus for pre-clinical airway skills labs. Faculty hope to transfer

lessons learned from this experience to other skills such as spinal and epidural placement, suturing, and ultrasound training. As healthcare educators continue to navigate teaching and learning in a remote environment, we must rely on creativity and adapt our curriculum to students' needs.

Funding Sources: The NAP faculty would like to thank the Pennsylvania Association of Nurse Anesthetists for their generous simulation gifts to the nurse anesthesia programs in the Commonwealth.

Emergence Delirium Screening in Military Veterans Receiving General Anesthesia: A Quality Improvement Project

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Background: Post-traumatic stress disorder (PTSD) is a mental condition plaguing our nation's military members and veterans. It has increased in prevalence over the past two decades. To date, there is no preoperative screening to predict episodes of emergence delirium (ED) following the delivery of general anesthesia among veterans with PTSD. Two studies reported a high incidence of ED among veterans with PTSD and one large study (1,736 patients) reported that PTSD was an independent predictor of ED even after controlling for preexisting anxiety and depression. The purpose of this project was to modify (Wheat, 2018), implement, and evaluate a screening instrument used by preoperatively to determine the risk for the development of emergence delirium (ED) in patients at high risk for ED about to have general anesthesia.

Method: This quality improvement project used a pre-implementation and post-implementation design. This project reviewed identification of those with a history of PTSD retrospectively dating back three months to depict pre-implementation identification of patients at risk for ED. Postimplementation, prospective data were gathered to test this modified assessment tool to determine if the screening tool identified an increased number of patients at risk for ED.

Results: Pre-implementation data depicted out of 1,579 surgeries done over 3 months, 245 were identified as at risk for emergence delirium based on the diagnosis of PTSD. This gives an identification rate of 15.5%. Post-implementation data depicted out of 391 veterans who completed the tool, 146 veterans screened at risk for emergence delirium. This number gives an identification rate of 37.3%. The data determined that out of the 146 veterans that screened positive 24 had no current or past medical history of PTSD or other mental illness. Based on an average of 1,500 surgeries per quarter, only 25% of those having surgery completed the survey.

Discussion: The survey had an identification rate of 37.3% which is over double the pre-implementation identification rate of 15.5%. The screening tool succeeded at identifying more veterans at risk for emergence delirium after general anesthesia. The average rate of PTSD in the veteran population is estimated at 26%, while the average rate in Vietnam veterans is closer to 40%. The identification rate captured by the screening tool agrees with these statistics. The majority of those completing the tool were between the ages 72-76, putting them in the Vietnam War era. However, the survey was completed by only 25% of those receiving surgery at the facility. Therefore, the survey needs to be completed on every patient having general anesthesia. With better implementation of the pre-screening instrument and an increase in compliance, the tool will be useful to identify those at risk for emergence delirium.

Evaluation of a Cardiac Enhanced Recovery After Surgery Protocol

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Background: Cardiac surgery maintains morbidity and mortality rates higher than other surgical specialties. While this may correlate with illness severity and comorbidities, current literature indicates that perioperative practices may also contribute to worsened patient outcomes. Cardiac ERAS protocols were developed to increase care quality and decrease morbidity and mortality rates after cardiac surgery. The ERAS process is divided into three phases: pre-, intra-, and post-operative. This quality improvement project analyzed interventions in the intra- and post-operative periods. A previous iteration of this project collected data prior to the implementation of a cardiac ERAS protocol, assessing opioid equivalents and multimodal analgesia usage, postoperative pain scores, extubation time, and intensive care unit and hospital length of stay. With a cardiac ERAS protocol now established, data were collected and compared to previous data to evaluate the protocol's efficacy in improving patient outcomes.

Method: A literature review was conducted by searching CINAHL and Embase databases, revealing 18 relevant articles. A retrospective record review was then conducted. Institutional review boards from University of Cincinnati and Kettering Medical Center granted approval. This project was deemed exempt, not meeting the definition of human subject research. One hundred thirty seven patients who underwent cardiac surgery between January and March 2021 were analyzed. Inclusion criteria comprised of surgery date after implementation of cardiac ERAS protocol, elective surgery status, and coronary artery bypass graft without other surgical procedures. Twenty three records met these criteria and were selected. The following data was collected: intra-operative midazolam, morphine equivalent, and ketamine administration; extubation times; post-operative sedation dosage, morphine equivalent administration, and multimodal analgesic usage; pain scores; and intensive care unit and hospital length of stay. This data were compared to the existing data via descriptive statistics.

Results: Intraoperative midazolam and morphine equivalent administration decreased from 4 mg to 2 mg and 81 mg to 77 mg, respectively. Use of intraoperative ketamine increased from 23% to 48%. Extubation time increased from 5 hours to 5.8 hours. Postoperative propofol infusion remained constant with a range of 25-50 μg/kg/min during transport. Postoperative morphine equivalent administration averaged 28 mg at 24 hours and 21 mg at 48 hours, which had not been recorded in the pre-implementation data. Previous data reported postoperative morphine equivalents at 12 hours, averaging 15.8 mg. Use of multimodal agents in the postoperative period increased from 12% to 76%, with agents including acetaminophen, methocarbamol, ketorolac, gabapentin, and tramadol being utilized. Pain scores averaged 4.5 at 24 hours and 2.8 at 48 hours, in comparison to previous data which reported an average pain score of 4.5 at 12 hours. Intensive care unit and hospital length of stay both decreased, from 62 hours to 55 hours and 5.4 days to 5.1 days, respectively.

Discussion: Use of the ERAS protocol resulted in a substantial reduction of intra-operative opioid and midazolam usage. Additionally, there was a significant increase in the utilization of intra- and post-operative administration of multimodal analgesics, such as ketamine, methocarbamol, acetaminophen, gabapentin, and ketorolac. Post-implementation intensive care unit and hospital length of stay were both decreased as well. Minimal changes in post-operative pain scores could be explained by discrepancies in data collection between the pre- and post-intervention data as well as inconsistent charting of pain scores in the post-operative period. Other limitations of this project include the small number of records included for review and inconsistent adherence to the ERAS protocol. The use of

multimodal analgesia adjuncts should be continued in both the intraoperative and postoperative period. We recommend ongoing chart reviews to assess the efficacy of intraoperative multimodal analgesia in reducing pain scores in the postoperative period. Other recommendations include continued provider education, as well as inclusion of nursing and respiratory therapy staff in the intensive care unit regarding the details and benefits of ERAS protocols in order to encourage increased protocol adherence.

Evaluation of Postcesarean Analgesia Management for Patients Receiving Opioid Replacement Therapy

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Background: Cesarean delivery pain contributes to postpartum depression, delayed functional recovery, decreased patient satisfaction, diminished mother-child bonding, and may promote the development of persistent postoperative pain with dependence on opioids. Evidence-based guidelines recommend multimodal analgesia with opioid sparing techniques for postcesarean pain management. However, it is currently unknown if these guidelines meet the analgesic needs of postcesarean patients on opioid replacement therapy (ORT). Broad practice variations exist among anesthesia providers regarding the approach to managing pain in ORT patients. The aim of this project is to assess if there is a need to optimize multimodal analgesia management for ORT patients in order to allow these mothers to experience improved postoperative functional recovery, diminished drug side effects, and minimization of opioid consumption and dependence.

Method: PICO: "In postcesarean patients who receive opioid replacement therapy (P), does implementation of multimodal analgesia guidelines (I) affect surgical pain scores and analgesic medication administration practices (O) compared to postcesarean patients not receiving opioid replacement therapy (C)?" Retrospective chart review of the electronic health record, between October 1, 2019 – November 30, 2020, took place in a level III obstetric unit at a large urban academic medical center. Data collection included postoperative pain scores, perioperative administration of multimodal analgesic medications and opioids, as well as the number and type of prescription opioid analgesic pills on patient discharge prescriptions. Data were stored securely online in a REDCap archive. Consumed opioids were converted to morphine milligram equivalents (MME) for standardization. JMP Pro software was used to analyze for significant differences in pain scores and analgesics utilized, between ORT and non-ORT patients, following cesarean delivery.

