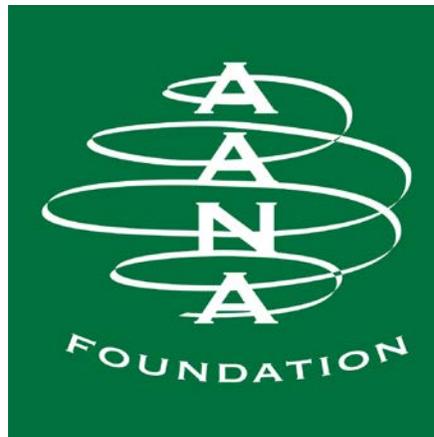


2016 Poster Abstracts



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2016 Poster Abstracts

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A1

Anesthesia Emergence Phenomena in Military Patients: An Instrument Development Study

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Introduction: Patients with combat exposure emerge from general anesthesia in a confused, agitated, angry, verbal, and combative manner. Some military patients experience flashbacks to combat. These behaviors place patients and their caregivers at risk for serious injury. Emergence phenomenon in military patients appears fundamentally different from emergence delirium exhibited by adult civilian patients. No validated and reliable instrument exists to measure emergence phenomenon in military patients and quantify its severity, which limits the clinicians' ability to interpret and use existing data and results for evidence-based clinical interventions.

Methods: The study was a mixed-method design with 2 expert panels that utilized the Delphi technique and structured interviews to generate and validate instrument content.

Results: Three rounds of the Delphi technique achieved a convergence of opinion on 68 characteristics. Existing instruments do not capture the military specific characteristics, such as flashbacks to combat or reliving battlefield experiences. A second expert panel validated the content. The research team produced an instrument with 5 categories to score on a 0 to 5 Likert scale.

Conclusions: Future use of the instrument will provide accurate, valid, and reliable data, thereby promoting interventional studies to prevent and treat the emergence phenomenon in the military patient.

Source of Funding: TriService Nursing Research Program. USU Grant No. HT9404-13-1-TS01.USU Project No. N13-002.

A2

Comparison of Tibial Intraosseous and Intravenous Administration of Albumin on Infusion Time and Hemodynamics in a Hypovolemic Swine Model

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Introduction: Resuscitation during hemorrhagic shock is dependent on vascular access. Obtaining intravenous (IV) access in patients in hemorrhagic shock is often difficult, and failed attempts delay administration of life-saving treatment. Intraosseous (IO) access can often be obtained faster than IV access. Albumin is an attractive volume expander because of the absence of coagulopathy and inflammation often associated with crystalloids and artificial colloids. The aim of this study was to compare the effects of tibial IO and IV administration of albumin on infusion time and hemodynamic parameters.

Methods: Sixteen male swine were divided into 2 groups: tibial IO and IV. All subjects were anesthetized and a class III hemorrhage was achieved by exsanguination of 31% of blood volume from a femoral artery catheter. Immediately following exsanguination, 500 mL of albumin was administered via the tibial IO or the IV route and infusion time was recorded. Hemodynamic measurements including mean arterial pressure (MAP), cardiac output (CO), heart rate (HR), and stroke volume (SV) were collected before and after exsanguination and every 20 seconds for 180 seconds during the albumin infusion.

Results: An independent t-test determined that albumin infusion was significantly faster when administered IV compared with IO ($p = 0.011$). Mean albumin infusion time for the tibial IO group was 7 minutes and 35 seconds ($SD \pm 2$ minutes, 44 seconds) compared with 4 minutes and 32 seconds ($SD \pm 1$ minute, 08 seconds) in the IV group. Multivariate analysis of variance (MANOVA) was performed on hemodynamic data at baseline and every 20 seconds for 180 seconds during the albumin infusion. Analyses indicated there were no significant differences between the tibial IO and the IV groups relative to MAP, CO, HR, or SV ($p > 0.05$).

Conclusions: Despite the significant difference in infusion time between the 2 routes, both routes demonstrated equal effects on MAP, CO, HR, and SV in a hypovolemic subject. Additionally, the faster IV infusion time may be negated by the amount of time required to establish IV access in a hypovolemic patient. Therefore, during resuscitative efforts in hemorrhagic shock when it is difficult to establish or maintain IV access, the tibial IO route should be considered an effective and viable option for albumin administration.

Source of Funding: This study was funded by a TriService Nursing Research Program (TSNRP) grant and was conducted at the Navy Medical Research Unit in San Antonio, Texas.

A3

Does Sevoflurane Exposure Alter the Activity of Pyruvate Dehydrogenase in PC12 Cells?

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Introduction: Pyruvate dehydrogenase (PDH) is essential in the formation of acetyl coenzyme A, which is used in the formation of the neurotransmitter acetylcholine, as well as in the citric acid cycle to carry out cellular respiration. Altered regulation of PDH may induce changes associated with Alzheimer disease and POCD. A reduction in PDH activity could lead to alterations in the amount of ATP released, potentially leading to irreversible apoptotic pathways. This study aims to determine if sevoflurane administration alters PDH activity, which will aid in identifying the mechanism for cognitive decline. This will allow anesthesia providers to risk stratify patients and make safe anesthetic decisions.

Methods: Differentiated and nondifferentiated PC12 cells were exposed to sevoflurane at various concentrations (1% and 2%) and times (30 minutes and 1 hour). Differential centrifugation was used to isolate mitochondria from both treated and control groups. PDH activity was measured via nicotinamide adenine dinucleotide (NADH) light absorbance using spectrophotometry.

Results: After performing a 2-tailed unpaired t-test using Graphpad Prism software, no statistically significant results were noted between control and treated groups for 1% or 2% sevoflurane at 30 minutes or 1 hour exposure with a n=4 for each group. Data showed that sevoflurane exposure does not alter PDH enzyme activity.

Conclusions: This study did not show a significant change in PDH activity after sevoflurane exposure. Research has shown that gaseous agents are associated with learning disabilities and POCD. However, a causal relationship or molecular mechanism has not been established. Given the implications of Alzheimer disease and POCD, further research is warranted. Before this mechanism is discredited, study limitations should be addressed. These include a small sample size, development of a novel and intricate assay, and shorter anesthetic exposure time.

A4

Effect of Humeral Intraosseous Versus Intravenous Epinephrine Pharmacokinetics on Return of Spontaneous Circulation in a Porcine Cardiac Arrest Model

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Introduction: Traditionally, vascular access has been obtained intravenously (IV); however, the intraosseous (IO) access provides a viable, 80% effective, noncollapsible alternative. Although previous studies indicate the pharmacokinetics of epinephrine administration via IV and IO routes differ, it has not been established if this difference affects return of spontaneous circulation (ROSC). The purpose of this study was to determine the effects of the humeral IO (HIO) and IV administration of epinephrine in cardiac arrest on pharmacokinetics and ROSC.

Methods: A prospective, experimental design was used; 21 swine were randomized into 3 groups: cardiopulmonary resuscitation (CPR)/defibrillation control (n=7), HIO (n=7), and peripheral IV (n=7). The investigators placed the swine into cardiac arrest for 2 minutes. CPR was then performed for 2 minutes followed by a single dose of epinephrine (1 mg). Blood samples were collected for analyses of concentration maximum (C_{max}) and time to maximum concentration (T_{max}). Defibrillation and administration of epinephrine according to ACLS protocol was initiated and continued for 20 minutes or until ROSC.

Results: Fisher exact test indicated that the HIO group was significantly different from the control group (p<.001) and that the IV group was significantly different from the control (p=.035). There was no significant difference between the HIO and the IV groups (p=.096). The odds of survival for the HIO group in comparison with the control group was 225 and the odds of survival for the IV group in comparison with the control was 19.28. The survival odds ratio for the HIO group versus the IV group was 11.667. A Wilcoxon signed rank test indicated there were no significant differences in C_{max} or T_{max} between the HIO and IV groups (p > 0.05).

Conclusions: This study provides additional evidence to support the use of the HIO noncollapsible entry into the vascular system. As no significant differences between HIO and IV groups were found in C_{max}, T_{max}, or ROSC, the ability to utilize the route in cardiovascular collapse may be superior in trauma, difficult IV access placement, or vascular collapse.

Source of Funding: This study was funded by a grant from the TriService Nursing Research Program.

A5

Effects of Intraosseous Epinephrine in a Cardiac Arrest Swine Model

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Introduction: During cardiac arrest, healthcare providers must limit interruptions of chest compressions when obtaining vascular access and administer epinephrine as quickly as possible. Tibial intraosseous (TIO) allows for faster vasculature access compared with intravenous (IV). There is little research that addresses max concentration (C_{max}) of epinephrine and time to max concentration (T_{max}) and their effects on the return of spontaneous circulation (ROSC). This study will address the pharmacokinetics of epinephrine administered by TIO versus IV and the effects of ROSC in a cardiac arrest porcine model.

Methods: This was a prospective, between subjects, experimental design comparing C_{max}, T_{max}, ROSC, and time with ROSC. Swine were randomly assigned to 1 of 3 groups: CPR and defibrillation only (n = 7), epinephrine via IV with CPR and defibrillation (n = 7), and epinephrine via tibial IO with CPR and defibrillation (n = 7). Swine were placed in cardiac arrest for 2 minutes before CPR was initiated. After 2 minutes of CPR, epinephrine was delivered either by IV or TIO, and serial blood samples were collected over 4 minutes. An ANOVA, MANOVA, Fisher exact test, and t-test were used to analyze the data.

Results: A Fisher exact test demonstrated a statistically significant difference between IV epinephrine versus CPR/defibrillation only (p = 0.035) and TIO epinephrine versus CPR/defibrillation only (p = 0.010) in achieving ROSC. A 1-way ANOVA demonstrated a significant difference between the IV and TIO groups in T_{max} (p = 0.025). A MANOVA showed significant differences in epinephrine concentration at specific time intervals: 60 (p = 0.023), 90 (p = 0.001), and 120 (p < 0.000) second time intervals. There were no significant differences in epinephrine concentration at the 30, 150, 180, and 240 second time intervals. Importantly, there were no statistically significant differences between IV versus TIO epinephrine in achieving ROSC, time to ROSC, and C_{max}.

Conclusions: This study found statistically significant differences in epinephrine levels at the 60, 90, and 120 second intervals and T_{max} between the tibial IO and IV groups. No significant difference existed between the TIO and IV groups in achieving ROSC, signifying the importance of quickly obtaining vascular access for epinephrine administration. Protocol should be developed to state if IV access cannot be obtained within the first attempt in cardiac arrest patients, TIO access should be immediately initiated. Healthcare providers use IO as an early means to deliver medications in emergencies.

Source of Funding: This study was funded by TriService Nursing Research Program.

A6

Effects of Intraosseous Tibial Versus Intravenous Administration of Vasopressin on Kinetics and Return of Spontaneous Circulation in a Hypovolemic Cardiac Arrest Porcine Model

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US Army Graduate Program in Anesthesia Nursing

Introduction: This study compared the effects of 40 units of vasopressin via tibial intraosseous (IO) and intravenous (IV) routes on the maximum drug concentration (C_{max}), the time to maximum concentration (T_{max}), and return of spontaneous circulation (ROSC) in a hypovolemic cardiac arrest model.

Methods: This study was a randomized prospective experimental design. Twenty-two Yorkshire swine were exsanguinated by 31% of their blood volume, and ventricular fibrillation was induced. CPR was initiated and continued for 2 minutes, followed by administration of 40 units of vasopressin to the IO and IV groups. Blood samples were collected at 0.5, 1, 1.5, 2, 2.5, 3, and 4 minutes. CPR and defibrillation continued for 20 minutes or until ROSC was achieved. Vasopressin concentrations were measured using high performance liquid chromatography and mass spectrometry (HPLC-MS).

Results: There was no significant difference in mean C_{max} or T_{max} between the IO and IV groups (p = .079 and p = .084, respectively). Difference in survival between the IO and IV groups was not significant (p = .919; OR 1.1667, CI .059-22.94, p = .912). Mean time to ROSC was not significantly different between the IO (8.21 ± 1.54 minutes) and IV groups (10.72 ± 1.92 minutes) (p = .345).

Conclusions: The tibial IO and IV vasopressin groups did not have statistically significant differences in C_{max}, T_{max}, time to ROSC, or survival rates. Prompt access to the vascular system utilizing the IO route can circumvent the interruption in treatment observed with attempting conventional IV access. The IO route is an effective modality for the treatment of hypovolemic cardiac arrest and may be considered first line for rapid vascular access.

Source of Funding: This study was funded by TriService Nursing Research Program and was conducted at the Navy Medical Research Unit in San Antonio, Texas.

A7

Evaluation of Peripheral Nerve Block Outcomes in an Ambulatory Care Center: Establishing a Center of Excellence for Regional Anesthesia

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Introduction: Peripheral nerve blockade (PNB) is capable of providing many benefits to include improved quality and duration of pain relief, shorter hospital stays, decrease postoperative nausea/vomiting (PONV), and improved patient satisfaction. It is essential for anesthesia providers to obtain and evaluate data regarding the outcomes from the performance of peripheral nerve blockade. This evaluation is not routinely performed at most institutions. The purpose of this project was to develop and implement a system to evaluate outcomes from the performance of peripheral nerve blockade in an ambulatory surgical center over a 4-month period.

Methods: A prospective project was conducted over a 4-month period after institutional review board approval. A data collection tool and database were developed for this investigation. Outcome data was collected throughout the perioperative period and first postoperative day. Data was then de-identified and entered into an Excel spreadsheet (database). Data from all patients who received a peripheral nerve block at this facility were included with outcomes established as important to the focus overall effectiveness and duration of the block, length PACU stay, PONV incidence, and patient satisfaction. CRNAs performed all PNBs with predominately the same technique (91.5% ultrasound) and medications.

Results: Information on 268 patients was obtained. Three patients were not included as they were under 18 years of age. Some surgical procedures require more than 1 block so a total of 356 peripheral nerve blocks were performed. The results on the 5 main foci were: overall effectiveness of all PNBs (85.5%), average blockade duration (18.86 hours), PONV incidence (5.6%), average PACU stay (57 minutes), and average patient satisfaction score 9.5 out of 10 (Likert scale). More in-depth results were examined as well. Specific block effectiveness, factors affecting PONV incidence (gender, pain, length of surgical procedure), factors affecting PACU stay (pain, PONV, length of surgical procedure), and reasons for dissatisfaction were all examined.

Conclusions: Results from this project validated most of the current practice being performed at this facility and are in line with outcomes found in the review of literature. However, an in-depth analysis suggested that lower volumes and concentration of local anesthetic negatively impacted effectiveness and duration. Provider experience, tourniquet times, use of nerve stimulator during block placement, history of PONV, and nerve block complications are variables that were not included in this project. These variables may influence patient outcomes and should be included in future investigations.

Source of Funding: Self-funding for Excel consultation.