Results: A total of 52 patients were included, 30 non-ORT and 22 ORT. Statistical analysis revealed the mean pain scores for the ORT group to be greater than that of the non-ORT group at all selected time intervals: recovery admission, 1, 2, 4, 8, 12, 24, and 48 hours postoperatively. The *t* tests revealed that both the total postoperative opioid MME consumption (98.5 for ORT and 55.3 for non-ORT) and the mean pain score for the first 48 hours postoperatively (5.2 for ORT and 2.8 for non-ORT) were significantly higher in the ORT group. Consumption of postoperative non-opioid analgesics, such as acetaminophen (~ 2500mg average total in 24 hours) and ibuprofen (~ 1800mg average total in 24 hours), was not significantly different between groups. No significant difference was discovered between the means of the opioid prescription sizes at discharge, 155 MME for the ORT group and 165 MME for the non-ORT group. The median discharge prescription size of 157.5 MME was the same for both groups.

Discussion: Patients on ORT report greater pain intensity and consume higher amounts of opioid MME after cesarean delivery. All patients were treated with the same multimodal analgesic guideline and thus scheduled consumption of non-opioid analgesic medications and opioid prescription sizes did not differ between groups. A dearth of scholarly studies have been conducted to compare the analgesic needs of ORT and non-ORT patients; however, few studies have produced results that are commensurate with those of this project. Recommendations suggest maintaining baseline ORT regimens throughout the perioperative period. Combined spinal-epidural anesthesia is preferred to allow for administration of postoperative epidural analgesia. Scheduled oral acetaminophen and ibuprofen should be provided with the addition of analgesic adjuvants as needed in a monitored environment, including gabapentin,

ketamine, and dexmedetomidine. If general anesthesia is necessary, administer a transversus abdominis plane (TAP) or quadratus lumborum (QL) block with catheter placement for intermittent repeat dosing. Implementation of these suggestions with a specific ORT order set and anesthesia provider staff education may optimize care.

Funding Sources: Funding was provided by the Nurse Anesthesia Program of the University of Cincinnati College of Nursing in the amount of $89 to procure the services of the Center for Health Informatics (CHI).

Examining Enhanced Recovery After Surgery (ERAS) Protocol Compliance

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Background: The development of enhanced recovery after surgery (ERAS) protocols have allowed for improved patient outcomes by utilizing a multimodal approach. The use of ERAS for surgical procedures reduces perioperative complications that could lead to increased morbidity, mortality, and length of stay. Additionally, by utilizing a multimodal approach, ERAS protocols help limit opioid use during the perioperative period. The purpose of this quality improvement project was to examine the rate of compliance to the ERAS protocol during colorectal surgery at Beaumont Hospital- Royal Oak. The different levels of compliance were evaluated for their effects on the following patient outcomes: opioid consumption during the postoperative period and hospital length of stay.

Method: A retrospective chart review was conducted on 100 patients who underwent colorectal surgery with the use of an ERAS protocol at Beaumont Hospital- Royal Oak. The chart review focused on 12 specific components of the ERAS protocol in the three perioperative phases (pre-, intra-, and postoperative). A high rate of compliance was defined as greater than 70% of the ERAS components followed, moderate compliance included 40-70% of the ERAS components followed, and low compliance had less than 40% of the ERAS components followed. Based on the literature review, high compliance to the components of the ERAS protocol led to better outcomes. Upon completion of the chart reviews, evaluation of patient outcomes were compared between the three levels of compliance. After obtaining the results and noting where lack of compliance occurred, appropriate and specific education was provided to the perioperative staff. Intellectus Statistics was utilized for data computation.

Results: All components were classified as a high rate of compliance (> 70%), except for consumption of a carbohydrate drink and discontinuation of a Foley catheter on postoperative day 1, which were classified as low and moderate rate of compliance respectively. The total ERAS compliance was 9.83 out of 12 components. Opioid administration was compared by using morphine milliequivalents (MME). The average MME was 49.70 milligrams (mg), and the average hospital length of stay (LOS) was 104.84 hours. A significant negative correlation was found between total ERAS compliance and hospital LOS (rs -0.23, $p < .02$). A significant positive correlation was found between opioid consumption (MME) and hospital LOS (rs 0.48, $P < .001$). Each ERAS component was examined for significant decrease in hospital LOS. A significant decrease in hospital LOS was shown with compliance to Foley catheter removal ($P < .001$) and early mobilization ($P < .014$) by postoperative day 1.

Discussion: The average rate of ERAS compliance was 81%, indicating high compliance. A significant negative correlation existed between ERAS protocol compliance and hospital LOS—as ERAS protocol compliance increased, hospital LOS decreased. This finding is congruent with that of the literature. In addition, as MME increased, hospital LOS increased. This is likely due to the negative effects of opioids, including postoperative nausea and vomiting as well as postoperative ileus. The negative effects of opioids may require a patient to stay in the hospital longer than expected, thereby raising costs that the hospital must absorb. Patients who received ERAS protocol can have a cost savings of up to approximately $7,000. Preoperative component documentation was lacking, resulting in low compliance. It is recommended that an ERAS tab be created in the charting system that allows for easier documentation of the components. The application of ERAS protocols involves implementing best practice evidence from the literature to improve patient outcomes and promote patient satisfaction. Our findings suggest that high ERAS protocol compliance for colorectal surgery leads to a decrease in MME and hospital LOS for patients.

Impact of Guidelines for the Use of High Flow Nasal Cannula by Nurse Anesthetists in the Gastrointestinal Laboratory

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Background: Propofol sedation for patients undergoing procedures in the gastrointestinal (GI) laboratory has become the standard of practice. Propofol can lead to airway obstruction and desaturation in 20% of patients undergoing these procedures. This risk is increased in patients who have a history of obstructive sleep apnea or a body mass index >30. High flow nasal cannula (HFNC) improves oxygenation by washing out the nasopharyngeal dead space which improves alveolar gas exchange. The high flow of oxygen through the nasopharynx can provide positive end expiratory pressure (PEEP) which encourages alveolar recruitment. PEEP generated by the HFNC is flow dependent and statistically significantly (P <0.001). The purpose of this project was to develop guidelines and implement the use of HFNC in the GI lab at UPMC Presbyterian to decrease the number of hypoxic events and airway maneuvers in patients receiving sedation for GI procedures.

Method: Data on the usage of the HFNC, number of airway maneuvers, airway adjuncts utilized, number of adverse events, and guideline criteria met were collected in the post procedure unit on 93 patients following each procedure. Airway maneuvers, hypoxic events, and apnea were compared to baseline data from a previous project at the same site. This project was approved by the QI committee at UPMC Presbyterian. This quality improvement project aimed to create guidelines for the use of HFNC and provide educational interventions such as just in time education for nurse anesthetists to implement the use of HFNC to prevent hypoxia and reduce airway maneuvers in patients in the GI lab. The guidelines were created based on previous studies at the same site, literature review and in collaboration with staff in the GI lab. Just in time education regarding the guidelines and HFNC set up was given to nurse anesthetists and anesthesiologists assigned to GI lab at the beginning of their shift.

Results: There was a statistically significant difference between the pre and post guidelines intervention groups in the number of oral airways utilized (P =0.007) and chin lifts (P =0.045). HFNC is effective at reducing the number of airway obstructions due to propofol sedation requiring intervention. The just in time education was successful as indicated by the provider's satisfaction with the use of HFNC, confidence in their ability to identify patients that meet guideline criteria, and providers significantly following guidelines criteria in patient selection (STOP-BANG ≥5 (P =0.025), OSA (P =0.000), significant cardiac history (P =0.02), BMI (P =0.000), Diabetes (P =0.001)), indicates the just in time education was successful.

Discussion: In the post implementation group there were no statistically significant differences between the HFNC and no HFNC groups in terms of use of airway maneuvers, decreased saturation, or apnea. This indicates that the guidelines for HFNC included the appropriate at-risk patients. This study corroborated findings that HFNC is effective at reducing the number of airway obstructions due to propofol sedation requiring intervention. Additionally, the provider's satisfaction with the use of HFNC, confidence in their ability to implement guideline criteria, and significantly followed guidelines criteria in patient selection indicates the just in time education was successful. This quality improvement project had several limitations such as the convenience of a sample size of scheduled GI patients over three consecutive weekdays and limited to one hospital. Further examination is warranted. Just in time education on the use of HFNC in the GI lab in high-risk patients is an effective method to decrease airway maneuvers.

Implementation of a SAFE Obstetrical Handover for CRNAs

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Background: The United States has the greatest maternal mortality ratio (maternal deaths per 100,000 live births) of all high-resource countries. Many of these deaths could have been prevented by addressing systematic errors that contribute to poor maternal outcomes, such as ineffective communication. Communication issues have been identified in 72% of sentinel events resulting in perinatal death or permanent disability. The SAFE Handover Tool is a standardized mnemonic: Sick patients, At-risk patients, Follow-ups, and Epidurals. Its use during handover significantly increases the percentage of relevant parturients that are discussed and improves provider communication. This study implemented the SAFE Handover Tool for Certified Registered Nurse Anesthetists (CRNAs) in a Level III (Subspecialty) Maternal Care unit. Descriptive, statistical, and content analysis compared PRE- and POST-implementation assessments of handover quality after using the SAFE Handover Tool.
Method: A mixed methodology was used to operationalize handover quality. Likert-type scales compared the current handover and SAFE Handover Tool for: effectiveness in transferring important information, comprehensiveness, propensity for error, and appropriateness. Content analysis examined positive and negative aspects of the handover; suggestions for improvement; and barriers to use.
Results: When compared to the current handover, the SAFE Handover Tool was more effective in transferring important information, comprehensive, and appropriate. Descriptive analysis and paired-samples *t* tests showed large, statistically significant improvements with use of the SAFE Handover Tool. The SAFE Handover Tool was described as useful, identified anesthetically relevant patients, increased communication among CRNAs, improved the handover process, and promoted situational awareness.
Discussion: Enhanced handover quality is associated with improved patient outcomes. The SAFE Handover Tool was subsequently integrated into the hospital obstetrical anesthesia electronic charting system. The SAFE Handover Tool is a novel, low-cost, sustainable method to improve CRNA handovers, communication, and patient safety.

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Implementation of Single-use Anesthesia Circuit Disinfection Guidelines in a Resource-scarce Setting

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Background: Single-use medical devices (SUDs) are reused in both developed and developing countries. In resource-scarce settings, this practice is borne out of necessity. A lack of resources results in this practice occurring without a standardized protocol to reprocess and reuse SUDs. This can contribute to an increased risk of infection and adverse patient outcomes. Anesthesia breathing circuits (ABCs) are among some of the most commonly reused SUDs in resource-scarce settings. The purpose of this quality improvement project was to create and implement evidence-based guidelines on the reuse of single-use ABCs at Lao Friends Hospital for Children (LFHC) in Luang Prabang, Laos. Current practice at LFHC lacks a standardized approach to ABC and anesthesia work area (AWA) disinfection, with reuse of the ABC occurring until it loses its functionality.

Method: An extensive literature search took place using the PubMed, CINAHL, and Embase databases. The identified themes found in the literature included safe reuse of ABCs up to 7 days with filter use, the importance of surface disinfection of both the outer surface of the ABC and AWA, and the impact of protocols for preventing infection. Single-use ABC disinfection guidelines were created based on available evidence, and tailored to fit within the funding and resource capacity of LFHC. The highlights of the guideline include scheduled disinfection of the outer surface of the ABC and AWA, and disposal of the ABC after 7 days or following a known infectious case. The purchase of new ABCs was made possible using funds from a charitable donation intended specifically for the operating theater. Education on guideline use was provided remotely to the three LFHC nurse anesthetists. Compliance to the guidelines and barriers to compliance were assessed via verbal survey at a remote follow-up meeting three weeks following implementation.

Results: The survey included two sections. The first seven questions pertained to guideline compliance, and the last 3 questions pertained to barriers to guideline use. One hundred percent guideline compliance was achieved for nearly every component of the guideline from all 3 participants. The exceptions were due to a lack of new ABCs secondary to shipment and delivery restrictions as a result of the 2019 coronavirus disease (COVID-19) pandemic, and inapplicability of one of the questions to current practice at LFHC. The only identified barrier to compliance was the lack of necessary supplies. No changes to the guidelines were suggested by the participants.

Discussion: Survey results demonstrated that all components of the guidelines, excluding those that were dependent on the arrival of new ABCs, were followed. While extensive literature exists regarding the reuse of ABCs, the setting for this research is in high income countries. Thus, this quality improvement project is unique in that it required the adaptation of existing literature into a setting that required careful consideration regarding available resources. Noted limitations include the lack of supplies necessary for executing a central component of the guidelines, and the inability to be on-site for this project due to the ongoing COVID-19 pandemic. Regardless of limitations, this project lends cautious optimism to the idea that, with careful tailoring and the incorporation of feedback from stakeholders, practice improvement is possible even in the most challenging of settings.

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Improving Cost-Awareness and Likelihood to Consider Costs for Postoperative Nausea and Vomiting in a Military Anesthesia Department

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Background: The Department of Defense (DoD) provides a limited healthcare budget for over nine million service members and their families. Anesthesia departments within the military healthcare system are tasked with providing services to these beneficiaries within budget constraints. However, cost-containment initiatives in military anesthesia may not be as progressive as in civilian-based anesthesia groups and cost information not as readily available. Post-operative nausea and vomiting (PONV) is a common complication of anesthesia that occasionally results in costly sequelae. The costs of medications to treat PONV vary widely and no cost-awareness or likelihood to consider cost evaluations have been performed among military-based anesthesia providers for PONV medications. The purpose of this assessment was to evaluate the impact of an informational presentation on cost-awareness and likelihood to consider costs for PONV medications among military anesthesia providers.

Method: After IRB exemption, an informational presentation describing the costs of PONV medications was given to a single military anesthesia department. Paired, pre- and post-intervention paper surveys were conducted on a convenience sampling of 9 (60%) providers asking them to write in estimates of the acquisition costs of nine PONV medications, and their likelihood (5-point Likert scale) to consider those costs in decision making. Post-intervention surveys were completed 2-4 weeks after the presentation. Surveys were anonymized by a non-investigator. Other studies of cost-awareness asked providers to write in cost estimations and did not provide validity testing. For likelihood to consider cost questions, question stems and Likert rating scales were adapted from a report that provided reliability and validity testing. Cost estimates were converted to absolute percent error ([(estimate-actual cost])/actual cost*100) and frequency of accurate estimations (within 25%) in Microsoft Excel. Wilcoxon signed-rank tests were performed via SPSS.

Results: Overall cost estimation accuracy for the pre- and post-intervention surveys was 10% and 28% respectively. Of the 9 PONV medications, 4 showed significant differences after the informational presentation: aprepitant (*P*=.03), droperidol (*P*=.04), propofol (*P*=.03), and ephedrine (*P*=.008). Likelihood to consider costs also significantly increased after the presentation (*P*=.03).

Discussion: Providers showed poor overall cost-awareness and worse likelihood to consider costs compared to other assessments. Military anesthesia providers may simply not be as cost-aware nor likely to consider costs. However, no anesthesia-specific assessments evaluated PONV medications, and those that assessed likelihood to consider costs were not specific to anesthesia or the military. During our presentation, some providers expressed surprise at the costs of some of the medications and this may account for the improved estimations. For the likelihood component, respondents may have inflated their ratings without their practice reflecting such a change. Alternatively, they may have been more likely to consider costs on account of the presentation. Educational interventions in anesthesia have shown short-lived or no improvement in expenditures. Even though we did not measure actual expenditures, we did detect differences in cost-awareness and likelihood to consider costs after the presentation. However, these impacts are expected to be temporary without consistent focus. This student-led presentation and survey highlighted deficiencies in cost-awareness and likelihood to consider costs in a military anesthesia department. Additional evaluations should delineate military-wide results for all anesthesia medications, and compare the results to civilian anesthesia departments.