Everyday Stress, Psychological Outcomes, and Dispositional Mindfulness in Student Registered Nurse Anesthetists

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Introduction: Stress negatively affects student registered nurse anesthetists' (SRNAs) wellness. At present, there is no effective method to identify individual vulnerability to stress to better prepare SRNAs for adaptive stress coping. Dispositional mindfulness, an innate, personal tendency to remain focused on present-moment experience, may mitigate stress vulnerability in SRNAs. The goals of this research were to assess subgroup differences in psychological outcomes of everyday stressors and to evaluate if dispositional mindfulness buffered the impact of stress on psychological outcomes.

Methods: This anonymous cross-sectional online survey was distributed to randomly selected 5,000 SRNAs, and 881 responded. The survey questionnaire included 4 validated self-report measures to assess everyday stressors, perceived stress, depression, anxiety, dispositional mindfulness, demographic, and anesthesia training information. Missing data was handled using multiple imputations. Complete case ($n=728$) and multiply imputed data were simultaneously analyzed using Stata 14. Generalized linear models were used to examine the moderation effect of dispositional mindfulness on stress and its outcomes.

Results: Dispositional mindfulness had significantly negative correlation with everyday stressors, perceived stress, depression, and anxiety ($r_s = -.12$ to $-.53$, $p < .05$). Female SRNAs had significantly higher everyday stressors, perceived stress, and anxiety than their male peers. Two aspects of mindfulness, being nonjudgmental and acting with awareness, significantly attenuated the impact of everyday stressors on depression and anxiety after controlling for demographic and anesthesia training information and meditation experience. The findings of the complete case and multiply imputed data analyses were congruent except for depression, in which significant moderation was observed only in complete case analysis after Holms sequential alpha correction.

Conclusions: The present study had 3 key results that are relevant to SRNA wellness. First, this research provided robust estimates of everyday stressors, perceived stress, depression, anxiety, and dispositional mindfulness in SRNAs. Female SRNAs were found as at risk for more severe psychological effects of everyday stress than male SRNAs. Finally, this study discovered that differences in the levels of dispositional mindfulness might have a significant impact on psychological adjustment to stress. More research is needed to explore how deficits in mindfulness might affect adaptive stress coping in SRNAs.

Source of Funding: 2015 AANA Foundation Doctoral Fellowship.

A9

Investigation of the Anxiolytic Effect of Curcumin, a Compound From Turmeric (*Curcuma longa*), in the Adult Male Sprague-Dawley Rat

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Introduction: Forty million adults in America suffer from anxiety disorders. Herbal medications are often used to treat these disorders and may have interactions with drugs commonly used in anesthesia. Curcumin, a compound found in turmeric, has been shown in studies to have anxiolytic effects. Several mechanisms have been implicated, involving numerous neurotransmitter systems. The purpose of this study was to further investigate the anxiolytic effects of curcumin and to determine if its effects are at the benzodiazepine site of the γ -aminobutyric acid (GABAA) receptor.

Methods: Using a prospective, between subjects group design, 55 male Sprague-Dawley rats were randomly assigned to 1 of 5 groups: (1) vehicle 0.5% dimethyl sulfoxide; (2) curcumin 20 mg/kg; (3) midazolam 1.5 mg/kg; (4) flumazenil 3 mg/kg + curcumin 20 mg/kg; or (5) midazolam 1.5 mg/kg + curcumin 20 mg/kg. Rats received 2 1-mL injections and after 30 minutes were evaluated on the elevated p maze (EPM) and the open field test (OFT), which are valid measures of anxiety in rats. Two-tailed multivariate analysis of variance (MANOVA) and least significant difference (LSD) post hoc tests were used for data analyses.

Results: In the EPM, data were collected measuring the ratio of open arm time to total maze time, time mobile, distance traveled, and mean speed. Curcumin had no significant difference from the negative control in any of the measurements. Midazolam had significantly more open arm time and significantly less time mobile when compared with the other groups. In the OFT, center entries, time mobile, distance traveled, and mean speed were measured. The curcumin group had no significant differences in center entries, time mobile, distance traveled or mean speed from control. A strong positive correlation was noted between EPM mean speed and OFT time mobile, distance traveled, and mean speed.

Conclusions: Based on results of EPM and OFT, no significant anxiolytic effect of curcumin was demonstrated. Due to a lack of interaction between curcumin and flumazenil, our findings do not support our hypothesis that curcumin modulates the benzodiazepine binding site of the GABAA receptor. Additional studies are recommended that examine the anxiolytic effects of curcumin through alternate dosing regimens, modulation of other subunits on the GABAA receptor, and interactions with other central nervous system (CNS) neurotransmitter systems.

Source of Funding: This study was funded by the American Association of Nurse Anesthetists (AANA) Foundation

A10

Quantifying and Reducing Anesthesia Workspace Contamination

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Introduction: Two major aims of this study were to quantify the dispersion of biological material from a simulated patient's mouth to the anesthesia workstation during the induction period and secondly to test the hypothesis that there would be fewer contamination sites by those using a double-glove technique versus a single-glove technique.

Methods: A convenience sample of 20 anesthesia providers, blinded to the purpose of the study, performed a simulated induction of general anesthesia. Group 1 (N=10) and Group 2 (N=10) used single-glove and double glove techniques respectively. DAZO®, a clear fluorescing gel, was used as an analog for a patient's oral secretions. An ultraviolet emitting Wood's Lamp was used to fluoresce the DAZO®, quantifying its spread across the work area. Dispersion of the gel was considered a result of the anesthesia provider's actions and served as the dependent variable.

Results: Nine of the 33 discrete surfaces monitored were contaminated greater than 50% of the time inclusive of both the single and double-gloved groups. Group 1 contaminated an average of 16.0 (SEM = 0.89) discrete sites. Group 2 contaminated an average of 7.6 (SEM = 0.85) discrete sites. ($t = 6.823$, $P = 2.2$) The cart drawers, fresh gas flow dial, medication vials and ventilator controls were significantly contaminated by group I and not by group II ($P < 0.05$ in all cases). The Adjustable Pressure Limiting valve and the temperature probes were also more contaminated in group I at a marginal level of significance ($P = 0.070$ for both surfaces).

Conclusions: Anesthesia providers do contaminate their workstations with the patient's oral biologic materials. Utilizing a double-glove technique during the induction period mitigates environmental contamination but does not entirely eliminate inoculation of work surfaces.

A11

Teaching Student Registered Nurse Anesthetists to Appropriately Respond To Simulated, Life-Threatening, Anesthetic Emergencies

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Introduction: Life-threatening complications may occur during anesthesia and must be treated emergently to prevent worsening complications or even death. The purpose of this study was to determine if high-fidelity simulation is an effective learning tool to prepare students to diagnose and treat emergent conditions in the practice environment. We proposed that students exposed to 13 life-threatening anesthetic scenarios at 3 different time intervals would be better prepared to manage anesthetic emergencies compared with students who only experience the scenarios once at the end of their program.

Methods: Using convenience sampling, after IRB approval/informed consents were obtained, 6 students from 1 cohort (control group) experienced 13 life-threatening scenarios once during their program compared with 6 students from another cohort (study group) who experienced the same 13 scenarios at 3 different intervals. Two faculty members used a “yes”/“no” checklist to score 58 criteria. Students were given 5 minutes maximum to diagnose and treat each scenario. They received immediate feedback on their performance during debriefing after each scenario. Sessions were videotaped for scoring discrepancies.

Results: There were no significant differences between control and study group demographic characteristics (independent t-test and chi-square). The study group had higher or equal percent of correct items for 11 of 13 scenarios; control group had higher percent for total spinal and hyperkalemia. Both groups had 100% correct for MH, acute hemorrhage, can't ventilate/can't intubate. There was significant difference for percent of correct items for myocardial ischemia and marginally significant difference for tension pneumothorax (Mann-Whitney U). Study group scores increased over the 3 sessions; study group final scores (completed at end of program) were higher compared with the control group ($p < 0.05$) using Friedman and Wilcoxon signed rank tests.

Conclusions: This study showed that repeated high-fidelity simulation sessions are an effective learning tool compared with only 1 session. However, repeating scenarios over several sessions is resource intensive. Future studies should investigate the use of asynchronous computerized scenarios to replace some of the simulated lab sessions. This will reduce both faculty and lab resources. Once the student feels competent using the computerized scenarios, follow-up in the simulation lab will reinforce the student's management of life-threatening anesthetic emergencies prior to the practice environment.

Source of Funding: American Association of Nurse Anesthetists Foundation.

A12

The Comparison of Humeral Intraosseous Versus Intravenous Administration of Vasopressin on Return of Spontaneous Circulation and Pharmacokinetics in a Cardiac Arrest Swine Model

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Introduction: The American Heart Association (AHA) recommends vasopressin in ACLS. Obtaining vascular access in hypovolemic cardiac arrest patients can be difficult. Vascular access is essential for life-threatening situations. While prior studies have demonstrated the efficacy of sternal intraosseous (IO) access with lifesaving drugs, no studies have been conducted to determine the effects of humeral IO access with vasopressin in the return of spontaneous circulation (ROSC). Our study compared the kinetics of vasopressin and ROSC with humeral IO compared with intravenous (IV) access in the hypovolemic swine model.

Methods: Twenty-two Yorkshire swine were divided into 3 groups: humeral IO (n=7), IV (n=8), and a control group (n=7). The IV and humeral IO group received vasopressin and CPR while the control group received CPR and no vasopressin. All subjects were exsanguinated 31% of their blood volume and resuscitated per standard ACLS. Subjects that achieved ROSC were then monitored for 20 minutes. Cmax and Tmax of vasopressin were measured by blood samples (10 mL) collected at 0.5, 1, 1.5, 2, 2.5, 3, and 4 minutes after vasopressin injection. Data was analyzed using a MANOVA and a Fisher exact test.

Results: ROSC was achieved in every subject that received vasopressin via the humeral IO route. Data analysis using a MANOVA pairwise comparison revealed no difference between mean Cmax ($p = 0.601$) and Tmax ($p = 0.771$) of vasopressin administered IV versus humeral IO routes. Analysis of the mean serum concentrations at time intervals using a repeated measures ANOVA found no difference ($p > 0.05$). A Fischer exact test revealed no difference in time to ROSC between humeral IO and IV groups ($p > 0.05$). Our odds ratio determined there was a 33 times higher chance of survival among humeral IO subjects versus control (CPR and defibrillation; $p = 0.03$) and no difference in the survivability of the humeral IO or IV groups ($p = 0.52$).

Conclusions: The data from this study strongly suggest there is no significant difference in ROSC, time to ROSC, hemodynamics, or pharmacokinetics between humeral IO vasopressin and IV vasopressin. Although generalizations may not be made from our study to humans, the cardiovascular anatomy and physiology of swine are very similar. Delays in obtaining vascular access also delays ROSC and increases the chance of mortality and morbidity. This research reinforces current AHA guidelines recommending the use of humeral IO route early over delaying care awaiting IV access.

Source of Funding: This study was funded by a TriService Nursing Research Program (TSNRP) grant and was conducted at the Navy Medical Research Unit in San Antonio, Texas.

A13

The Role of Documentation Quality in Anesthesia Related Closed Claims

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Introduction: Clinical documentation is used as the legal record of patient care, assists in financial reimbursement of services, informs clinical decision support tools, and serves as a repository for secondary data analysis. Poor documentation can impair patient safety and increase malpractice risk because it results in using low-quality information to guide patient care decisions. This thematic analysis explored the antecedents and consequences of documentation quality in anesthesia related closed claims. This secondary data analysis used a database generated by the American Association of Nurse Anesthetists Foundation closed claim review team.

Methods: A manual query of every closed claim case in the closed claim database searching for mention of documentation quality attributes. The final review included 72 claims. Thematic analysis was used to determine themes regarding the relationship between documentation quality and anesthesia-related closed claims.

Results: There were 4 major themes. First, poor documentation implies provider incompetence and the standard of care was not met. Second, good documentation decreases legal liability by proving the standard of care was met. Third, poor documentation by 1 provider may impair patient safety and implicate other providers in malpractice claims. Fourth, poor documentation can allow claims of malpractice where it otherwise would not have occurred if documentation was better.

Conclusions: The major consequences of poor documentation can include questioning the quality of care provided, impeding the evaluation of patient care events to defend against accusations of malpractice, and using inaccurate information to guide future patient care decisions. Clinical documentation is used to evaluate healthcare providers and determine if the standard of care is met. Timely documentation is important because late documentation that occurs in response to a recognized complication makes it appear as though “something is being covered up.”

Source of Funding: This study was supported by the AANA Foundation

A14

Utility of a Handoff Checklist for Student Nurse Anesthetists to Guide Transfer of Care to the Postanesthesia Care Unit

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Introduction: Medical errors often are the result of inadequate communication. The dynamics of the perioperative environment includes various professionals and patient populations compounding the likelihood of errors. Checklists are known to help decrease errors in the healthcare arena. We believe there is a need for a checklist in this complex clinical setting to minimize errors and improve patient outcome. The purpose of this project was to provide the student nurse anesthetist (SRNA) in their pediatric rotation with a checklist to guide the handoff to the postanesthesia care unit (PACU).

Methods: This was a pilot project using SRNAs as subjects to examine the effectiveness of a written handoff checklist, adapted from a validated checklist. Subjects served as their own control. There were 14 items on the checklist and each item could earn 0, 0.5, or 1 point. Scoring was performed by 4 CRNAs who received instructions as well as simulation training to ensure uniform scoring of the handoffs. Handoff scoring included an average for each item on the checklist preutilization and postutilization. The mean pretest and posttest scores were also obtained for the entire group of handoffs by dividing the total score by 14. Analysis of the mean scores was made using the Wilcoxon signed ranked test.

Results: Eleven SRNAs performed 57 handoffs. Average scores of checklist utilization showed 6.38 pre-intervention (42%) and 12.19 on the postintervention (81%). Differences were statistically significant at $p < 0.001$. Often omissions occurred because the information was not applicable to the case. For example, a procedure was not conducted, or paralyzing medications were not administered. Summarizing statements yielded high utility allowing intuitive concerns discovered by the anesthesia provider throughout case to be reliably conveyed to PACU nurse. SRNA anxiety levels were higher than expected during data collection.

Conclusions: The usefulness of a handoff checklist is not debatable. ACGME common program requirements include training in handoff communication; however, no such curriculum requirements have been adopted by the AANA. Providing SRNAs with such a tool can teach trainees fundamental patient safety principles that will apply when specific protocols and checklists do not exist. For implementation in a pediatric setting, thorough customization and collaboration with all involved professionals is necessary.

A15

A Comparative Review of Postoperative Pain in the Gastric Pacemaker Insertion Patient Compared With the Laparoscopic Cholecystectomy Patient

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Introduction: Gastroparesis is defined as a chronic gastric motility disorder with delayed gastric emptying in the absence of a structural or mechanical obstruction. Gastric pacemakers have become the primary surgical intervention when pharmacological avenues have been exhausted. The purpose of this study was to determine if gastric pacemaker insertion patients experience a greater amount of pain when compared with laparoscopic cholecystectomy patients. There currently is a gap in the research identifying that these patients have more pain than other patient groups undergoing similar procedures.

Methods: A randomized chart review was performed. Seventy-six subjects were randomly selected and divided into 2 groups based on procedure type. Inclusion criteria: age greater than 18 and placement of a gastric pacemaker or laparoscopic cholecystectomy during the past 5 years. Exclusion criteria: pregnant women. Opioid requirements were converted into morphine equivalents to determine a standardized unit of measurement. Nurses were surveyed to determine if gastric pacemaker insertion patients were perceived to have more difficulty managing pain.

Results: The results of this study determined that gastric pacemaker insertion patients with associated disease states of anxiety do experience a higher verbalized pain rating and an increased amount of opioid administration compared with laparoscopic cholecystectomy patients. The survey that was administered also demonstrated that nurses perceive gastric pacemaker patients to have a higher degree of pain, greater need for pain medication, and an increased length of stay compared with patients who underwent similar laparoscopic procedures. It has also been determined through our survey that nurses caring for these patients believe this patient population would benefit from a standardized postoperative pain control protocol.

Conclusions: Our study demonstrated that gastric pacemaker patients with anxiety do require an increased amount of pain medication, have a higher stated pain rating, and have increased length of stay compared with laparoscopic cholecystectomy patients. It is our recommendation that a standardized pain protocol be developed and implemented in the care of future gastric pacemaker patients. A future study needs to determine if this protocol is successful in improving pain outcomes and patient satisfaction.

A16

A Comparison of Propofol With Nitrous Oxide Versus Propofol With Nitrous Oxide Plus Desflurane in Analyzing Hospital Discharge Times in Patients Undergoing Hysteroscopy in the Outpatient Setting

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Introduction: This cohort study retrospectively investigated the relationship between the use of 2 multimodal general anesthetic techniques in patients undergoing outpatient hysteroscopy: propofol with nitrous oxide and propofol with nitrous oxide plus desflurane. The primary outcome identified if there was an association between the 2 different techniques and time to readiness for discharge. Secondary outcomes included anesthesia duration, propofol dose, average PACU pain score, perioperative opioid dose, frequency of PONV, and the use of the Bispectral Index (BIS) monitor.

Methods: A total of 1,133 patients were identified and divided into 2 groups: 500 patients received propofol + nitrous oxide and 633 patients received propofol + nitrous oxide + desflurane. Chart reviews were conducted on patients receiving anesthesia between 1/1/2010 and 12/31/2014. Because patients could not be randomized, a propensity stratified analysis was performed. Continuous outcomes with skewed distributions were summarized using both mean \pm SD and median (25th, 75th) and compared between groups using the rank sum test. Dichotomous outcomes were compared between groups using the chi-square test.

Results: No difference was found between groups regarding time to readiness for discharge. There was also no difference between groups regarding frequency of nausea and vomiting, postoperative pain score, or perioperative opioid consumption. The desflurane group received significantly less propofol by infusion ($(116.3 \text{ mcg/kg/min} \pm 22.3)$ vs (109.6 ± 25.3) $p < 0.001$). Some evidence suggests that the duration of anesthesia was slightly increased for the desflurane group ($+2.5\text{min}$, 95% C.I. $+0.4$ to $+4.6\text{min}$, $p=0.018$).

Conclusions: The outcomes of this study give CRNAs who provide anesthesia in an outpatient setting evidence that adding desflurane to their anesthetic does not affect readiness to discharge. There were no statistically significant differences between the 2 techniques and the outcome variables under study. Therefore, no practice change is suggested for outpatient settings, which use desflurane as part of their anesthetic plan.

Source of Funding: Funding was provided by Mayo Clinic College of Medicine, Department of Anesthesiology.

A17

A Comparison of Teaching Methods Based on Kolb Learning Style in a Nurse Anesthesia Program

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Introduction: A challenge was made by the Carnegie Foundation to nursing educators to shift from a focus on decontextualized knowledge to an emphasis on teaching for a sense of salience. Team-based learning (TBL), a type of active learning, has been used in health science programs to address these needs. The purpose of this project was 2-fold: first, to evaluate student satisfaction, accountability and preference for team-based learning, and second to determine if a correlation exists between student satisfaction, accountability, and preference for team-based learning and learning style as defined by Kolb.

Methods: Team-based learning was used during the first semester of a nurse anesthesia program to teach 4 out of 9 sessions in the learning module. Students were given a Kolb learning style inventory (LSI) as well as a team-based learning student assessment questionnaire (TBLSA) at the conclusion of the course. The LSI categorized the students into one of Kolb's 4 learning types. The TBLSA evaluated the students' perception of accountability, preference for lecture or TBL, student satisfaction with the TBL method, and overall experience with TBL.

Results: Sixty percent of nurse anesthesia students in this study had a positive experience with team-based learning. There were significant differences between accountability, satisfaction, overall experience, and the neutral scores within each category, indicating that the experience with TBL was generally well received by the students. Pearson correlation demonstrated a positive correlation between the use of concrete experimentation to grasp knowledge and student satisfaction and overall experience with TBL. A negative correlation was identified between the use of reflective observation and accountability, preference for TBL, student satisfaction, and overall experience.

Conclusions: Students in this study were more accountable for their education and felt satisfied with TBL but were neutral regarding preference for TBL. Students who learned by concrete experimentation were more accountable and satisfied with TBL than those with a preference for the other learning modes. Students with a preference for reflective observation were not satisfied with TBL and felt it negatively affected their accountability. This study suggests those with a preference for learning by concrete experimentation may better accept TBL than those with a preference for learning with reflective observation.

A Comparison of the LMA and Endotracheal Tube as Airway Adjuncts Affecting Hemodynamic Stability During Carotid Artery Surgery

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Introduction: The most severe complications associated with carotid endarterectomy surgery are stroke and myocardial infarction. The physiologic derangements associated with atherosclerotic disease combined with anesthetic technique can generate dramatic variations in blood pressure and heart rate. Hypertension and tachycardia, for example, can cause stroke and myocardial infarction. The purpose of this study was to identify which airway device, the laryngeal mask airway (LMA) or the endotracheal tube (ETT), used for carotid endarterectomy surgery, is associated with large increases in heart rate and blood pressure at 3 distinct time periods compared with baseline.

Methods: This study was carried out as a retrospective electronic record review. After obtaining IRB exempt status, the medical records of those who had carotid endarterectomy surgery between January 2014 and January 2015 were accessed and separated into 4 groups: LMA with or without cervical plexus block (CPB), and ETT, with or without CPB. Data extracted from the records included demographic and anesthesia management detail, heart rate, and blood pressure measurements at baseline and 3 distinct time points: induction, emergence, and the first hour following PACU admission. Pharmacologic agents required to manage blood pressure and heart rate according to patient history were also documented.

Results: A total of 98 records were available for analysis: 28 anesthetics were conducted with an LMA, 26 with combined LMA and CPB, 33 with an ETT, and 11 with combined ETT and CPB. The largest average of differences between maximal systolic blood pressure and baseline during induction, emergence, and PACU were in the ETT/CPB group, 44 mm Hg; the ETT group, 36 mm Hg; and the LMA group, 11 mm Hg; respectively. Interesting to note, during the PACU time period, the LMA/CPB group had the lowest average systolic blood pressures compared with baseline. Defining tachycardia as either a heart rate at least 20 greater than baseline and/or greater than 100, the proportions with tachycardia during emergence ranged from 19% (LMA with CPB) to 55% (ETT with CPB).

Conclusions: Techniques used to establish and maintain the airway have significant influence on blood pressure and heart rate at key time points during an anesthetic. The sympathetic response to tracheal intubation is an increase in circulating catecholamines; this response can be catastrophic in certain situations. Supraglottic devices such as the LMA do not precipitate similar reactions and are often selected for use to minimize blood pressure and heart rate increases such as during carotid endarterectomy. The results of this small study support previous theories; however, a prospective adequately powered study should be considered to further validate the findings.

A19

A Phenomenographical Study on the Perceived Factors Affecting CRNA Role Transition

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Introduction: Making the transition from SRNA to CRNA can be challenging and stressful. Prior research has focused on identifying personal characteristics of successful CRNAs. This study identifies perceived social and environmental factors affecting CRNA role transition and identifying interventions that may be implemented to provide optimal support to newly graduated CRNAs during their role transition.

Methods: A qualitative phenomenographical methodology utilizing online purposive recruitment and individual interviews over computer mediated technology was used to conduct semi-structured online individual in-depth interviews (n=15) of recently graduated CRNAs. Data saturation was agreed on by supervising researchers. Recordings were transcribed verbatim with standard inductive thematic content analysis completed. Dependability was addressed through supervising experienced qualitative researchers. Credibility was verified through participant verification of findings and interpretation.

Results: Five factors were found promoting CRNA role transition: mastery of self-efficacy and confidence, expert coaching and guidance, supportive work environment, peer support, and previous experience as a SRNA. Four factors were found impeding CRNA role transition: practice limitations, lack of orientation and preceptor, hostile work environment, and decreased work or case load. Four interventions identified as influential included a formal orientation, trained preceptors, mentors (online or in person), and new employee meetings.

Conclusions: This study identified 5 factors promoting and 4 factors impeding CRNA role transition. This study's findings offer insight into the role transition of CRNAs and offer faculty and employers possible interventions to assist recently graduated CRNAs during their role transition. Further research is needed to verify these findings and address the feasibility of possible interventions in the larger population of recently graduated CRNAs.

A20

A Pressure Situation: How Much Endotracheal Tube Cuff Pressure Is Needed to Prevent Fluid Aspiration?

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Introduction: Aspiration of oropharyngeal and gastric secretions around endotracheal tube cuffs can have detrimental effects on patient outcomes following surgical procedures requiring endotracheal intubation. Current recommendations suggest inflating endotracheal tube cuffs to the minimum occlusive pressure that creates an air seal during positive-pressure ventilation. But, at this minimal air occlusive pressure, can liquid contents still make their way past the endotracheal cuff into the lungs of the patient? The following bench study describes the incidence of aspiration of fluid contents past endotracheal tube cuffs using variable endotracheal tube sizes and cuff pressures.

Methods: Pig tracheas were used for intubation with cuffed Mallinckrodt Hi-Lo Oral/Nasal tubes. An endotracheal tube cuff manometer was used to accurately inflate each cuff to the desired pressure. Five tracheas were intubated with 7.0 mm endotracheal tubes, each with a different cuff pressure (20, 30, 40, 50, and 60 cm H₂O). White absorbent paper was placed in the distal end of each trachea before 10 cc of blue dye was deposited on the proximal end of the cuff. The absorbent tissue was removed after 1 hour and inspected for aspiration indicated by the presence of blue dye. The above steps were then repeated for 7.5 and 8.0 mm tubes. Results were recorded as either positive or negative for aspiration.

Results: Positive aspiration was noted within 10 minutes for all tube sizes tested with cuffs inflated to 20 cm H₂O. Aspiration was also noted at cuff pressures of 20, 30, and 40 cm H₂O for all tube sizes tested. The endotracheal tube sizes 7.0 and 7.5 were negative for aspiration at pressures of 50 and 60 cm H₂O. However, the 8.0 mm endotracheal tube was positive for aspiration at 50 cm H₂O pressure during both trials. Aspiration was negative for all tube sizes and cuffs inflated to 60 cm H₂O.

Conclusions: The results of this study show that current recommendations for inflating endotracheal tube cuffs to minimal air occlusive pressure are not adequate to prevent aspiration of fluid past the cuff. However, the pressures needed to prevent fluid aspiration through microfissures in the cuff also put the patient at risk for tracheal pressure injuries if they are sustained for a significant period of time. More studies are needed to accurately predict the incidence of fluid aspiration past endotracheal cuffs during the intraoperative period.

A Retrospective Efficacy Study Comparing Single-Administration Liposomal Bupivacaine With Continuous Infusion (On-Q) Bupivacaine Following Lumbar Spinal Fusion

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Introduction: Lumbar fusion is associated with significant postoperative pain, and most often treated with opioids, which have a multitude of adverse effects that can complicate the patient's hospital stay. Poorly controlled postoperative pain decreases patient satisfaction while increasing healthcare costs; thus appropriate postoperative pain management is crucial in promoting earlier patient mobilization, shorten in-patient length of stay, and reduce healthcare costs. Multimodal analgesia is considered the most effective method for postoperative pain control, with goals of increasing pain relief and decreasing unwanted side effects from excessive opioid use.

Methods: This is a case-control, retrospective study, which consisted of (convenience) surgical patients who underwent lumbar spinal fusion from May 2011 until May 2013: those who received plain bupivacaine (PB) through an On-Q pump from May 2011 until August 2012; and from September 2012 until May 2013, those who received single-dose liposome bupivacaine (LB). Inclusion criteria were diagnosis of lumbar spondylosis and >18 years of age; while those with allergy to bupivacaine and those younger than 18 years old were excluded from the study. Simple imputation method was employed to less than 5% of data collected on both groups by carrying forward last available objective data.

Results: A total of 93 patient charts were reviewed: 47 for the plain bupivacaine (PB) group and 46 with the liposomal bupivacaine (LB) group. No statistical difference was found when liposomal bupivacaine was used compared with bupivacaine delivered via On-Q pump in providing postoperative pain control from lumbar fusion surgery. Variables investigated were: age (average 50.27 in the PB group vs 54.76 in the LB group, $p=0.096$), total opioid consumption within 72 hours (283.63 mg PB vs 269.14 mg LB, $p=0.754$), time to first rescue (34.1 min PB vs 32.78 min LB, $p=0.325$), incidence of nausea and vomiting (0.36 PB vs 0.48 LB, $p=0.51$), average pain score (3.19 PB vs 3.42 LB, $p=0.158$), and total length of hospital stay (83.63 h PB vs 88.53 h LB, $p=0.456$).

Conclusions: While local anesthetics, like bupivacaine, prove to reduce postoperative pain, duration of analgesia is brief, and single-shot injections do not provide long-term benefits. The use of liposomal bupivacaine is as effective as plain bupivacaine in providing postoperative pain control from lumbar fusion surgery. However, the use of continuous infusion anesthetic via a delivery system carries inherent significant drawbacks making single administration of liposomal bupivacaine the logical and attractive choice to manage postoperative pain following lumbar fusion.

Alveolar Recruitment Maneuvers: Influencing Practice

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Introduction: Atelectasis has been shown to affect more than 90% of patients undergoing anesthesia. Anesthesia providers play a key role in helping to prevent and reverse atelectasis. Alveolar recruitment maneuvers (ARMs) is a technique utilized to reverse atelectasis in the intubated patient. The purpose of this research was to assess the knowledge base of CRNAs on the importance and correct administration or technique of ARMs and potentially influence changes in practice to reflect current research and standard of practice.

Methods: A total of 238 CRNAs attending the Florida Association of Nurse Anesthetists symposium on February 18-21, 2016, were invited to participate in the study. Qualtrics software was used to elicit knowledge of ARMs and included 3 sections: a pretest, an educational PowerPoint, and a posttest. The pretest assessed baseline knowledge of the participants. The questions and PowerPoint presentation were developed using current research and literature. Validity of the PowerPoint was determined by the increase of correct responses in the posttest. Additionally, data was collected on demographics and opinions of the participants' utilization of ARMs and future practice implications.