Initiation of an Electronic Feedback Tool for Rational Sugammadex Dosing Based on Adjusted Body Weight

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Background: Sugammadex is a gamma cyclodextrin compound that is specifically formulated to encapsulate and inactivate rocuronium for neuromuscular blockade reversal. Sugammadex has been shown to be a superior reversal agent, when compared to neostigmine both in terms of time to complete reversal and side effect profile. The increased drug acquisition cost for sugammadex has been a rate limiting step for its adoption at some hospitals. Through education, the adoption of adjusted body weight (ABW) can be utilized for the dose calculation for safe reversal and extubation. This approach limits excessive consumption of sugammadex vials and offers a cost savings while maintaining quality. This quality improvement project was designed as a response to concern generated for pharmaceutical cost escalation at the outset of introducing sugammadex onto formulary at a major academic medical center.

Method: Sugammadex adoption increased pharmaceutical expenses more dramatically than expected when it was introduced at this major academic medical center. While the providers embraced the safety and efficiency of reversal with sugammadex, financial concerns were quickly realized. Through a literature review about safe dosing of sugammadex, especially in the obese population, the discovery of dosing based on adjusted body weight (ABW) was considered. Upon further review to ensure safety, the adoption of sugammadex dosing based upon ABW was implemented and shared with the anesthesiology providers in the department. Since many trainees rotate in and out on a monthly basis, the decision to follow this up with provider-level feedback when ABW dosing was exceeded was implemented to provide proximal feedback. Once cases were finalized for the day, automated messages were sent to providers. The frequency of dosing above ABW was monitored to determine if an effect was occurring.

Results: Education, followed by proximal feedback by e-mail, on sugammadex dosing based on ABW resulted in a 75% reduction of excessive sugammadex dosing. Excess dosing was defined as greater than 200 mg when ABW was utilized for weight-based calculations. Since the department actively utilizes accelerographic neuromuscular blockade monitors, the ability to ensure adequate reversal, as well as patient safety was maintained as state-of-the-art, which otherwise could have been a concern as residual neuromuscular blockade is nearly impossible to detect outside of quantitative monitors. Annual excess spending, tracking at $278,960 was reduced to $68,508, a 75% cost reduction. The Pharmacy & Therapeutics Committee reviewed this quality-based initiative and found the department's governance surrounding sugammadex utilization to be highly acceptable and worthy of formulary continuance without further restriction.

Discussion: Through the use of a mixed educational and electronic feedback method, the utilization of ABW, based on literature evidence, has provided a successful platform to ensure rational use of sugammadex at a major academic medical center. Innovative new drugs, such as sugammadex, provide an enhanced ability to reverse neuromuscular blockade, but they come at a premium cost. Developing a strategy to monitor and moderate the cost increase can facilitate and ensure the adoption of new agents. The engagement of the entire department as stakeholders in the process generated buy-in, and the feedback messages that were delivered when excess dosing was present kept the quality improvement effort close to top of mind to maintain sustained results over the long term. Leveraging the ability for this feedback loop through the electronic health record to be done in an automated fashion made the maintenance very simplistic. Provider level feedback was often received surrounding

the circumstances of the excess dosing, but since there was no punitive (low-stakes) impact to the message, education continued to be the primary endpoint to direct reversal dosing practices. This effort could easily be replicated at other facilities with similar outcomes. It should be clearly stated that the ability to measure train-of-four ratio provided the appropriate safety net for the utilization of ABW dosing.

Maternal Health Disparities: Risk Factors for Obstetric Hemorrhage During Primary Cesarean Delivery

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Background: In the United States, maternal mortality rates are increasing and Black mothers are twice as likely to die from childbirth-related complications than White mothers. In contrast, global maternal mortality is decreasing. Hemorrhage is the leading cause of maternal morbidity and mortality. Labor and delivery services in the US need quality improvement interventions aimed at improving maternal outcomes, particularly among minority populations. A recent retrospective chart review at a Midwestern metropolitan academic hospital showed that Black mothers had increased risk for morbidity (hemorrhage, preeclampsia, and cesarean delivery) compared to White mothers. This institution used a quality improvement toolkit for identifying and managing obstetric hemorrhage. The current project's goal is to identify risk factors for obstetric hemorrhage during primary cesarean delivery and determine if the existing hemorrhage toolkit is adequate.

Method: We performed a retrospective chart review of 2019 cesarean deliveries at a Midwestern metropolitan academic hospital for women with primary cesarean delivery at ≥ 37 weeks gestation of a non-anomalous fetus in vertex position (N=171). Data extracted from the electronic health records were quantitative blood loss (QBL), indication for cesarean delivery, gravidity, parity, race, age, body mass index, tobacco use, relationship status, zip code, insurance type, primary care provider, and anesthesia type. QBL ≥ 1000 mL was defined as obstetric hemorrhage. Relative risks (RR) with 95% confidence intervals (CI) were calculated to compare risk for obstetric hemorrhage for selected outcome variables.

Results: No maternal variable had significant differences in relative risks to the reference groups for obstetric hemorrhage during primary cesarean section. The sample population had the following mean values: 26.7 years old, BMI 35.1, and QBL 999.8 mL. About a third (38.2%) of the sample had obstetric hemorrhage. Notably, the RR for Black mothers with obstetric hemorrhage was 0.92 (0.61–1.38 95% CI) compared to White mothers. While not statistically significant, the strongest variable for obstetric hemorrhage in our sample was epidural (RR 1.73, CI 0.62 – 4.77) compared to spinal anesthesia.

Discussion: Obstetric hemorrhage is relevant to CRNAs, because CRNAs are an integral part of the interdisciplinary team providing care to parturient patients. In addition to providing neuraxial and general anesthesia for obstetric procedures, CRNAs are responsible for treating hemodynamic instability through the administration of blood products and vasoactive medications during the peri-operative period. Though the finding was not significant, anesthesia type (epidural or spinal) had the largest risk on maternal hemorrhage in our sample. If epidural anesthesia is indeed a relative risk of consequence for maternal hemorrhage, the implications could affect future obstetric care. In our sample, women with epidural anesthesia generally labored before converting to cesarean delivery, while those with spinal anesthesia were generally scheduled cesarean deliveries. In this scenario, prolonged labor time could be a potential relative risk for obstetric hemorrhage, though further investigation is needed. While our negative findings may reflect positive impact of organizational efforts, they also may reflect the potential of a Type II error due to small sample size. In either case, the severity of US maternal morbidity and mortality warrants continued scrutiny, especially in light of health inequities that burden minority populations.

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Reducing the Incidence of Post-operative Pruritus in Cesarean Section Patients with Low Dose Intrathecal Morphine

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Background: Neuraxial anesthesia using a combination of opioid and local anesthetic provides a superior anesthetic and post-operative pain control for obstetric patients undergoing cesarean section (CS). Intrathecal morphine has become the "gold standard" opioid among providers because it reduces the requirements for systemic opioids postoperatively. Despite the long-acting analgesic effects achieved from ITM, several side effects may be encountered including pruritus, nausea and vomiting, hypothermia, urinary retention and respiratory depression. In post-cesarean patients, pruritus is the most common side effect experienced from ITM with a 60-100% occurrence. The goal is to provide adequate postoperative analgesia with the least amount of side effects. This may be achieved with ITM doses of 100 μg or less. The purpose of this project is to promote a change in clinical practice and improve patient outcomes through presenting the evidence of the effectiveness of 100 μg or less of ITM in decreasing pruritus and maintain adequate analgesia.

Method: The project was implemented at two clinical sites. Clinicians at Site A received a survey pre- and post-implementation to evaluate if providers changed their practice and decreased the delivered dose of ITM after educational posters and emails were distributed with the relevant evidence and information. At Site B, educational materials via posters and presentations as well as evidence from previous studies were provided. Providers were asked to give 100 μg or less of ITM for CS cases over a 16-week period and to clearly document the dose. Data were collected from an electronic medical record data mine that assessed CS patients 16 weeks prior to implementation and compared that information to the 16 weeks post-implementation group. Data collected from both groups included: ITM dose, additional post-operative pain medicine administered, pain scores and anti-pruritic medications received.

Results: Results from the surveys provided at clinical Site A revealed a pre-implementation willingness of providers to change their ITM dosing practice to reduce side-effects. The post-implementation survey illustrated an increase in their knowledge base of ITM and a large majority provider practice change of reducing ITM dosing to 100 μg or less. Site B showed providers consistently utilized 100 μg or less with an overall decrease in the treatment of pruritus with no statistically significant increase in pain scores.