Results: Forty-one percent of CRNAs (n=238) reported occasional use of ARMs. Only 24% of participants indicated prior knowledge of ARMs as a result of a conference, completed a CEU, or learning module. There was a 19% increase in average correct responses following the educational PowerPoint. Demographic data showed the majority of the participants currently practice in Florida (32%) and have experience of either 0 to 2 years (31%) or greater than 10 years (31%); most participants had received a master's degree in nursing anesthesia (77%). The results of the posttest survey revealed that following the PowerPoint, most CRNAs were likely or very likely to use ARMs in their future practice (91%). Most of the participants agreed or strongly agreed that they would like more information regarding ARMs (80%).

Conclusions: Analysis of the data suggests that CRNAs need and desire additional education regarding the proper administration of ARMs. Additional analysis indicated that the PowerPoint presentation provided in the survey improved the knowledge of ARMs among CRNA participants.

Amniotic Fluid and Human Platelet Aggregation

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Introduction: Amniotic fluid embolism (AFE) carries significant maternal morbidity and mortality. AFE manifests as respiratory arrest, cardiovascular collapse, and disseminated intravascular coagulopathy. The cardiopulmonary symptoms are thought to be due to acute right heart failure precipitated by severe pulmonary hypertension. Activated platelets aggregate, degranulate, and release serotonin and thromboxane-A₂ into the systemic circulation, both of which are potent pulmonary vasoconstrictors. The primary focus of this study was to evaluate the effect of amniotic fluid on platelet aggregation *ex vivo*.

Methods: A dose response curve using known platelet aggregating agents, adenosine diphosphate (ADP) and thrombin, was established and the IC₅₀ of each aggregant was determined. Platelet-rich plasma (PRP) suspensions prepared from 7 female individuals were each exposed to 4 µg/mL, 20 µg/mL, and 100 µg/mL final concentrations of 5 different human amniotic fluid samples. In addition, each PRP suspension was preincubated with human amniotic fluid followed by stimulation of aggregation with ADP and of thrombin. Aggregation was measured using an aggregometer, recorded over time and represented as area under curve.

Results: The IC₅₀ doses of ADP and thrombin derived from the dose response curves were 3 µM and 0.05 µU, respectively. Exposure of PRP isolated from 7 female subjects to 4 µg/mL, 20 µg/mL, and 100 µg/mL final concentrations of 5 different amniotic fluid samples showed no appreciable platelet aggregation regardless of the dose used when compared with aggregation induced by 3 µM ADP and 0.05 µU thrombin. Preincubation of PRP with various doses of amniotic fluid followed by stimulation of aggregation with either 3 µM ADP or 0.05 µU of thrombin showed a slight but significant decrease in both ADP-induced and thrombin-induced platelet aggregation ($p < 0.05$). All aggregation assays contained 100,000 platelets/µL. GraphPad software was used to analyze the data.

Conclusions: Exposure of PRP to amniotic fluid has been reported to cause platelet aggregation in 1 study and in another study was found capable of inducing platelet-neutrophil aggregation but not platelet aggregation. In this study, ADP and thrombin caused aggregation of platelets contained in the PRP isolated from healthy females. Human amniotic fluid did not elicit aggregation of platelets contained in the PRP isolated from healthy females. Preincubation of PRP with various doses of human amniotic fluid caused a slight but significant decrease in platelet aggregation induced by both ADP and thrombin.

Source of Funding: Webster University Nurse Anesthesia Department.

Analysis of Minnesota's Enactment of APRN Full Practice Authority

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Introduction: Various groups of Minnesota (MN) APRNs tried unsuccessfully to pass full practice authority (FPA) legislation in 1996, 1999, and 2009. According to Safreit (2011), 2 primary factors that historically hamper passage of APRN FPA include legislators' aversion to difficult scope of practice issues and the strength of organized medicine opposition groups' advocacy efforts in many states. APRN FPA is a complex policy issue that challenges legislators to comprehend technical educational and scope of practice differences between medicine and advanced practice nursing and act on practice act legislation despite polarized, entrenched opposition and support coalitions. Decades of evidence substantiate APRN safety and quality.

Methods: Using the Advocacy Coalition Framework (ACF) (Sabatier and Weible, 2007), researchers conducted a retrospective analysis of MN's successful 2014 FPA legislative effort. Researchers used directed content analysis of key MN legislative hearing transcripts and documents using ACF concepts for coding categories. Researchers independently abstracted and coded data from organizational and meeting documents as well as transcripts from 2014 MN legislative committee hearings. Historical data analysis included descriptive analysis of MN's healthcare environmental factors, national contextual factors, and competing coalitions' organizational structures, resources, and processes.

Results: Key external events occurred and the APRN coalition heavily leveraged these events through legislative fact sheets, hearing testimonies, and legislative meetings. Analysis of policy subsystem factors yielded significant differences in beliefs, human and financial resources, and strategies between the MN APRN Coalition and the informal coalition of the 7 MN medical organizations opposing FPA legislation. No evidence could be found for any type of unified or targeted grassroots physician campaign. The APRN coalition utilized a strategic, timed, and targeted grassroots campaign with state APRNs organized by legislative districts. APRN hearing testimonies included evidence-based arguments to refute each of the 5 basic arguments presented by the medical coalition.

Conclusions: The APRN coalition leveraged the coalescence of key external events to provide a sense of urgency and motivate legislators to pass FPA. The APRN coalition's strategic use of evidence, broad-based support, unified voice, and robust targeted grassroots campaign contributed to influencing MN legislators' support for APRN FPA. Strong ties cultivated over a number of years between the 4 APRN groups into a single APRN coalition led to a significant strategic advantage for the APRN coalition in contrast to the medical groups. Findings from this analysis may provide useful strategies for other states' APRN organizations seeking FPA.

A25

Assessment of Certified Registered Nurse Anesthetists' Knowledge of Costs of Anesthetic Medications

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Introduction: Cost is a factor that has grown exponentially in every aspect of healthcare; hence the constant discussion. Anesthesia medication costs are no exception. Anesthesia can be done in an infinite number of ways. These range between thousands of dollars, all depending on the drugs chosen. This is what makes this study relevant. The purpose was to identify Certified Registered Nurse Anesthetists' knowledge of costs of different anesthetic drugs and how it could affect their anesthetic plan. In order to remain competitive in the market, CRNAs must assess the cost factor and implement fiscally responsible improvements.

Methods: CRNAs knowledge and understanding of anesthetic drug costs were evaluated using a survey via Qualtrics software. Appropriate review and approval of the University of North Florida's IRB was obtained prior to data collection. The data was collected at the fall Florida Association of Nurse Anesthetists meeting, held October 23-25, 2015, and at 1 community hospital on February 2 and 5, 2016. The survey included 5 demographic questions, 12 survey questions, and 15 drugs in the form of a table with sliding scale of costs. A total of 90 surveys were collected from CRNAs.

Results: Responses from the 90 participants resulted in 67% stating they have never received any type of formal education on the costs of anesthetic drugs or equipment, yet 62% still considered costs when forming their plan. Of the same participants, 70% stated they would be more cost conscious if the money saved could be recycled to benefit the anesthesia department in some fashion. A total of 77% stated they have given neuromuscular blocking drug reversal for medical legal protection. Despite guidelines available, CRNAs surveyed resulted in 50% using anecdotal evidence or drug availability to determine antiemetic drug administration. CRNAs participating either overestimated or underestimated drug costs on an average by 40% of actual value.

Conclusions: Cost is important in healthcare. The cost of service for a CRNA as an anesthesia provider is a big selling point in their utilization. Providing an anesthetic plan that is reasonable and justifiable on costs is just as important. The results of the survey administered showed that CRNAs do not have a reliable understanding of the cost of the drugs they use. Departmental education by employers could bring a better understanding of these costs to their anesthesia providers and help reduce hospital costs as well as the cost to patients.

Broken Spinal Needle: An Uncommon Complication of Spinal Anesthesia

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Introduction: Few incidences of broken spinal needles have been reported in the literature, most of which were case studies involving healthy patients with uncomplicated placement of the spinal needle. There are no reports in which the factors or actual process of fracturing a spinal needle were studied. The purpose of this research was to determine the amount of force required to fracture a spinal needle, within an introducer and to assess congruent techniques such as bending, manipulation, or redirection, which may contribute to the fracturing process.

Methods: A bench study was conducted utilizing a displacement controlled bending load test and fully reversed bending of the spinal needle. For displacement controlled bending, a tension/compression device performed constrained bending of the spinal needle tip at a displacement rate of 1 cm/min, while load was measured. For the second test, the tip of the spinal needle was manually displaced to an angle of 45° relative to its initial position, while in the introducer, which was again rigidly constrained at the base. Fully reversed bending cycles were performed until needle fracture occurred. The resulting displacement of the needle tip was approximately 1 cm from the unloaded position.

Results: Results from the constrained bending load test of 10 spinal needles included no fractures, even when the needle tip was displaced 90° from the unloaded position. When the needle tip was displaced to 45° relative to the unloaded configuration, the maximum bending load of the spinal needle was 28.8 lb, without evidence of needle fracture. In the manual displacement test, fully reversed bending of 10 spinal needles resulted in fracture, occurring on average of 4 cycles.

Conclusions: Despite the large unidirectional bending load on the spinal needle, fracture was not observed, even when the needles were manipulated to 90°. However, fracture was consistently observed during fully reversed bending with significantly smaller displacements. As the bending was reversed, plastic-deformation-induced embrittlement resulted in crack nucleation and propagation. The addition of an axial force may result in needle fracture caused by a reduced cross section due to cracks in the needle wall. Predicting from the calculated stress in the needle wall, displacement of the spinal needle tip only needs to be 1.6 cm or 18° for fracture to occur.

Clinical Teaching Behaviors: A Comparison of CRNA and SRNA Opinions Regarding Effectiveness and Frequency of Use

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Introduction: As the main facilitators of clinical teaching, nurse anesthesia clinical educators (CEs) serve a vital role in the preparation of student registered nurse anesthetists (SRNAs). Teaching behaviors used by CEs have been found to influence student perceptions and learning of fundamental clinical knowledge. Studies in medicine and nursing document learner perceptions of the quality of clinical education; however, relatively little is known about the nature and frequency of teaching behaviors used by CEs to produce competent graduates. The purpose of this study was to determine if there is agreement between CEs and SRNAs regarding the effectiveness and frequency of use of 13 commonly employed clinical teaching behaviors.

Methods: A parallel web based survey was distributed to Certified Registered Nurse Anesthetists (CRNAs) serving as CEs and SRNAs enrolled in the Oakland University-Beaumont Graduate Program of Nurse Anesthesia. Respondents were asked to rate the effectiveness of 13 teaching behaviors commonly employed by CEs using a 5-point Likert scale (1 = always effective) and the frequency at which these teaching behaviors occurred using a 4-point Likert scale (1 = often). Group means and standard deviations were calculated along with the difference in group means (SRNA minus CE), the lower and upper bounds of a 95% confidence interval for the difference, and the p-value of a t-test for difference in means.

Results: A total of 29 (74%) SRNAs and 59 (45%) CEs responded to the survey. Student registered nurse anesthetists rated the frequency of teaching behaviors as occurring substantially less frequently than CEs in 12 of 13 behaviors. There is much less evidence of such differences on the efficacy of teaching behavior items.

Conclusions: This study suggests substantial differences exist between SRNA and CE perceptions of the frequency at which teaching behaviors occur. This disparity may underscore a major gap in nurse anesthesia education. If SRNAs report teaching behaviors as less frequent than CEs, the reality is likely to fall somewhere in the middle. Clinical educators may not teach as frequently as they say they do, whereas SRNAs may sometimes fail to recognize learning opportunities when they occur. Differences may reflect the failure of CEs to recognize and adapt to changes in the needs of current learners or the tendency to view oneself more positively than others do. Students may fail to recognize teachable moments.

Comparison of Intraoperative Course of Surgical Resection of Functioning and Nonfunctioning Pheochromocytoma and Paraganglioma Resection

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Introduction: Surgical resection of pheochromocytomas or paragangliomas is often curative, although the surgical procedure itself can be life threatening because of significant intraoperative hemodynamic instability. Preoperative preparation for these patients consists of alpha-adrenergic antagonists, beta-adrenergic antagonists, calcium channel blockers, metyrosine, and normalization of intravascular volume. If patients with nonfunctioning tumors require preoperative preparation is unknown. In this study, we compare the clinical course of functioning and nonfunctioning tumor resection.

Methods: The medical records of 262 patients who underwent resection of pheochromocytomas or paragangliomas at the Mayo Clinic from January 1, 2000, through December 31, 2014, were reviewed. The perioperative course of functioning and nonfunctioning tumor resection procedures on these patients was compared using a 2-tailed student t-test with a P value < 0.05, considered statistically significant.

Results: A total of 262 patients underwent resection including 51 paragangliomas (21 nonfunctioning, 30 functioning, all open approach) and 211 pheochromocytomas, 46 via open (12 nonfunctioning, 38 functioning) and 161 laparoscopic approach (34 nonfunctioning, 127 functioning). Pharmacologic pretreatment was used in the majority of patients. Patients with functioning paragangliomas had greater maximum blood pressures (192 ± 34 vs 158 ± 21 , $P < 0.001$) and variations (119 ± 35 vs 82 ± 21 , $P < 0.001$). Functioning adenomas resected via open approach did not have greater blood pressure (187 ± 36 vs 177 ± 27 , $P = 0.420$), while laparoscopic approach had greater pressure (185 ± 35 vs 163 ± 21 , respectively, $P < 0.001$). There were 62 complications, and 1 death.

Conclusions: While patients with functioning pheochromocytomas or paragangliomas during resection often had greater intraoperative blood pressure than those with nonfunctioning tumors, both patient groups were observed to have intraoperative hypertension. Thus, prior optimization of patients with nonfunctioning tumors, with adrenergic blockade medication(s), appears to be warranted.

Source of Funding: Mayo Clinic College of Medicine, Department of Anesthesia.

Comparison of Simulation Evaluation Tools in Nurse Anesthesia Training

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Introduction: Simulation has become a core component of many nurse anesthesia programs. A review of the literature identified a lack of a valid and reliable tool specific to evaluation of simulation training in anesthesia. This study aimed to establish validity and reliability of an induction skills checklist (ISC), created for this study, when compared with the Creighton Simulation Evaluation Instrument (CSEI), an established tool in nursing simulation.

Methods: Thirteen volunteer student registered nurse anesthetists (SRNAs) performed simulated induction sequences based on 1 of 4 randomly assigned scenarios. Students were de-identified and video recorded during simulation. Four student evaluators scored the simulations using either the CSEI or the ISC within 1 week of simulation. Two weeks later, the alternate tool was used. This process was repeated a week later by each evaluator using a randomly assigned 20% of the participants. Participants received results via email. Both evaluators and participants completed a Likert score for each tool.

Results: The intraclass correlation coefficient (ICC) was used to establish interrater reliability. Using the first ratings from all 4 evaluators, the ICC for CSEI was 0.89788, and the ICC for the ISC was 0.86999 indicating consistency in scoring between evaluators. In a repeated measures linear regression model that accounts for multiple observations per person, there was a statistically significant difference between the CSEI and the ISC in terms of percent correct ($p < 0.0001$). The ISC had a higher average percent correct (87.8 ± 3.9) than the CSEI (83.1 ± 3.9). The Spearman correlation coefficients ranged from 0.69 to 0.89 and Lin's concordance correlation coefficient ranged from 0.82 to 0.88, depending on the rater.