Discussion: Survey results showed that the post-implementation change of practice was successful at clinical Site A after the presentation of evidence was disseminated to providers. Data from Site B showed an increase from 17% utilizing 100 mcg or less of ITM to 81% post implementation. There was a decrease in the use of antipruritics, from 35% to 27%, with a decrease in average pain scores from 2.83 on day of surgery (DOS) to 2.13. These results are consistent with those reported, which showed pain scores did not vary significantly between groups receiving 100 μg ITM up to 400 μg, however, mean pruritis scores were statistically significantly lower when ITM doses of 100 μg or less were utilized. Limitations include the use of medications such as partial agonist-antagonists and histamine blockers which are often used to treat pain as well as pruritus, therefore making the resulting numbers in electronic data mining collection open to interpretation. In conclusion, the results of this quality improvement project showed decreasing the dose of ITM to 100 μg or less provides adequate analgesia while also reducing the incidence of pruritus. Further study utilizing patient questionnaires related to pruritus symptoms and pain scores can decrease the ambiguity related to treatment.

Standardization of Ocular Care for the Prevention of Corneal Abrasions in Surgical Patients

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Background: During the perioperative period, the surgical patient is at an increased risk of sustaining an abrasion to the corneal surface due to a variety of factors. The development of ocular surface desiccation from various anesthetic agents, as well as the blunting of normal ocular reflexes while anesthetized, have been shown to contribute to this phenomenon. This particular injury has been demonstrated within the literature to be a significant perioperative event with a rate of 0.13 to 1.51 per 1,000 surgeries. The implementation of a standardized guideline based on the best available evidence in combination with an occlusive dressing for the performance of ocular care during the perioperative period was found to reduce the incidence of corneal abrasions in sample patients who were undergoing thoracic surgery. The outcomes of this study may likely be applied to other surgical populations.

Method: The purpose of this literature search was to determine the best practice recommendations for performance of ocular care in surgical patients. A comprehensive literature review was performed using PubMed and EMBASE with the search terms of corneal injury, corneal abrasion, surgical procedure, and anesthesia. An interdisciplinary work group helped develop the ocular care guideline. After obtaining QIAB approval, the guideline was implemented as a within a thoracic surgical population at a large-volume hospital using the Plan-Do-Study-Act cycle process. The implemented guideline included temporary application of tape after loss of lash reflex. After tracheal intubation, eye care was performed using a methylcellulose-based ocular lubricant and an occlusive eye dressing. Baseline corneal abrasion incidence was reviewed for 12 months prior to implementation. Data collection continued for 3 months after guideline introduction, examining corneal abrasion incidence, guideline compliance, as well as other reported complications.

Results: The literature review demonstrated that the use of an occlusive ocular dressing and a standardized ocular care guideline may reduce corneal abrasion occurrence. The baseline corneal abrasion incidence within this institution was demonstrated to be 0.14%, with a four-fold higher incidence of 0.6% within the thoracic surgical population. For this reason, the thoracic surgical population was selected for the study. The incidence of corneal abrasions in the thoracic surgical population decreased from 0.6% to 0% in cases where the guideline was utilized. Anesthesia provider compliance with guideline implementation was high, with a 90% rate of use within the project cohort. No evidence of ocular complications were noted, however, the rate of minor periorbital skin complications (eg, petechiae, skin tear) approached 1%, with an incidence of 0.97%.

Discussion: The results demonstrate that the use of an evidence-based, standardized ocular care guideline in combination with an occlusive ocular dressing within the thoracic surgical patient population may be effective at reducing the incidence of perioperative corneal abrasions. The study shows that standardizing the highly variable methods of ocular care among anesthesia providers may be beneficial. The occlusive nature of an ocular dressing may help prevent inadvertent eyelid opening to a superior degree than tape alone. Monitoring for an increase in skin complications related to the use of this dressing is prudent based on project results. High levels of compliance demonstrate the possible ease of reproducibility across a variety of surgical populations and facilities. Provider adherence to the ocular guideline was not directly observed, but was based on self-reporting, making this a significant limitation for the project. Additionally, the occurrence of corneal abrasions is a low frequency event, therefore a longer collection period may have provided the opportunity to evaluate the intervention with more data. The project results align with existing literature, supporting the standardization of ocular care and use of an occlusive eye dressing. Further study should include examining data over a

longer period of time, as well as direct observation of ocular care provision.

The Effectiveness of Magnesium Sulfate Intraoperatively on Reducing Postoperative Pain

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Background: Magnesium's nociceptive properties include inhibition of calcium ion transmission thereby blocking the *N*-methyl-*D*-asparate (NMDA) receptors, alongside mu receptors of which narcotics are specifically antagonized by opioids. A critical appraisal was conducted on 8 randomized clinical trials which looked at the effectiveness of bolus only, infusion only, and a combination of a bolus and infusion of magnesium sulfate. The results of these studies found that in the four studies in which patients received a magnesium bolus followed by an infusion, there were lower pain scores and an overall reduction in mg morphine equivalents (ME) that was statistically significant compared to the bolus only patients. The purpose of the project was to describe the evidence on the effectiveness of intra-operative intravenous magnesium sulfate administered to patients undergoing gynecologic surgical procedures at reducing post-operative pain.

Method: A presentation was given to the entire anesthesia department demonstrating the effectiveness of magnesium infusions at reducing postoperative pain. Following the presentation, a practice change was implemented in which eligible gynecologic surgical patients received a 30 mg/kg bolus via an IV pump upon arrival to the operating room, and then a 10 mg/kg/hr infusion of intraoperative magnesium sulfate ran throughout the case until emergence began. Upon completion of the procedure, Visual or Verbal Analogue Scores (VAS) were assessed for up to 24 hours in the PACU and during their hospital admission, when admitted. Total amount of narcotic administered for up to 24 hours was assessed as per the VAS criteria. All narcotic types administered were converted to morphine equivalents (ME). Correlation and variances were assessed between the two variable groups. Independent two sample *t* tests were used assuming equal variances and two tails to assess the potential differences between pre and post intervention variables.

Results: Intraoperative usage of magnesium among providers increased significantly (pre 3.8%, post 52.5%), yet there was no correlation with magnesium usage and VAS scores or post-operative narcotic usage. A significant association between magnesium administration and post-operative narcotic usage was not found through the change in practice. Average PACU morphine equivalents (ME) received by patients decreased from 10.24 ME pre intervention to 8.42 post intervention. This was not a statistically significant change (*P*=.3). A slight increase in post intervention 24-hour ME was found, increasing from 31.89 to 32.75, although not statistically significant. The median VAS score during hospital length of stay was 4.418 for the magnesium group, and 3.186 for the control group. In summary, there was no difference pre vs post intervention in VAS or ME. Likewise, there was no correlation with mag dosage and ME consumption or VAS scores.

Discussion: The practice change was successful. The percentage of eligible patients receiving magnesium pre intervention was 3.8% while after intervention it was 52.5%. Mean magnesium dose before intervention was 0.149 grams while afterwards it was 2.125 grams. However, a significant association between magnesium administration and post-operative opioid usage was not found. There was not significant Pearson's correlations between Magnesium and VAS scores at 30 minutes, 4 hours, 8 hours, 12 hours, or 24 hours. There was weak inverse correlation at 30 minutes (r = -0.015) and 12 hours (r = -0.062) but weak positive correlation at 4 hours (r = 0.05), 8 hours (r = 0.125), 24 hours (r = 0.08). There was also weak positive correlation when adding the sum of the 30 minute, 4, 8, 12, and 24 hours VAS scores together (r = 0.03). Due to the fact that some correlations were positive and some negative, it is hard to argue that simply enlarging the sample size would alter the result. Isolating the sample to

just hysterectomies and excluding patients on other non-narcotic modalities such as ketamine, dexmedetomidine, and lidocaine infusions may have allowed a better measurement of the effects of magnesium. The implementation of magnesium was very successful and could be used as a model for other locations. However, data collection and case inclusion for ME and VAS scores would need to be reevaluated.