Conclusions: Reliability of the ISC can be established based on consistency of scoring between evaluators. While the ISC scores were significantly different from the CSEI, validity can be interpreted based on the consistent difference between the 2 scores. Likert scales indicate both evaluators and participants preferred the ISC because of ease of use and interpretation. This study was primarily limited by small sample size and tool design being based on school specific criteria. Results indicate that the ISC is reliable, valid, and can be modified as needed for anesthesia based simulation assessment.

A30

Dexmedetomidine Utilization to Decrease Emergence Delirium in Pediatric Surgical Patients

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Introduction: Emergence delirium is a phenomenon that is not well understood, but a common behavior exhibited by children between the ages of 2 to 18 years old after general anesthesia which can occur in 50% to 80% of cases. Symptoms include hallucination, psychomotor agitation, irritability, and uncooperativeness which may appear within first 15 to 30 minutes after surgery with period of excitation preceded by lethargy. In the event of suspected emergence delirium, anesthesia providers should initiate treatment and prevention in the intraoperative period. Therefore, patients' postoperative period is free of complications from emergence agitation.

Methods: Databases searched include PubMed, Cochrane Library, and Google scholar; 7 primary randomized control trials (RCTs) and 3 meta-analysis studies were found. Additional studies were located from the reference lists of the retrieved articles. Inclusion criteria were pediatric patients with American Society Anesthesiologist's Physical Status I and II undergoing general anesthesia. Exclusion criteria involved developmental delay, neurological disease, recent ingestion of sedatives, or analgesics and any known allergy to the study drugs or previous general anesthesia.

Results: Seven primary RCTs and 3 meta-analyses were found to support the beneficial effect of dexmedetomidine in the prevention of emergence delirium in as much as 95% of cases compared with placebo, propofol, and midazolam. Two primary RCTs found utilization of dexmedetomidine (0.25-0.5 mcg/kg) was more effective compared with propofol (1 mg/kg) injection, and 2 primary RCTs found utilization of dexmedetomidine (0.5 mcg/kg) was superior in preventing emergence delirium when compared with placebo-normal saline. Two meta-analyses found the utilization of midazolam and dexmedetomidine; results showed dexmedetomidine was effective in prevention of emergence delirium.

Conclusions: After reviewing 6 primary RCTs, and 3 meta-analyses of dexmedetomidine utilization in pediatric anesthesia to prevent emergence delirium, findings were consistent in regard to the effectiveness as an adjunct therapy. The administration of intravenous dexmedetomidine (0.3-0.5 mcg/kg) given intraoperatively is effective in prevention of emergence delirium in school-aged children. It also has a short terminal half-life of 2 hours making it a superior adjunct therapy intraoperatively.

A31

Don't Forget to Flush: Dead Space Volumes in Stopcocks and IV Ports

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Introduction: Intravenous (IV) tubing ports and stopcocks used by anesthetists contain variable dead space volumes. Recent literature describes adverse outcomes in both pediatric and adult populations due to residual medications in dead space volumes. Without flushing immediately after medication administration, dead spaces in stopcocks and IV ports may hold concentrated medications; subsequent flushing may cause unintended effects long after the original administration.

Methods: In this descriptive study, researchers identified dead space volumes using a convenience sample of IV tubing and stopcocks from 3 different manufacturers. Using tap water and an analytical scale, dead space volumes were determined by comparing the weight of primed infusion ports and stopcocks to their respective weights after flushing. Weight differences were converted to volumes using the formula $\text{density} = \text{mass}/\text{volume}$.

Results: Dead space volumes in the stopcock samples yielded averages of 0.0752 mL (Nordson Medical), 0.1305 mL (ICU Medical), and 0.2358 mL (Baxter). IV ports yielded average dead space volumes of 0.0558 mL (ICU Medical), 0.0588 (Baxter), and 0.0663 mL (CareFusion).

Conclusions: More variability between manufacturers exists among the samples of stopcocks compared with IV ports. The results underscore the importance of flushing behind medications administered in stopcocks and IV ports to ensure that all medication reaches the patient.

ecoFLOW: Does It Impact Provider Practice?

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Introduction: Clinical decision support (CDS) is a type of health information technology that supports healthcare practitioners by providing additional data during delivery of care. When used in conjunction with a provider's expertise, this input can lead to improvements in the quality of patient care, decreased costs, and improve efficiency in the delivery of care. ecoFLOW is a type of CDS that provides continuous visual feedback of anesthetic agent delivery, consumption, fresh gas flows (FGF), and cost of the volatile anesthetic delivered. The purpose of this research was to determine if the use of CDS technology and its immediate feedback of anesthetic consumption would affect provider's utilization.

Methods: Six months of data were collected (n=900 cases). One-third of cases used ecoFLOW as a CDS technology. Utilizing the anesthesia information management system, physiologic, respiratory, and pharmacologic data were extracted for analysis. For each general anesthetic delivered, the amount of consumed volatile anesthetic agent (VAA) consumption was calculated. The case duration was divided into quartiles to assess the typical behavior of flow rate and VAA used for that case. The middle 2 quartiles were then used to determine the impact of the case's (FGF) on the amount of anesthetic agent consumed. Variables such as the utilization of narcotics and anesthetic adjuvants were also evaluated.

Results: In a study conducted by Shores (2015), ecoFLOW was used to support clinical decision making and illustrated a statistically significant ($p < .001$) decrease in the cost of the anesthetic delivered. To establish that the decrease in cost was due to the presence of ecoFLOW, variables such as the use of narcotics, and FGF were assessed. All variables for the preintervention, intervention, and postintervention groups met similar conditions prior to analysis.

Conclusions: In a time where conservation of healthcare resources is paramount, the use of ecoFLOW technology has the potential to alter a provider's anesthetic delivery in a cost-effective manner. By providing the clinician with a visual representation of current (FGF) settings and cost of anesthetic agent, ecoFLOW can enhance clinical decisions. This type of CDS can lead to lower anesthetic agent consumption that impacts patient outcomes and, as importantly, serve to lower costs in a strained healthcare economy.

A33

Effect of General Anesthesia on Blood Flow Dynamics in the Brachial Artery: A Proof of Concept Study

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Introduction: Perioperative nerve injury is a significant source of morbidity and liability, ranking second in the ASA and AANA closed claims analysis. The ulnar nerve is most affected, often attributed to ischemia from pressure on the cubital fossa. These injuries occur despite proper padding and positioning. Studies show ulnar nerve function decreases to a greater degree with brachial artery occlusion than the radial or median nerves. A gap in the literature exists regarding general anesthesia and blood flow dynamic changes. Specifically, is there a threshold that alters perfusion to the ulnar nerve?

Methods: Following institutional approval, blood flow analysis of the brachial artery was assessed using duplex ultrasonography in a convenience sample of 30 subjects. Baseline values were obtained in the brachial artery at the mid-upper arm prior to the induction of anesthesia, then within 15 minutes after the induction of anesthesia, and at 45 minutes, during the maintenance phase of anesthesia. Brachial artery diameter and peak and minimum blood flow velocities were measured to calculate blood volume, pulsatility index, and resistance index. Parametric testing was applied with a prestudy alpha of $p < 0.05$.

Results: There was a significant decrease in the pulsatility index from the preoperative baseline assessment to the 15-minute postinduction value ($p = 0.000006$). Additionally, there was a statistically significant decrease from the preoperative baseline to the 45-minute maintenance phase value ($p = 0.02$). There was not a significant difference between the postinduction and maintenance phase values ($p = 0.14$). Taken together, this suggests the induction of anesthesia significantly changes blood flow dynamics in the brachial artery, and it remains altered during the maintenance phase of anesthesia.

Conclusions: The induction and maintenance of general anesthesia significantly changes blood flow dynamics in the brachial artery. The statistically significant decrease in the pulsatility index warrants further research to correlate clinical significance, if any. Additionally, different patient populations, comorbidities, various anesthetic techniques, and surgical procedures require investigation to identify those at potentially increased risk.

Source of Funding: AANA Foundation Post-Doctoral Research Grant.

Effects of Sevoflurane on Arginase Activity in Undifferentiated PC12 Cells

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Introduction: Alzheimer disease (AD) is the most common type of dementia and the fifth leading cause of death in Americans over the age of 65 (2014 Alzheimer's disease facts and figures). In a mouse model, the topic of microglia immunosuppression was introduced linking increased arginase activity to AD pathology (Kan et al, 2015). Arginine deprivation may cause memory impairments and immunosuppression suggesting AD may be linked with increased arginine catabolism and nutrient depletion (Kan et al, 2015). The purpose of this study is to determine if sevoflurane administration affects the rate of arginase activity, evidenced by arginine depletion in undifferentiated PC12 cells.

Methods: PC12 cells from rats were grown in flasks in an incubator at 37.0°C with 5% CO₂ at 80% humidity in RPMI 1640 media. The pH was assessed to ensure an adequate environment for growth. PC12 cells were exposed to 2% sevoflurane for 30 minutes, 1-hour and 2-hour time periods. Cell viability was ensured via CellTiter-Blue Assay®. A Lowry protein assay assessed protein concentration. A Sigma-Aldrich® arginase assay kit determined arginase activity of the control group and the sevoflurane treated cells. GraphPad Prism 6 was utilized for statistical analysis. An unpaired t-test was conducted. An ANOVA was used to compare results with significance noted as a p-value less than 0.05.

Results: Research results found no significant decrease in arginase activity following exposure of undifferentiated PC12 cells to 2% sevoflurane. Results did reveal an increase in arginase activity for the 30-minute exposure compared with the control group. The arginase activity appears to return to baseline as time elapses through the 1-hour and 2-hour sevoflurane exposure groups. Cell viability of the undifferentiated PC12 cells rendered no statistical significance between the control and the 3 experimental time groups.

Conclusions: Further understanding of the effects of sevoflurane on arginase activity should be determined in differentiated PC12 cells. Sevoflurane did not show statistical significance of arginase activity in undifferentiated PC12 cells. No correlation with the study by Kan et al can be made suggesting sevoflurane alters arginase activity in nerve cells. Continued studies are needed to determine if AD progression is associated with decreased arginine bioavailability. Limitations of this study include measurement of overall protein content. Mitochondria isolation in future studies will result in more accurate determination of arginase activity.

Functional, Cognitive and Behavioral Alterations in a Rodent Model of Repeated Isoflurane Anesthesia: Implications for the Development of Postoperative Cognitive Dysfunction

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Introduction: After surgery requiring general anesthesia, patients often experience cognitive and emotional disturbances, but it is unclear if this is due to the anesthetic exposure. In the present study, we examined whether isoflurane anesthesia produces long-term pathophysiological alterations in the CA1 region of the hippocampus and the basolateral amygdala (BLA), brain regions that play a central role in learning and memory and emotional behavior regulation.

Methods: Ten-week-old male Sprague-Dawley rats were administered either a single 1-hour-long isoflurane (1.5%) anesthetic, or 3 1-hour-long isoflurane exposures, separated by 48 hours. Behavioral testing, long-term potentiation (LTP), and spontaneous GABAergic activity in the CA1 region of the hippocampus and BLA were studied at 1 day, 1 week, and 1 month.

Results: Single isoflurane anesthesia impaired LTP 1 day after exposure, but was restored by 1 week postexposure in the CA1 region of the hippocampus and had no effect on LTP in the BLA. Following repeated exposure, LTP was enhanced at 1 day, impaired at 1 week, and restored by 1 month in the hippocampus, and in the BLA was dramatically impaired at 1 day and 1 week but restored by 1 month. Spontaneous GABA-A receptor-mediated inhibitory postsynaptic currents were increased in both brain regions at 1 day and 1 week and returned to control levels by 1 month. Spatial memory was significantly impaired at 1 week and returned to control levels at 1 month. Anxiety-like and depressive-like behavior tests did not yield any difference between controls and experimental animals.

Conclusions: Repeated exposures to isoflurane anesthesia cause a long-lasting—but not permanent—impairment of synaptic plasticity in the CA1 region of the hippocampus and BLA, which could be due to increased basal GABAergic activity.

Source of Funding: AANA Foundation TSNRP N14 - P02.

Impact of Testing and Intervention on Student Registered Nurse Anesthetists' Critical Thinking Skills

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Introduction: Recent research on education of student registered nurse anesthetists (SRNAs) argues that the instruction and evaluation of nontechnical skills prior to entering the clinical arena is essential to decreasing human error that risks patient safety. This study examines the impact of testing and intervention on SRNAs' critical thinking skills. Goals of this research were 2-fold: to determine baseline critical thinking scores for SRNA cohorts and to measure any growth in 5 categories of critical thinking (induction, deduction, analysis, inference, and evaluation) over the period of 1 year.

Methods: Twenty-four SRNAs participated in a "pretest, intervention, posttest" research design for 12 months utilizing the Health Sciences Reasoning Test. HSRT is the appropriate tool for this study, as it is specifically designed to assess the critical thinking skills of health science students and professionals. The HSRT results consist of an overall score and 5 categorical scores. Intervention consisted of test score debriefing and didactic and clinical experiences. Analysis of data included mean comparisons and correlation and regression analysis. Additional analysis based on student demographics was conducted. UTC IRB (FWA00004149) has approved this research project #15-005.

Results: Baseline pretest and posttest critical thinking scores for the cohort were successfully captured. Over 1 year, significant gains were made in the overall scores ($p < .05$). Overall score increases are driven by significant increases in deduction skills ($p < .01$) and analysis skills ($p < .05$). In terms of the demographic factors, 3 findings emerged: students that attended public high school have higher overall posttest scores, on average, compared with other students ($p < .05$); students from educationally disadvantaged schools significantly improved their deduction skills scores compared with other students ($p < .01$); and younger students have significantly higher analysis scores compared with older students ($p < .01$).

Conclusions: Significant increases were found between pretest and posttest for the overall critical thinking skills, particularly for the individual areas of deduction and analysis. While some patterned relationships exist on the basis of public school attendance, student age, and educational disadvantage status, the cohort do not vary significantly in their critical thinking skills based on demographic factors of race, gender, and first in family to attend college or rural school. Overall, skills intervention and evaluation were successful.

Source of Funding: The Health Resources and Services Administration of the U.S. Department of Health and Human Services (HHS) under grant number D19HP26972 and title, CRNAs in 3D: Increasing Diversity, Reducing Disparities, & Understanding the Social Determinants of Health, for \$1,026,153. 100% of this project is financed through governmental sources.

Incidence, Course, and Characteristics of Hydralazine-Associated Tachycardia During Phase I Postanesthesia Recovery

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Introduction: Efficient patient movement through the PACU is complex. Delays in the process can disrupt the flow of surgical practices. Our institution identified the use of antihypertensives as a common reason for delayed PACU discharge. An institution protocol mandates extended monitoring of patients following their administration. Hydralazine requires the greatest amount of extended monitoring due to concerns of baroreceptor-mediated reflex tachycardia. The primary aim of this study was to describe incidence, onset, severity, and outcomes of tachycardia associated with hydralazine therapy in the PACU.