Therapeutic Inhaled Essential Oils (TIEO) on Preoperative Anxiety in ERAS Gynecological Surgery

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Background: Preoperative anxiety is a negative symptom frequently experienced by surgical patients. Aside from administering benzodiazepine medications, there are no routinely used alternative treatment methods for anxiety in the preoperative area. This project evaluated the effectiveness of therapeutic inhaled essential oils (TIEO) on anxiety levels during the preoperative phase of surgery in Early Recovery After Surgery (ERAS) gynecological patients ages 18 to 65 years old. The use of TIEO aligns with ERAS guideline goals to improve surgical outcomes. Decreasing anxiety in the preoperative period may lead to many perioperative benefits such as improving surgical outcomes, patient satisfaction, and quality of care.

Method: A prospective, pre-posttest, quasi-experimental design was used to evaluate preoperative anxiety scores. Patients (N = 53) scheduled for gynecological surgeries were enrolled at a level II trauma center. Upon arrival to the preoperative area on the day of surgery, patients were asked to score their anxiety level using a 100 mm Visual Analog Scale for Anxiety (VAS-A). Patients were provided the TIEO intervention during their perioperative phase of surgery ranging from 15 to 60 minutes. Patients were encouraged to take mindful deep breaths and inhale the essential oil vapor. Before being transported into the operating room, patients were asked to re-evaluate their anxiety level using the VAS-A.

Results: A matched paired *t* test revealed the post-VAS-A measurements were significantly lower (n = 52, M = 31.37, SD = 24.334) than the pre-VAS-A measurements (n = 52, M = 53.50, SD = 26.863), t51 = 8.756, *P* = .000). On average, post-anxiety scores were 22.135 mm lower than pre-anxiety scores (95% CI [17.060, 27.209]).

Discussion: This project demonstrated decreased preoperative anxiety scores after using the TIEO intervention. The population in this project included a wide range of adult of women ages 18 to 65 of different races undergoing gynecologic surgery for both malignant and non-malignant diagnoses. The pre-and-post VAS-A scores revealed a statistically significant decrease in anxiety levels in women undergoing ERAS gynecological surgeries after utilizing TIEO in the preoperative area (*P* = 0.000). The TIEO intervention was found to be beneficial in decreasing anxiety scores by a mean of 22.135 mm on the VAS-A. No negative or adverse outcomes occurred during the project. The patients enjoyed having the additional option to help manage their anxiety while waiting for their surgery during the COVID-19 pandemic. The TIEO intervention was appropriate for and successfully used within the preoperative environment before surgery. TIEO can be utilized as an adjunct intervention to manage preoperative anxiety. Decreasing anxiety in the preoperative period may lead to many perioperative benefits such as improving surgical outcomes, patient satisfaction, and quality of care.

Funding Sources: STILL intervention donated by Soothing Scents, LLC.

Ultrasound (US) Training Course for Radial Artery Cannulation for Certified Registered Nurse Anesthetists (CRNAs)

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Background: Ultrasound (US) technology is becoming more prevalent and is an important tool in delivering safer care in anesthesia. The use of US for radial artery cannulation correlates with increased safety and decreased complications. US is a user-dependent and unique skill that requires training and experience to become proficient. Operator experience with US plays an important role in improving the first attempt success rate. Furthermore, findings indicate that there is no benefit of using US guidance when users are inexperienced and lack training. In 2013, COA implemented US requirement in the nurse anesthesia curriculum, which indicates that CRNAs who graduated prior to 2013 may not have received formal education and training on US, unless provided by employer or sought by the individual. The purpose of this project is to develop a training module on US guided radial arterial cannulation to provide CRNAs with an opportunity to develop foundational skills in US guided radial artery cannulation.
Method: Implementation included a voiceover PowerPoint that was uploaded to Panopto screencast software and an anonymous secure post-evaluation survey for CRNAs to vet the module. Data for this project were collected and analyzed by simple statistics. The link to the training course and the post-evaluation survey was distributed to 121 CRNAs at a southeast academic medical center. The PowerPoint included a synthesis of the literature on the use of US, the basics of US, a step-by-step procedure for US guided radial arterial cannulation, and a skill demonstration video. The skill demonstration video was created using an US machine and arterial line task trainer. It began with step-by-step instructions for US guided radial arterial cannulation and progressed to include both in-plane and out-of-plane approaches.
Results: Fifteen CRNAs (12.4%) completed the survey. Of those, 73% (n=11) had 10+ years of experience, 13.3%(n=2) had 5-10 years and 13.3 % (n=2) 2-5 years. 20% (n=3) of CRNAs received US training in their CRNA program and 13.3 %(n=2) CRNAs attended a program that focused on US outside of their initial anesthesia program. The survey asked how likely they were to utilize US for arterial cannulation, 46.7% (n=7) answered very likely, 26.7% (n=4) likely, 6.7% (n=1) neutral, 13.3% (n=2) unlikely, and 6.7% (n=1) very unlikely. When asked to rate confidence level in using US for arterial cannulation, 73.3% (n=11) felt very confident, confident, or somewhat confident, while 26.7 % (n=4) reported not very confident. When asked to rate the effectiveness of the 3 section of the training course, 53.3% found the US basics section extremely effective, 53.3% found the procedure section extremely effective, and 33.3% found the demonstration video extremely effective. 100% (n=15) of CRNAs answered Yes to recommending the course to a colleague.
Discussion: Based on the survey results, out of the 73.3% (n=11) of CRNAs with 10 + years of experience only one had received US training in their CRNA program. The two CRNAs with 2-5 years of experience had received US training in the initial nurse anesthesia program. This finding supports the lack of US incorporation as a part of the CRNA program for CRNAs who graduated prior to 2013. The CRNAs with 2-5 years of experience who had received training reported that they felt confident to very confident and would be very likely to use US for arterial cannulation, while those with 5-10+ years who had not received training initially reported that they were not very confident in using US and unlikely to use US for arterial cannulation. This project was limited by a small sample size and the inability to offer a hands-on session due to COVID-19 restrictions. This change to the implementation process created a time constraint, which may have decreased CRNA participation. In the future, pairing the PowerPoint module with a hands-on session will provide CRNAs an opportunity to develop foundational skills in US

guided arterial cannulation to increase their proficiency with US. Furthermore, US skills can be utilized in other invasive procedures. This will further support CRNA practice in the clinical arena.

Ultrasound Guided Central Venous Catheter Placement for Nurse Practitioner Students

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Background: As patient acuity continues to rise in the United States, so does the need for critical care services. It is increasingly common for patients in critical condition to require a central venous catheter (CVC) for monitoring and/or medication administration, with more than 5 million CVCs placed each year in the United States. Although the complication rate associated with CVC placement is considered relatively low, placement-related errors can have disastrous results causing there to be great concern regarding proper training of clinicians charged with CVC placement. The concern is warranted, as arterial cannulation can have a mortality rate as high as 36 percent making it imperative clinicians are properly trained in an effort to avoid such complications. The purpose of this project was to determine whether providing adult-gerontology nurse practitioner students an immersive educational experience improved student knowledge, skill, and comfort levels with ultrasound-guided CVC placement.

Method: Prior to implementation, students completed a survey exploring past experience with using ultrasound, assessed baseline knowledge of ultrasound techniques, and solicited self-reported skill and confidence levels pertaining to ultrasound-guided CVC placement. All students then received an hour-long educational presentation specifically reviewing key components of ultrasound-guided CVC placement. The educational presentation was followed by small group hands-on sessions in the simulation lab that allowed the students to practice placing CVCs with the use of ultrasound. Upon completing the hands-on session, students completed a second survey that included the same Likert scale as the pre-implementation survey to determine the impact of the educational experience. The second survey again assessed student knowledge regarding ultrasound-guided CVC placement to determine whether students scores improved after the immersive educational experience.

Results: Prior to the simulation experience, 40% of the nurse practitioner students had never utilized an ultrasound machine despite a majority of the students (42.4%) having 4 to 6 years of nursing experience. In regards to central venous catheter insertion experience, the highest percentage of students (33.3%) reported to have never inserted or assisted with insertion of central venous catheter. Data regarding foundational knowledge and confidence with ultrasound-guided CVC placement were analyzed using a paired *t* test. Data analysis demonstrated statically significant improvements to self-perceived knowledge ($P<.001$), self-perceived skill ($P<.001$), and self-perceived comfort levels ($P<.001$). Student assessment scores following the presentation and simulation experience improved as well, with the average knowledge assessment score increasing by 14%.

Discussion: Providing adult-gerontology nurse practitioner students an immersive educational experience pertaining to ultrasound-guided central line placement fosters improved knowledge comprehension and acquirement of skills. Not only did student knowledge increase, confidence in ultrasound-guided CVC placement techniques improved after the educational presentation and attending the simulation session. The results of this evidence-based quality improvement project demonstrate that the addition of hands-on simulation-based training to traditional classroom education is perceived as being beneficial from the student perspective. This project did have some limitations. It is recognized that sample for this implementation was small, with only 30 students total participating. Additional studies with larger sample sizes would be beneficial to ensure more accurate and precise mean values and the greater ability to identify outliers. It is also important to note that the values reported were obtained from self-assessment and cannot be used as a surrogate to determine a definitive increase in student competency. Nonetheless this project allowed students a safe and

constructive environment to practice key clinical skills in order to build confidence and knowledge. Instituting this immersive education into students' core curriculum would create more confident and better prepared practitioners.

Case Report

Anesthetic Management of a Patient with Hereditary Coproporphyria

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Introduction: The anesthetic management of a patient with hereditary coproporphyria (HCP) is complicated because many anesthetic drugs have the potential to induce an acute attack of porphyria. Acute attacks of HCP exhibit a wide variety of metabolic defects that may result in life-threatening reactions, such as severe autonomic dysfunction and blood pressure lability. The anesthesia provider must be aware of concomitant triggers, as well appropriate treatment of a porphyric crisis. Because anesthetic-linked porphyric crises are understudied, a lack of agreement on triggering anesthetic agents dominates literature although there is unanimity among commonly administered drugs such as barbiturates, etomidate, and ketamine.

Case Presentation: The case involved a 63-year-old male with a diagnosis of a right intracranial glioblastoma undergoing a right parietal temporal craniotomy for a tumor resection under general endotracheal anesthesia. The patient's symptoms in the intensive care unit were altered mental status, left-sided weakness, slurred speech, seizures, and combativeness. The patient's past medical history included coronary artery disease, carotid stenosis, history of tobacco use, gastroparesis, pemphigus vulgaris, schizophrenia, and HCP. The patient's past surgical history included cataract surgery and heart catheterization. The patient's previous anesthetics were noted as uneventful. After a thorough preoperative workup, the patient was brought to the OR, vitals were obtained, and a standard general anesthetic induction was performed. An airway was secured, and isoflurane was dialed in at ~0.5 MAC. The surgery was uneventful, and the patient was transported back to the neuro ICU post operatively where he remained intubated overnight in order to avoid increased intracranial pressures. The patient did not have any porphyrinogenic-related reactions to any anesthetic agents administered intraoperatively. The unique concerning issue was managing the patient's anesthetic despite his underlying history of HCP, which is associated with severe anesthetic risks.

Discussion: HCP is an inborn error of metabolism that causes accumulation of porphyrins and porphyrin precursors that can potentially lead to neurotoxicity and acute crisis with introduction of a triggering agent. Many anesthetic drugs have been labeled porphyrinogenic, therefore safe anesthetic management of patients with HCP demands understanding of the disease process. Although most of the current clinical reports are anecdotal and/or outdated, there is consensus that unsafe agents include: barbiturates, ketamine, and etomidate; and safe agents include: propofol, nitrous oxide, volatile agents, all neuromuscular blocking agents, all reversal agents, commonly used narcotics, antiemetics (excluding metoclopramide), and sedatives. Further investigation of anesthetic management of the patient with HCP is indicated, given that most current clinical reports are anecdotal and/or outdated. The anesthesia provider should refer to the American Porphyria Foundation website for the most up-to-date information on porphyria and up-to-date drug databases for healthcare professionals caring for porphyria patients.

Anesthesia Considerations for Leadless Pacemakers

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Introduction: Leadless ventricular pacemakers are a fairly novel technology. The miniaturized pacemaker, which is 93% smaller than conventional pacemakers, is delivered to the heart in a transcatheter approach through the right femoral vein and implanted directly to the right ventricle with four tines. It is a self-contained generator and electrode system that does not require chest incision or subcutaneous generator pocket. The leadless technology is intended to avoid complications such as lead fracture and generator pocket infection that can occur with traditional pacemakers. Anesthesia professionals need to be familiar with the device, how it is inserted, what anesthetic technique they may utilize during implantation, as well as anesthesia considerations for patients with leadless pacemakers presenting for other procedures. These devices are currently suitable for approximately 15% - 30% of patients in Western countries.

Case Presentation: An 85-year-old male presented for insertion of leadless pacemaker under monitored anesthesia care. The patient had multiple comorbidities, including meningioma, seizures, COPD, GERD, renal carcinoma s/p left nephrectomy, HTN, sinus rhythm with 1st degree atrio-ventricular block, Right bundle brunch block, Left anterior fascicular block, and bifascicular block. The patient had undergone craniotomy and resection of meningioma three days earlier. Postoperatively, he had an episode of paroxysmal complete heart block and a decision for implantation of permanent pacemaker implantation was made. The patient's pre-procedure vital signs were: blood pressure, 136/65 mmHg; heart rate, 72 bpm; respirations, 18 bpm; pulse oximetry, 95% on room air; temperature 97.6° F. Patient was positioned supine, standard anesthesia monitors applied and external defibrillator/pacemaker pads were placed. Oxygen was delivered at 6 L/min via simple facemask with capnography monitoring. Dexmedetomidine 35 µg bolus was given over 10 min, followed by infusion at 0.5 µg/kg/hr. The patient received fentanyl 10-20 µg boluses throughout the case, totaling 70 µg. He received a one-time bolus of propofol 30 mg, 1 gram of vancomycin, and 250 mL of lactated Ringer's. The was procedure lasted approximately 2.5 hours with successful implantation of the device. The patient remained stable and was transported back to ICU.

Discussion: The first leadless pacemaker (Micra [Medtronic PLC; Minneapolis, MN]) has been approved by the US Food and Drug Administration (FDA) for use in the US in 2016 as single-chamber pacemaker. In January 2020 FDA approved Micra AV for patients needing dual-chamber pacing. Anesthesia professionals need to understand the purpose of the device, how it is inserted, what anesthetic technique they may utilize during implantation, and other implications of the device, especially if a patient with a prior implanted leadless pacemaker presents for another procedure. Indications include chronic atrial fibrillation with AV block, complete AV block with a low level of physical activity, and sinus node dysfunction. The implantation may be done under local anesthesia, MAC, or general anesthesia. The presented case utilized MAC for implantation. There are several considerations for patients with leadless pacemakers undergoing subsequent procedures. The intracardiac location and absence of hall sensor make it so that reprogramming cannot be achieved with a magnet prior to or during surgery. The risk of electromagnetic interference (EMI) should be determined and preoperative asynchronous programming should be considered. The Micra leadless pacemaker is FDA approved for 1.5T and 3T magnetic resonance imaging. Battery life is 5-12 years. At the end of battery life the device can be turned off and a new leadless or a traditional pacemaker may be implanted. Studies revealed 71% reduction in complications compared to standard pacemakers such as, surgical pocket infections, hematomas, and lead fracture or dislodgment. Complications may occur related to femoral vein access

and cardiac perforation and pericardial effusion.

Decreased Pulse Oximetry Readings in Asymptomatic Patient with Hemoglobin Grifton

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Introduction: Hemoglobin Grifton presents as a decreased oxygen saturation as measured by pulse oximetry (SpO_2) reading despite a normal arterial oxygen saturation (SaO_2) in an asymptomatic patient. Hemoglobin Grifton is caused by a mutation on an alpha chain of hemoglobin at codon 87, which affects the absorption wavelength of its oxyhemoglobin. A standard pulse oximeter is designed to measure the absorption of light at specific wavelengths and perceives the hemoglobin Grifton oxyhemoglobin as a deoxyhemoglobin. In a patient with a known variant hemoglobin, ordering additional diagnostic or therapeutic testing can increase stress for a patient requiring routine medical interventions or emergencies. Careful evaluation of each individual case is warranted prior to proceeding with an anesthetic.