Methods: Patients administered hydralazine during phase I recovery from January 2010 to December 2014 had their electronic medical records reviewed for tachycardia and hypotensive events. Patients < 18 years of age undergoing obstetric, cardiothoracic, or cardiac catheterization procedures were excluded. Tachycardia was defined as a heart rate ≥ 100 beats per minute (BPM) and hypotension as a mean arterial pressure ≤ 55 mm Hg. These indices were collected 120 minutes before and after the administration of hydralazine and were included in the analysis. Medical records were electronically abstracted using proprietary software.

Results: A total of 745 patients were administered hydralazine during phase I recovery. Seventy patients (94.0 [CI 95% 74.0-117.2] cases per 1,000 administrations) developed tachycardia with a median increase 23 [15, 37] BPM and a maximum rate of 106 [103, 111; range 101 to 131] bpm. The duration of tachycardia was 28 [5, 86] minutes, and all cases resolved without treatment. The median onset of tachycardia following hydralazine administration was 43 [20, 93] minutes, with 40% occurring after the first hour. Tachycardia was more likely associated with female sex ($P < 0.001$), younger age ($P < 0.001$), and those with lesser comorbidities ($P = 0.009$). Outcomes were not different between patients who did or did not develop tachycardia.

Conclusions: A sizeable proportion of patients administered hydralazine developed dose-independent tachycardia. The propensity for tachycardia was more likely observed in younger females and in those with less comorbidity. Even though all incidents of tachycardia were self-limited and without obvious clinical sequelae, anesthesiologists must consider these effects and avoid it in patients in whom tachycardia should be avoided. Our findings suggest that patients who received hydralazine during the phase I recovery warrant heart rate monitoring for longer than 1 hour.

Increasing Diversity: Building Pathways To the CRNA Profession

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Introduction: The nursing workforce is comprised of only 24.6% minorities, and among CRNAs only 9%. Increasing the number of minority nurses is 1 solution for eliminating health disparities and increasing quality of care. Patients are more likely to receive high quality preventative care and treatment when they and their providers share race, ethnicity, language, and/or religion. Project examines impact of individual-level and social-level strategies of recruitment and education outreach on minorities applying to and gaining acceptance in a MSN-NA Program.

Methods: Project implemented both individual-level and social-level strategies over a 12-month period to target minorities across 4 entry points: high school, community college, 4-year institutions, and the workplace. Demographic data was collected at each entry point. Data analysis compared 2016 and 2017 program candidates with historical applicant data. Additionally, qualitative data regarding participant experiences, perceptions, and exposure was collected from high school students. UTC IRB (FWA00004149) has approved this research project #15-005.

Results: Of the 98 applicants for the 2016 MSN-NA Program, 24.5% were candidates of color—a significant change ($p < .01$) resulting in an increase of 100% over the previous year. Of those accepted, 20% self-identify as minorities, resulting in a significant ($p < .01$) increase of 400% over the previous year. Data analysis indicates the minority high school students ($n=44$) who participated in the various outreach activities were engaged, encouraged, and interested in learning more about nursing, with 62% of respondents reporting that they would like to pursue nursing as a profession.

Conclusions: Project strategies resulted in significant gains in overall student registered nurse anesthetist diversity. The model for education and recruitment strategies across multiple entry points to the CRNA pathway has proven to be highly successful and one that could be easily replicated. Repeated exposure and education to nursing activities and information fosters an interest in the profession. The various recruitment methods employed supports an increase in diverse program candidates.

Source of Funding: The Health Resources and Services Administration of the US Department of Health and Human Services (HHS) under grant number D19HP26972 and title, CRNAs in 3D: Increasing Diversity, Reducing Disparities, and Understanding the Social Determinants of Health, for \$1,026,153. One hundred percent of this project is financed through governmental sources.

Interrater Reliability and Usability of a New and Innovative Student Registered Nurse Anesthetist Clinical Performance Evaluation Instrument

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Introduction: The purpose of this process improvement (PI) project was to determine the interrater reliability (IRR) and usability of a new and innovative Student Registered Nurse Anesthetist (SRNA) clinical performance evaluation instrument, which to the best of our knowledge also incorporates a visual analogue scale (VAS) for the first time. The SRNA clinical performance evaluation instrument is used to define expectations, provide single event and summative feedback, gauge acquisition of skill sets, and validate students as safe practitioners. Instrument IRR is critical for impartiality toward both the student and the program while usability allows evaluators to use the instrument correctly.

Methods: This prospective, mixed qualitative/quantitative, fully crossed observational design project with a usability survey was approved by the AMEDD Center and School, Human Protections Administrator; Madigan Army Medical Center, Department of Clinical Investigation; and Northeastern University (NEU) IRB as a PI project and in partial fulfillment of NEU DNP requirements. The clinical performance of 3 first clinical year SRNA volunteers and 3 second clinical year SRNA volunteers was video recorded during simulation. The SRNAs' recorded performance was evaluated by a convenience sample of 5 program clinical faculty and 5 CRNAs, who also mentor SRNAs, using the instrument. All participants were invited to complete the usability survey.

Results: IRR was assessed using a 2-way mixed effects model, absolute, average-measures intraclass correlation coefficient (ICC). Aggregate ICC is high for all measures and participants [$n = 10$], $ICC = .982$, 95% CI [.884, .960] indicating a high degree of evaluator agreement between and among participants. However, for evaluated categories, IRR for Professional Role was not statistically significant at the 95% CI for any measures or participants. Communication was not statistically significant at the 95% CI for clinical faculty measures only. Internal consistency is excellent as measured by Cronbach alpha (CA) indicating the instrument is constructed appropriately and will elicit consistent and reliable responses, $CA = .943$. The instrument is easy to use, easy to learn, and participants were mostly confident they used the instrument correctly.

Conclusions: The project instrument demonstrated high IRR and CA for all measures and participants. Future projects should focus on individual category IRR with emphasis on Professional Role and Communication, as well as relevancy testing of instrument objectives. This project should also be replicated using a web-based instrument and include intrarater reliability and validity testing. It is also critical to determine the reliability and validity during SRNA performance in the operating room. As clinical evaluation is a critical component of the SRNA's program of study, determining the IRR and usability of the project evaluation instrument is the first step to improve the SRNA education process.

A40

Investigation of the Antidepressant Effect of Curcumin, a Compound from Turmeric (*Curcuma longa*), in the Adult Male Sprague-Dawley Rat

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Introduction: Depression is the leading cause of disability between the ages of 15 and 44 in the United States. Limitations of antidepressant therapy often cause people to use alternatives to traditional antidepressant therapies in an attempt to ameliorate or obviate their depressive symptoms. Herbal medications such as curcumin, a compound from turmeric (*Curcuma longa*) have long been reported to have antidepressant properties. The purpose of this study was to examine the antidepressant effects of curcumin and its possible modulation of the benzodiazepine site on the γ -aminobutyric acid (GABA_A) receptor.

Methods: Utilizing a prospective, between subjects group design, 55 male Sprague-Dawley rats were randomly assigned to 1 of 5 groups: vehicle, 0.5% dimethyl sulfoxide; curcumin, 20 mg/kg; midazolam, 1.5 mg/kg; flumazenil, 3 mg/kg + curcumin, 20 mg/kg; or midazolam, 1.5 mg/kg + curcumin, 20 mg/kg. Forty minutes after intraperitoneal injection of 1 of the study medications, the rats were evaluated during a forced swim test (FST), a tool for evaluating behavioral despair in the rat. Data analyses were performed using a 2-tailed multivariate analysis of variance and least significant difference post hoc test.

Results: The 5-minute FST was used to observe 2 behaviors: time mobile and fecal pellet output (FPO). Time mobile was determined to be the total mean time the rats were actively moving. The mean time mobile was significantly lower in the curcumin group compared with the midazolam + curcumin group ($p = .021$). Furthermore, the midazolam group had the lowest mean time mobile when compared with the vehicle group ($p = .028$), the flumazenil + curcumin group ($p = .026$), and the midazolam + curcumin group ($p = .001$). Mean FPO was significantly higher in the vehicle group (5.9) compared with the curcumin group (4.1, $p = .021$), the midazolam group (3.4, $p = .002$), and the midazolam + curcumin group (4.0, $p = .015$).

Conclusions: In isolation, curcumin did not demonstrate a significant increase in mean time mobile during the FST. However, FPO output was decreased with curcumin and also in the group that received curcumin + midazolam. Despite no evidence of a main effect on behavioral despair, the combined results suggest that curcumin may reduce the sedative effects of midazolam and display a slight effect (decreased FPO) on behavioral despair. The effects of herbal medications and their interactions with traditional medications are key pharmacological considerations for the anesthetic provider to understand.

Source of Funding: American Association of Nurse Anesthetists (AANA) Foundation.

A41

IV Acetaminophen: Efficacy in Reducing Narcotic Consumption in Laparoscopic Cholecystectomy

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Introduction: A core component of a nurse anesthetist's role is to provide analgesia in the perioperative period. Opioids, a common intervention, cause side effects of nausea, vomiting, and respiratory depression. The use of intravenous (IV) acetaminophen in a multimodal approach has been shown to decrease the amount of narcotics and subsequent induced side effects in the perioperative period. There is limited evidence if this benefit applies to laparoscopic cholecystectomies. This study was designed to determine if perioperative use of IV acetaminophen could improve patient outcomes and pain control in this patient population.

Methods: This study is a retrospective chart review of a single center to assess the efficacy of using IV acetaminophen to improve analgesia in laparoscopic cholecystectomy surgeries. All laparoscopic cholecystectomy surgery patient records from April through September 2015 were reviewed. Records of 203 patients were reviewed; 18 who had concomitant procedures were not included in the statistical analysis. Data collected included pain and antiemetic medications administered in the perioperative period, timing of medications, pain scores, liver function test (LFT) lab work, patient demographics, and surgical timing statistics. Opioids were converted to morphine equivalent doses for comparison.

Results: Records of 185 patients meeting inclusion criteria included inpatient and outpatient, male and female, ASA classes I-IV, and both emergent and nonemergent patients. Within this group, 121 received IV acetaminophen and 64 did not. The non-IV acetaminophen group had a higher percentage of emergency cases ($p=0.035$) and a greater number of elevated total bilirubin values ($p=0.056$), which may have affected the analgesia selection. The results indicated that there was not a statistical difference during the immediate perioperative period in the pain scores or narcotics consumption between patients who did or did not receive IV acetaminophen.

Conclusions: The results of this study do not indicate additional benefits in analgesia or a decrease in narcotic consumption during the perioperative period. The timeframe of the study may be too narrow to see the statistically different long-term effects of multimodal vs narcotic anesthesia. The pain stimulus from this procedure, when performed efficiently by the experienced surgeons at this facility may not generate a level of pain that requires the introduction of IV acetaminophen, despite its proven efficacy in other types of operations. A study of a larger population in a variety of hospital settings, inclusive of academic facilities, may present different findings.

Labor Cost Analysis of Rotational Thromboelastometry (ROTEM®)

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Introduction: ROTEM® is a viscoelastic point-of-care technology used to assess interactions of coagulation factors over time during the phases of clotting and subsequent thrombolysis. A graphical representation of the ROTEM® can be used to evaluate the specific type of blood products, if any, needed for coagulopathic patients. The supply cost of running rotational thromboelastometry, including quality control and all supplies, is approximately \$235. The purpose of this study was to investigate the workflow (cost) necessary to analyze a blood sample with a viscoelastic rotational thromboelastometry method.

Methods: Rotational thromboelastometry tests were conducted by both experienced and inexperienced providers. A stopwatch was used to determine the time it takes to mix the agents and start each point-of-care test. The cost of labor was calculated by applying the respective salary of the operator to the average time it took them to run the test. The timing of quality control tests, performed once each week, was also recorded and the salary of the operator was applied to determine labor cost of the quality control test.

Results: There was no difference in the time it took an experienced versus inexperienced provider to mix the reagents and start the test. This suggests that the mixing procedure is easy to do and quick to learn. Thus it may be inferred that the mixing procedure is negligible in cost. However, the quality control test requires a substantial amount of time commitment, and unless tasked with other duties, the labor could be costly while waiting for calibration to complete.

Conclusions: It is apparent that the costs for the labor of the mixing procedure is minimal, while the most substantial cost of thromboelastometry is driven by the price of the supplies and labor associated with running quality controls. Delegating quality control testing to a lower-waged, trained professional could be beneficial in reducing costs. A second key message is that mixing the agents is easy to do and quick to learn, which is favorable when considering adopting the use of the thromboelastometry or using it in place of standard laboratory coagulation tests.

Lethal Injection: Implications for Anesthesia Providers and Current Case Law

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Introduction: Lethal injection was instituted as a humane form of execution. Lack of regulation, monitoring, and availability of lethal injection drugs have contributed to inconsistent methods of capital punishment. Most execution personnel have little to no medical knowledge. In most death penalty states, prison officials have minimal or no anesthesia training, drugs are administered without adequate monitoring, and data is rarely recorded.

Methods: A search of the electronic databases PubMed, CINAHL, UpToDate, and Google was completed between April 2015 and July 2015. MeSH terms included lethal injection, lethal injection drugs, physician participation, inadequate anesthesia, botched executions, and ethics and execution. Nineteen articles were retrieved. Only peer-reviewed, English language articles were accepted for review. Thirteen articles were accepted for inclusion.

Results: Review of the literature revealed that 80% of physicians surveyed indicated that at least 1 disallowed action was acceptable, 53% indicated that 5 or more were acceptable, and 34% approved all 8 disallowed actions. The percentage of respondents approving of disallowed actions varied from 43% for injecting lethal drugs to 74% for determining when death occurred. All 4 allowable actions were deemed acceptable by the majority of respondents. Favoring the death penalty ($r^2=0.20$, $p<.001$) was also associated with an increased number of disallowed actions that were deemed acceptable.

Conclusions: As of June 2015, the Supreme Court ruled that current methods of lethal injection do not violate the US Constitution's 8th Amendment. Increased litigation along with supporting evidence that inmates suffered agony and pain during lethal injection has reinvigorated the debate about physician and anesthesia provider involvement. Current scholarship and research suggest doctors or anesthesia providers should be mandatory or at least allowed to participate in the lethal injection process to lower the risk of unnecessary pain and suffering during the execution process.

Life-Saving Zofran? The Role of Serotonin in Fulminant Pulmonary Embolism Syndrome

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Introduction: Pulmonary embolism syndrome (PES) occurs as a result of embolization of various materials: thrombi, fat, bone cement, and amniotic fluid. Fulminant PES resembles anaphylactic/shock states, with pulmonary hypertension, systemic hypotension, cor pulmonale, right ventricle dilation, and failure, ultimately leading to cardiac arrest. The severity of insult is not dependent on size/amount of embolus, suggesting a pathogenesis not entirely associated with mechanical obstruction, as previously thought. This literature review examines the underlying mechanism of PES and elucidates possible novel treatments.