Case Presentation: The case involved a 5-year-old female requiring general anesthesia for a foreign object removal in the ear. Because of the known history of hemoglobin Grifton and the brevity of the procedure, general anesthesia via mask induction was used. During the preanesthetic evaluation, the patient was becoming stressed and agitated. SpO_2 monitoring preoperatively was 84%. The patient's pulse oximeter reading when she entered the room was 85%. The patient's color appeared pink, she had a capillary refill of less than 2 seconds, and she had a normal ventilatory pattern without signs or symptoms of respiratory distress. Oxygen was administered between 30-90% FiO_2 and her SpO_2 ranged from 84%-87%. The patient's SpO_2 did not change with the addition of supplemental oxygen. The patient tolerated the anesthetic well and her baseline SpO_2 was maintained in the perioperative period.

Discussion: Previous case studies reported variant hemoglobinopathies, specifically on the alpha chain, that produce a false low SpO_2 reading. In these case studies, the arterial blood gas resulted in normal oxygen saturation. Another case study reported that the issue with hemoglobin Grifton was the oxyhemoglobin Grifton absorbed light at approximately 740 nm. The light absorption on normal oxyhemoglobin is at a wavelength of 940 nm. Because of this, the hemoglobin Grifton is detected by the pulse oximeter monitor as deoxyhemoglobin. Standard transcutaneous pulse oximeters do not consider the different absorbance spectra of variant hemoglobinopathies where the oxyhemoglobins may be absorbed at lower spectrums. In all the literature reviewed, patients experienced a myriad of unnecessary diagnostic tests to figure out the cause of the hypoxia. Some patients were even prescribed treatment based on this false hypoxia. This results in unnecessary additional expenses for treatment and can also cause stress for patients. The patient in this case study presented with a baseline SpO_2 of 84% with a known diagnosis of hemoglobin Grifton. The surgeon was unable to do this procedure in the clinic due to the child's agitated behavior and general anesthesia was required. The decision was made to forgo invasive testing due to her known condition and the unnecessary stress it would add to the patient. Hemoglobin Grifton is a hemoglobinopathy caused by a mutation on the alpha chain of the hemoglobin molecule which affects the wavelength at which the oxyhemoglobin is absorbed. The mutation causes a false low SpO_2 reading yet the hemoglobin molecule has normal function with oxygen transport to tissues.

Excessive Dynamic Airway Collapse Resulting in Negative Pressure Pulmonary Edema in an Obese Patient

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Introduction: Negative pressure pulmonary edema (NPPE) is a life-threatening complication affecting 0.05% to 0.1% of anesthetics. It has a multifactorial pathogenesis and is classified as Type I and Type II. Type I NPPE occurs from an acute airway obstruction, whereas, Type II NPPE develops after relieving a chronic airway obstruction. Type I NPPE is well recognized among adult surgical patients, in which 50% of cases were attributed to laryngospasm, an inspiratory airway obstruction. Expiratory airway obstruction can also produce pulmonary edema but is not well reported. Excessive airway dynamic collapse (EDAC) occurs when the posterior tracheal wall bulges anteriorly during expiration, narrowing the lumen by more than 50%. EDAC is usually asymptomatic and may unfold in general anesthesia, where increased intrathoracic pressure from coughing produces a complete obstruction. This case report will highlight NPPE secondary to EDAC in an obese patient to promote early detection, and timely treatment of this under recognized complication.

Case Presentation: A 47-year-old female, diagnosed with stage IIa endometrial cancer, was scheduled for a hysterectomy. Her medical history includes morbid obesity, obstructive sleep apnea, hypertension, and hypothyroidism. A post-induction vaginal exam revealed a large friable tumor prolapsing through the cervix. The surgery was aborted, and radiation oncology was consulted for treatment options. The patient was placed in high fowler's position and the neuromuscular blockade was reversed for emergence. She was extubated after following commands and her oropharyngeal secretions were cleared. The patient immediately developed respiratory distress with excessive coughing, oxygen desaturation, and pink frothy secretions. Auscultation of lung sounds detected bilateral coarse crackles. With a preliminary diagnosis of NPPE, furosemide 10 mg and hydrocortisone 100 mg were administered and BiPAP was initiated. The patient was transported to the intensive care unit, at which a chest radiograph revealed extensive bilateral opacities, confirming NPPE. An echocardiogram was negative for cardiac abnormalities. A computed tomography (CT) scan demonstrated marked collapse of the posterior tracheal wall during expiration and no evidence for pulmonary embolism. The patient was weaned off BIPAP to high-flow nasal cannula after 24 hours. She was discharged on postoperative day five after tolerating room air.

Discussion: Advances in bronchoscopy and CT have improved the diagnosis of EDAC. EDAC may be caused by chronic airway irritation and extrathoracic compression, commonly seen in OSA and morbid obesity. The patient's risk was amplified by general anesthesia effects such as airway reactivity from intubation, atelectasis, and reduced functional residual capacity. Her excessive coughing caused a complete expiratory obstruction. The elevated intrathoracic pressure from exhaling against a closed airway will create intrinsic positive end expiratory pressure and reduce venous return. The decrease in intrathoracic pressure during inspiration will increase venous return and right ventricular filling. The septum will shift to the left to impede left ventricular filling and cardiac output, leading to pulmonary congestion. Elevated intrathoracic pressure will compress pulmonary vessels, which increases vascular resistance and damages the alveolar-capillary membrane. Both mechanisms shift fluid from the pulmonary capillaries into the interstitial space. Diuretics and steroids can limit edema and vascular injury. EDAC treatment is based on the severity of collapse. Non-invasive positive pressure ventilation improves expiratory flow and airway patency by acting as a pneumatic stent. It also treats NPPE by reducing the work of breathing, improving alveolar recruitment, and cardiac output. EDAC can be treated with high flow nasal oxygen therapy, as it applies positive pressure and reduces airway

resistance. Therapeutic interventions include stent placement, tracheostomy, or tracheoplasty. EDAC is an under reported cause for NPPE. Identifying risk factors and learning treatment modalities will facilitate early detection and timely resolution.

Patient with Congenital Insensitivity to Pain

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Introduction: This is a case report of a 9-year-old patient presenting for an orthopedic procedure with a history of congenital insensitivity to pain with anhidrosis (CIPA) and a genetic mutation that causes a loss-of-function in a type of voltage gated sodium channel that leads to inability of nociceptors to respond to tissue trauma or inflammation. It is an autosomal recessive genetic mutation that can autonomic dysfunction, alterations in pain processing, unexplained fever, and anhidrosis. Signs of this disorder are first recognized in childhood as lack of pain with injuries and procedures, tooth eruption can cause lip, gum, and tongue injuries, self-mutilation, and families have been suspected of child abuse due to unexplained injuries. Long term damage to joints and blindness from untreated corneal abrasions can occur as well.

Case Presentation: A 9-year-old female presented for right knee hardware removal with medical history of CIPA, bilateral osteochondritis, bilateral genu valgum, right clavicle fracture, and cataract of the left eye. Per the patient's father, she did not experience pain with noxious stimuli or injury rather she described it as a "funny" feeling. Prior to the surgical decision to remove old hardware, the patient had been limping and walking differently. The patient received a standard pediatric inhalational induction, one peripheral IV, and was intubated uneventfully. She was maintained on sevoflurane 1.7% and 1 µg/kg of fentanyl was given prior to incision. There was no evidence of reaction to surgical stimulation and no analgesics were administered postoperatively prior to discharge to home.

Discussion: According to the literature, specific anesthetic considerations for CIPA patients include their innate pain modulation lending to significantly decreased, possibly non-existent, opioid requirement and potential autonomic nervous system dysfunction. These patients may be at an increased risk for aspiration, temperature disruptions, and hemodynamic instability, specifically bradycardia. The literature recommended potentially treating these patients as if they have a full stomach and monitoring core temperature. Anesthesia providers should carefully monitor for hypotension and bradycardia. Studies are being performed to develop an analgesic targeted at the specific voltage-gated sodium channel affected by CIP and a study in rats indicates that a treatment for inflammatory bowel disease could arise from gene modification of SCN9A.