Methods: An online search of Columbia CLIO Library and Google Scholar revealed 3 systematic reviews, 6 randomized peer-reviewed studies, and 4 case reports that met inclusion criteria. PES is rare and therefore inherently difficult to study in man; thus, animal studies were included in all but case reports. The wealth of historical studies necessitated inclusion of peer-reviewed studies as old as 1981. Systematic reviews were considered after the year 2000. Human case studies after 2013 were included.

Results: The data suggest a strong influence of vasoconstriction on the pathophysiology of fulminant PES. Serotonin (5HT) is the strongest pulmonary vasoconstrictor known to man, and 5HT is released from degranulated platelets in all types of PES. In both experimental studies and human case studies, blockade of 5HT had profound influence on sequelae of (and survival after) PES. It is suggested that serotonin antagonists may be a highly beneficial measure in the acute phase of treatment by reducing pulmonary vasoconstriction.

Conclusions: The evidence presented seeks to bring some clarity to the complicated and poorly understood pathogenesis of PES. With knowledge of the mechanism of PES, new treatment options including 5HT antagonism may be shown to be highly successful in clinical practice, with little downside. This deadly and relatively rare syndrome is inherently difficult to study in man, so education and implementation in clinical practice is of primary importance. Because of the relative paucity of human studies, additional case studies and research are needed to further delineate successful treatment strategies in man.

A45

Loss of Heterozygosity in *Drosophila Melanogaster* Related to Exposure of Anesthetic Gases and Mutations in Offspring

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Introduction: Teratogenic effects from exposure to volatile anesthetics have been shown to cause congenital anomalies and increase the risk of spontaneous abortion by 50%. Also, repeated exposure may result in genotoxicity. The purpose of this study is to compare the degree of genotoxicity of desflurane, isoflurane, and sevoflurane by analyzing loss of heterozygosity (LOH) in the offspring of *Drosophila melanogaster* (DM) after exposure to 1 minimum alveolar concentration (MAC) of these agents.

Methods: In this quantitative, experimental laboratory study, the SMART assay was used to determine changes in eye color in female offspring of *Drosophila melanogaster* that were exposed to 1 MAC of desflurane, isoflurane, or sevoflurane. Experimental groups were compared with control groups, which consisted of a no treatment group and a group exposed to EMS, a known teratogenic chemical used to induce DNA mutations for scientific research.

Results: In all 3 experiments, in comparison with control animals, the *Drosophila* exposed to any of the 3 anesthetics tested showed a sex-skew in the offspring population, with more females than males observed. When assessing LOH in females, as measured by white spots in a normally red eye: in all 3 experiments run, the isoflurane-exposed flies exhibited more white spots (LOH) than controls, whereas the desflurane-exposed flies had significantly more LOH in 2 of the 3 experiments, and the sevoflurane-exposed flies showed no significant difference compared with the control (unexposed) animals.

Conclusions: Sevoflurane resulted in the least amount of genetic mutations present in *Drosophila*, whereas isoflurane resulted in the most. Desflurane produced genetic mutations in 2 out of the 3 experiments.

Source of Funding: Webster University Nurse Anesthesia Program.

Lung Protective Tidal Volumes and the Incidence of Mortality in Cardiovascular Surgery Patients Undergoing Left Ventricular Device Placement

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Introduction: Use of lung protective tidal volumes has proven to be beneficial in patients undergoing different types of surgical procedures. Studies have explored lung-protective mechanisms; lung protective ventilation was shown to improve the outcomes of critically ill patients with acute respiratory distress syndrome (ARDS) by preventing an ongoing recruitment and derecruitment of distal lung units; however, there has not been significant research to suggest that lung-protective tidal volumes are beneficial in cardiac surgical patients undergoing left ventricular assist device (LVAD) placement.

Methods: Following institutional review board approval, a retrospective study was conducted on patients who had cardiovascular surgery for LVAD implantation at the Mayo Clinic-Rochester Campus between January 1, 1997, and December 31, 2014. These patients were placed into 2 groups. The first group consisted of patients who received conventional tidal volumes during mechanical ventilation of > 8 mL/kg. The second group contained patients who received lung protective tidal volumes of $< \text{or} = 8$ mL/kg during mechanical ventilation.

Results: Analysis of data showed lung protective tidal volumes were statistically significant for in-hospital morbidity (death, pneumonia, ARDS). Additionally, patients were evaluated for preexisting lung conditions, and each of these was cross matched for mortality. This analysis showed that patients who had preexisting lung conditions were no more likely to experience in-hospital morbidity. The data was examined to determine if higher tidal volumes are associated more frequently with hypoxia (low paO_2 and low $\text{PaO}_2/\text{FIO}_2$ ratio. if lower tidal volumes are associated with higher CO_2 values, and finally, if there was any difference in renal dysfunction between the 2 populations.

Conclusions: Results showed benefit for patients receiving tidal volumes less than or equal to 8 mL/kg. Additionally, it did not show an association with postoperative morbidity/mortality with preexisting lung disease. Higher tidal volumes were associated with hypoxia, lower tidal volumes were not associated with hypercarbia, and there was a difference in risk of renal dysfunction between the 2 groups, although not statistically significant. Perioperatively, it is important for anesthesia providers caring for patients undergoing LVAD placement surgery to ventilate with lung protective tidal volumes.

Source of Funding: Mayo Clinic College of Medicine, Department of Anesthesiology.

A47

Measuring the Initial Success of Nurse Anesthesia Students: Ultrasound Versus Nerve Stimulator in Simulation

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Introduction: The aim of this study was to evaluate novice learners attempting peripheral nerve block placement in a simulated setting. The intention was to discover if there is a difference in a novice learner's initial success using ultrasound (US) versus nerve stimulator (NS) in a simulated learning environment. It was hypothesized that after being taught both techniques, initial attempts to identify the nerve on the peripheral nerve block simulation model would be more successful in the US group than the NS group.

Methods: A sample of 19 students was enrolled and randomized into 2 groups, which correlated with placement in either the US group or the NS group. All were instructed on nerve block methods. Nine students attempted US guided block of a nerve for peripheral nerve blockade, followed by simulated nerve identification using the nerve stimulator technique. Ten students attempted in the reverse order. Nerve identification with the block needle was a sufficient measure of success. The attempts using each technique was measured in seconds. The number of needle redirections and needle reinsertions were also recorded.

Results: Though not statistically significant, nerve stimulator had a faster time-to-nerve identification (93.8 seconds) and averaged more reinsertions (1.6) than the ultrasound time-to-nerve identification = 113 seconds and average reinsertions = 1.5. The use of the nerve stimulator required a significant number more redirections (6.9) than the use of ultrasound (2.8). Gender and years of experience were independently associated with time to successful nerve identification. Advanced age and increasing number of redirections were associated with more time to nerve identification.

Conclusions: The findings of this study were inconclusive and support the continued need for more research in this area. The results demonstrated a faster time to nerve placement when the nerve stimulator was used; however, this was coupled with a significantly increased number of redirections. We were unable to reject the null hypothesis of this study. We identified a small number of limitations. The use of high fidelity models in this study is a necessary evolution of the currently available research in this field and with further refinement will likely yield significant results that can be used to guide the implementation of simulation for instruction in peripheral nerve blockade.

A48

Mild Cognitive Impairment and Exposure to Surgical Anesthesia: A Population-Based Nested Case Control Study

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Introduction: Much of the previous research examining long-term cognitive decline after anesthesia utilized dementia as the primary outcome. Mild cognitive impairment (MCI) is more sensitive to detect an association between anesthesia and cognitive decline, as such a decline often precedes the diagnosis of dementia. The hypothesis predicted that exposure to surgical anesthesia after the age 40 is not associated with MCI.

Methods: A case-control study within a population-based cohort ages 70 to 89 years, underwent baseline evaluations that included the Clinical Dementia Rating scale, a neurologic evaluation, and neuropsychological testing. Individuals identified with MCI were matched 1:2 on several factors with participants who were cognitively normal at the time of the index visit. Medical records from age 40 until the index visit were reviewed to determine anesthesia exposures. Conditional logistic regression was used to assess whether exposure to surgical anesthesia after the age of 40 was associated with the MCI.

Results: A total of 454 Mayo Clinic Study of Aging (MCSA) participants (259 males, 195 females) were diagnosed with MCI at enrollment with mean age 82.0 ± 5 years. Anesthesia exposure after the age of 40 was not found to be significantly associated with MCI when analyzed as a dichotomous variable (any vs none, adjusted odds ratio 0.96 [95% CI 0.71-1.31]) or the number of exposures odds ratio 1.10 [0.76-1.60], 0.81 [0.57-1.14], and 1.05 [0.73-1.51] for 1, 2-3, and ≥ 4 exposures with no exposure as the reference. Similar results were obtained for anesthesia exposure after the age 60, and during 5, 10 and 20 years prior to the index visit.

Conclusions: Study exposure to surgical anesthesia after age 40 was not significantly associated with MCI in participants older than 70 years of age. These results mirror previous reports indicating that exposure to anesthesia after age 40 is not associated with the development of MCI in individuals who were cognitively normal on enrollment in the studies. Findings suggest that underlying cardiovascular comorbidity increases risk for MCI and not exposure to anesthesia and surgery. Clinicians should educate their patients regarding these risks and neurocognitive evaluation is recommended.

Source of Funding: This study was supported by National Institutes of Health grants, Robert H. and Clarice Smith and Abigail van Buren Alzheimer's Disease Research Program, the Rochester Epidemiology Project, the Mayo Clinic Center for Translational Sciences Activities, and the Department of Anesthesiology Mayo Clinic

Passport To Ongoing Education: Nurse Anesthetists Volunteering Abroad

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Introduction: Internationally, Certified Registered Nurse Anesthetists (CRNAs) provide the majority of anesthesia care. A worldwide survey conducted in 1997 found nurse anesthetists administered 75% of anesthesia, and independently, CRNAs comprised 50% of anesthesia providers in rural areas and 38% in urban areas. Volunteer CRNAs provide care and services “that are not consistently available,” and they teach local medical personnel how to provide care to patients. A gap exists in the extent of care provided and the experiences of CRNAs who participate. The goal was to gain insight into the processes from motivation and recruitment to limitations and barriers of volunteering internationally.

Methods: A literature review was conducted in PubMed and CINAHL. The survey included 22 questions designed to offer responses as well as write-in answers. Through skip logic, we analyzed the participants and separated them into CRNAs who participated in medical trips abroad, as well as those who were interested in volunteering abroad. The survey was administered through a social network site. The participants in the survey are members of the social network website, who are either a CRNA or a student registered nurse anesthetist (SRNA). Answers were collected and organized based on CRNA/SRNA status and volunteer status, and a statistical analysis was conducted.

Results: A total of 131 responses were received. Over 80% of participants who completed the survey showed interest in volunteering abroad as an anesthesia provider. The average number of times they volunteered was 6.27. The greatest obstacle to volunteering internationally is time, followed by finances. When volunteering internationally, CRNAs worked mostly with other CRNAs, and 93% of CRNAs administered the anesthesia independently. Results showed that CRNAs began volunteering abroad after having worked for more than 5 years. CRNAs reported that the biggest difference in practicing in the United States versus practicing internationally was types of equipment, followed closely by documentation, resource staff, and medications. Most volunteers learned about opportunities to volunteer via their place of employment and were self-funded.

Conclusions: This study supports the hypothesis that international volunteerism is interesting to CRNAs and volunteering internationally benefits the providers. Our results agree with the finding that nurses in general report volunteering abroad to be an emotionally valuable experience, help develop a career, increase the providers’ sense of compassion and self-worth, sharpen nursing skills, and present new challenges to overcome. The conclusion holds recommendations for the future from areas of potential research to education programs offering a mentorship program or accredited elective to foster student international volunteerism.

Pediatric Preoperative Handovers: Does a Checklist Improve Information Exchange?

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Introduction: Problems inherent to transfer of medical care between providers include miscommunication and lack of vigilance and are directly related to clinical complications and negative patient outcomes. Our study sought to evaluate incidence of specific problems during preanesthetic handoffs and to demonstrate improvement following institution of a structured handoff tool.

Methods: Evaluation of preanesthetic handoffs was made by observation of 60 preoperative transfers of care. A structured handoff tool was developed based on these observations, and implemented with ongoing staff education. Two weeks after implementation, evaluation of preanesthetic handoffs was repeated by observation of 60 preoperative transfers of care. Time required for handoff was assessed before and after implementation, and a satisfaction survey was administered to participating staff.

Results: Fifteen critical elements of preanesthetic handoffs were identified. The structured handoff tool had no significant effect on accuracy of information conveyed for 6 elements, increased confirmation of 2 elements (consent, history and physical) by > 50%, and increased verification of 7 elements (isolation status, holding room medications, deep venous thrombosis prophylaxis, antibiotic administration, IV placement/plan, OR destination, and surgical site marking) by > 75%. Survey results indicated 95% of staff agreed or strongly agreed they were satisfied with the structured handoff tool; 85% agreed or strongly agreed the tool was efficient. Time required for handoff was similar before and after tool implementation.

Conclusions: Use of a structured handoff tool significantly increased quality of preoperative transfers of care for a majority of critical elements. Staff satisfaction with the structured handoff tool was high; time required for handoff was not increased. Given these results, the structured handoff tool now serves as our standard preoperative checklist. Since implementation, there have been several near misses identified with the use of the structured handoff tool.

Perianesthetic Risks and Outcomes of Partial Hepatic Resections or Hepatic Arterial Ligations for Metastatic Carcinoid

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Introduction: Patients with metastatic carcinoid tumors often undergo surgical procedures to reduce tumor burden and associated debilitating symptoms. These procedures and anesthesia can precipitate a life-threatening carcinoid crisis. We undertook the following study to determine the frequencies of outcomes and factors predictive of perioperative complications in patients undergoing hepatic resections for metastatic carcinoid tumors.

Methods: The surgical database at Mayo Clinic in Rochester contains the names and clinic numbers of patients who underwent a partial hepatic resection for metastatic carcinoid. Between January 1, 1997, and June 30, 2015, 171 patients underwent this surgery. These patient records were reviewed according to a prepared data abstraction form. We identified additional categories of data to be abstracted for further examination. Data abstraction was performed by coinvestigators using an extensive, well-accepted set of definitions for each data entry.

Results: Medical records of 84 males and 87 females (mean age 58.9 years) were reviewed and the following outcomes were identified. Intraoperative red blood cell transfusion was required in 25 out of 169 (14.8%) cases with an average of 2.4 units administered in each patient receiving blood transfusion. Postoperative admission to ICU occurred in 15 out of 169 (8.9%) cases. Postoperative myocardial infarction occurred in 2 out of 169 (1.2%) cases, and pulmonary embolism occurred in 1 out of 169 (0.6%) cases. Death within 30 days of operation occurred in 2 out of 169 (1.2%) patients: one due to postoperative gastrointestinal bleed, and one due to cardiac arrest related to coronary arterial disease.

Conclusions: Evaluation of the perianesthetic risk factors and outcomes of metastatic carcinoid surgery has considerable practical significance. Despite advances in chemotherapy, immunotherapy, and invasive radiologic techniques, metastatic carcinoid surgery continues to be indicated in certain patients.

Aggressive surgical therapy in these patients is performed to reduce the patient's tumor burden, thereby decreasing debilitating carcinoid symptoms and prolong life. Understanding potential perioperative complications allows us to anticipate and promptly treat any complication that may arise.

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Predictors of At-Home Arterial Oxygen Desaturation Events in Ambulatory Surgical Patients

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Introduction: Little is known about the early at-home recovery phase in patients undergoing outpatient surgical procedures. Many Americans today are overweight and suffer from various comorbidities, yet they are being sent home to recover unmonitored more frequently than ever before. The current study aimed to investigate, via patient journaling and at-home pulse oximetry, the early recovery period of patients who have undergone ambulatory orthopedic surgery.

Methods: Fifty adult patients were recruited from 2 ambulatory surgical centers in Richmond, Virginia, and West Burlington, Iowa. These patients all underwent orthopedic surgery involving an extremity and were discharged home the same day. Patients went through preoperative assessment including STOP-Bang analysis. Following postoperative discharge, for the first 48 hours of recovery, they were instructed to fill out a journal every 4 hours and to wear a portable pulse oximeter, equipped with a memory device, when sleeping or resting. Regression analysis assessed relationships among noteworthy variables.

Results: Patients with STOP-Bang scores of zero experienced approximately 60 oxygen desaturation events, defined as SpO₂ < 90%, in study period. Patients with higher STOP-Bang scores had a precipitous increase in desaturation events and duration of time spent with a low SpO₂. Severe desaturation events were common in those with higher STOP-Bang scores. Body mass index (BMI) and age were the most significant predictors of desaturation events. Patient journal derived predictors of avoiding desaturation were using home continuous positive airway pressure (CPAP), using prescription opioids, and experiencing a happy mood.

Conclusions: Patients following ambulatory surgery recovering at home are found to have desaturation events in the immediate postoperative period. Increased STOP-Bang scores are associated with more frequent and severe episodes of low SpO₂ and a longer duration of hypoxemia. CPAP utilization, pain relief, and happy mood are associated with fewer desaturation events. Results of this study highlight the importance of STOP-Bang analysis screening, patient access to CPAP in the immediate postoperative period, and appropriate patient education regarding analgesic regimen.

Source of Funding: AANA Foundation.

Preoperative Relaxation Techniques for Breast Cancer Patients Undergoing Breast-Altering Surgery: A Systematic Review

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Introduction: The purpose of this systematic review is to examine the current research on complementary alternative treatments used to decrease preoperative anxiety in breast cancer patients undergoing breast-altering surgery. Preoperative anxiety is an issue that affects many surgical patients. “Anxiety can be defined as feelings of tension, apprehension, nervousness, fear and high autonomic activity that varies in intensity and degree of fluctuation over time” (Valenzuela-Millan, Barrera-Serrano, Ornelas-Aguirre, 2010). Studies have reported the immediate preoperative period to be one of the surgical time periods of highest anxiety for patients.

Methods: The PubMed and CINAHL databases were searched with multiple searches and included the terms: preoperative and anxiety, anxiety and breast cancer, preoperative anxiety and breast cancer, and preoperative and relaxation techniques. Other keywords used in the search included distress, integrative, alternative, and complementary, combined with terms including treatments, therapies, practices, surgery, biopsy, and procedures. Additional articles were included from the references of resulting articles.

Results: Patients of younger age, those undergoing invasive surgeries, and those without a support system have higher anxiety within the surgical breast cancer patient population. Complementary therapies such as the use of essential oils, music, and hypnosis have been effective in reducing anxiety for preoperative breast cancer patients. When adhered to a mindfulness-based stress reduction program can be beneficial in reducing anxiety in this patient population. Waiting period between diagnosis and surgery is a high anxiety time period for this patient population, climaxing the day before surgery. Additional preoperative information regarding the disease process may not be helpful in decreasing anxiety in patients undergoing mastectomy.

Conclusions: More research still needs to be conducted in the use of complementary alternative medicine for the use of decreasing anxiety in breast cancer patients undergoing breast-altering surgery. There is substantial research related to complementary alternative medicine to decrease preoperative anxiety in general surgery patients but not much research specifically targeted for those patient populations with a higher baseline level of anxiety such as breast cancer patients. These therapies have been around for a long time but are now being integrated with western medicine to treat the whole person, body, mind, and spirit.

Residual Neuromuscular Blockade in the Postanesthesia Care Unit

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Introduction: The peripheral nerve stimulator is somewhat limited in its utility; it offers the qualitative and not quantitative measurement of the train-of-four ratio. The acceleromyography unit provides the quantitative measurement of the ratio, and current evidence supports its use to identify residual neuromuscular blockade. A ratio > 0.9 is indicative of adequate return of muscle strength without residual blockade. The purpose of this study was to measure the quantitative train-of-four ratio in the immediate postoperative period, and identify if residual blockade was present that was not identified by using subjective measures.

Methods: After IRB approval, patients gave consent and were scheduled for elective surgery greater than 1 hour with general endotracheal anesthesia that included use of a nondepolarizing muscle relaxant. Nurse anesthetists were asked to deliver care and extubate at case end in their usual and customary manner. Within the first 5 minutes of PACU admission, the train-of-four ratio was measured with an acceleromyography unit; an average of 3 ratios was calculated. Additionally, signs of skeletal and respiratory muscle weakness were noted as well as any interventions needed to support ventilation.

Results: A total of 69 subjects were enrolled and separated into 2 groups: Group 1 had train-of-four ratios < 0.9 in the PACU, and group 2 were those with train-of-four ratios > 0.9 . Gender was the only demographic difference between the 2 groups; group 1 had more females ($p = 0.003$). Considering total anesthesia time, total dose of nondepolarizing muscle relaxant, and whether anticholinesterase agents were administered and dosage, no differences were noted between groups. Significant findings included a dependent relationship between group and weakness at PACU admission: Group 1 revealed more signs of muscle weakness compared with those with ratios > 0.9 , ($p < 0.001$). Interventions were required to improve respiratory status when weakness was observed.

Conclusions: Complications in the PACU related to residual neuromuscular blockade are frequently reported. The peripheral nerve stimulator is the most commonly used monitor to gauge neuromuscular blockade; however, more attention should be paid to the quantitative determination of the train-of-four ratio. This study identified that the visual and/or tactile assessment of the train-of-four ratio using the peripheral nerve stimulator, as well as clinical indices of muscle strength, may not provide adequate information specific to residual neuromuscular blockade and respiratory status may be compromised.

Reverse Trendelenburg and the Prevention of Postoperative Vision Loss in the Prone Position

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Introduction: Postoperative vision loss (POVL) is a catastrophic complication that affects 1:61,000 patients undergoing general anesthesia and remains at the forefront of patient-safety concerns. The prevalence of ophthalmic injury is 10-fold in patients placed in the prone position. A noteworthy rise in intraocular pressure (IOP) is discernible with minutes of prone positioning. The notion that body positioning influences IOP has reinforced the merit of investigating table inclination as a protective strategy to optimize ocular perfusion pressure. Reverse Trendelenburg may be an amicable solution to ameliorate increases in IOP.

Methods: An exhaustive literature search of published and unpublished literature was preformed. Abstracts and references were searched for other pertinent studies. A total of 262 articles were found, 4 articles were found to meet inclusion criteria. Studies were evaluated using the JBI Meta Analysis of Statistics Assessment and Review Instrument. Data were extracted from papers and standardized using the JBI-MAStARI data extraction tool. Quantitative data was pooled into a statistical meta-analysis and weighted mean differences with a 95% confidence interval were calculated.

Results: Intraocular pressure was statistically significant only at 10 degrees of reverse Trendelenburg. The mean difference was -0.806 (-1.304 to -0.416), Z-value testing -3.793 with p-value of 0.000, I-squared is 0.000. At 4 and 5 degrees of reverse Trendelenburg, the mean difference included 0 (-1.094 to 0.267) and was therefore found not to be statistically significant. Mean arterial pressure was statistically insignificant at all degrees of reverse Trendelenburg. There were no findings of changes to visual acuity reported in any of the studies.

Conclusions: The meta-analysis conducted in this systematic review revealed a decrement in IOP on average of 1 mm Hg at 10 degrees reverse Trendelenburg. Such findings theorize 10 degrees reverse Trendelenburg positioning may help to decrease the risk of POVL in high risk patients and thus may be implemented in conjunction with other protective modalities to minimize ones' overall predisposition. These findings offer a cost-effective solution that can be used in a multifaceted approach to dissuade permanent visual deficits that are currently estimated in 1 of 1,100 patients placed in the prone position.

Shaking Things Up: Cefazolin Reconstitution Practices

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Introduction: Cefazolin sodium, or Ancef, is a preferred antibiotic used perioperatively to prevent surgical-related infections. Cefazolin is reconstituted and administered to patients by anesthesia providers. Our aim with this research was 2-fold. Initially we wanted to establish that despite differences in provider reconstitution practices, the same percent in solution concentrations were obtained for administration. The second objective of this research was to investigate the various factors that affect reconstitution times including volume of diluent, temperature of diluent, and method for reconstitution.

Methods: To measure reconstituted concentrations, we created 4 dilutions of the control sample to create a linear progression on which to measure each trial sample. Using ultraviolet (UV) spectrophotometry, we measured absorbency readings at 270 nm for control dilutions and 40 trial samples, then converted readings to a reconstitution percentage. Then we measured “time to visual reconstitution” (point when no powder could be visualized in the reconstituted solution). Variables measured include volume of diluent (10 vs 20 cc), temperature of diluent (room temperature vs warm Lactated Ringer’s), and method of reconstitution.

Results: In all 40 trials, our absorbency readings were less than expected. For cefazolin doses at 20 mcg/mL, our expected absorbance from the UV spectrophotometer was 1.09. When readings were converted to a percent reconstituted, on average the 40 trials obtained percent reconstitutions from 57% to 80%. These numbers are consistent with one another, but this data reveals we are obtaining concentrations less than expected following reconstitution. For factors that affect reconstitution times, our data showed it was faster to reconstitute with 10 cc as opposed to 20 cc of solution and to use warmed lactated Ringer’s. The data supported that both agitation/pumping and shaking methods were faster than instillation/rolling, but shaking was the most consistent.

Conclusions: Following this research, we can conclude that regardless of provider reconstitution practices we obtain relatively consistent numbers when it comes to concentrations of reconstituted cefazolin, however these numbers are recurrently below what the expected concentrations should be prior to administration. Furthermore, cefazolin is consistently reconstituted fastest by shaking method with 10 cc of warmed lactated Ringer’s. Future research should incorporate additional trials, as well as multiple control trials to be sure the expected absorbance reading is an accurate number.

Skin Contamination Following Use of Forced Air Warmers

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Introduction: Forced air warming (FAW) has proven to be a cost-effective and efficient means for reducing the loss of core body heat during anesthesia. The warm air supplied by these devices is gathered from the operating room (OR) environment, generally on or very near the floor. The warm air delivered can only be as clean as the OR itself and the filters provided by the manufacturer. The potential for transmission of infection could possibly be increased if the filters are dirty or allowed to be used beyond the recommended period of replacement.

Methods: Thirty-one patients undergoing surgical procedures that would benefit from active warming gave consent for this study. Three contact agar plate samples were obtained from each subject. After cleansing the skin, the first sample was taken directly below the nozzle connection for the FAW prior to blanket application. At the end of the procedure a second sample was taken from the same area; the third sample was taken from the interior of the blanket. Following incubation for 48 hours, the plates were inspected for growth. The numbers of colony-forming units (CFUs) were counted for comparison between all 3 samples.

Results: Of the 30 patients included in the study, 3 (10%) had contamination of the skin following removal of the FAW blanket, and the remaining 27 (90%) displayed no skin contamination. Colony growth was present on the interior of 14 (47%) of the FAW blankets postoperatively. No patient had any postoperative or surgical site infections after a 30-day follow-up. Statistically significant correlations were noted between the number of CFUs within the interior of the blanket and the patient's total body surface area, as well as the patient's height.

Conclusions: FAWs are not the only choice available to anesthesiologists for intraoperative warming, and they may not always be the best choice. However, until a superior method of warming is developed that is as effective, economical, and available to be placed in wide use, CRNAs should thoughtfully consider if FAWs should continue to be used. The ongoing research and available evidence support the use of FAWs in delivering safe care. When the decision is whether or not to warm a patient and the only way to do so is with a FAW, the preponderance of the evidence agrees that its use is justified and safe.

The Dose and Time Dependent Effects of Sevoflurane on the Expression of Ttbk2 in Differentiated PC-12 Cells in Culture

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Introduction: Alzheimer disease is a chronic neurodegenerative disorder, characterized by diffuse amyloid rich senile plaques and neurofibrillary tangles. The neurofibrillary tangles are thought to develop as a result of hyperphosphorylation of tau, a protein essential for the maintenance of microtubules, by the enzyme tau tubulin kinase II (Ttbk2). Evidence suggests that sevoflurane causes hyperphosphorylation of tau and thus accelerates the disease process. This research explored the effects of sevoflurane on differentiated rat pheochromocytoma (PC-12) cells and the expression of Ttbk2.

Methods: PC-12 cells were grown in flasks containing an RPMI-1640 media supplemented with serum and housed in an incubator set at 37°C, 5% CO₂, and 70% humidity. Once the PC-12 cells reached a uniform confluence of 50% to 60%, they were exposed to nerve growth factor for 48 hours. The differentiated PC-12 cells were exposed to 2% sevoflurane for 1 hour. The ribonucleic acid (RNA) was extracted immediately, 6 hours, and 24 hours postexposure to sevoflurane. Real time reverse transcriptase polymerase chain reaction (RT-qPCR) was utilized to determine the expression of messenger RNA (mRNA) present for the enzyme Ttbk2.

Results: Our research found that there was not a significant increase in the expression of Ttbk2 following exposure to 2% sevoflurane. We did discover an increase in the expression of the protein tau, following the exposure of 2% sevoflurane for 1 hour. The unpaired t-test comparing the expression of tau 24 hours after exposure to 2% sevoflurane for 1 hour compared with the control group, generated a p-value of 0.0091. The 1-way ANOVA comparing the expression of tau immediately, 6 hours, and 24 hours after exposure to 2% sevoflurane for 1 hour yielded an F-ratio of 21.21 and p-value of 0.0001. A Tukey multiple comparison test yielded a significant difference between the control, immediate, 6-hour, and 24-hour groups as well.

Conclusions: Following the analysis of the RT-qPCR, it was determined that 2% sevoflurane exposure for 1 hour does not increase the expression of Ttbk2 in differentiated PC-12 cells but does increase the expression of tau.

Source of Funding: Webster University.

A59

The Effects of Preoperative Oral Acetaminophen Versus Intraoperative Intravenous Acetaminophen Administration on Postoperative Pain Control

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Introduction: The intravenous formula of acetaminophen is regarded as an asset to multimodal pain control in the perioperative setting. Many facilities are hesitant to administer intravenous acetaminophen due to costs. Oral acetaminophen remains an alternative for such facilities, yet there is conflicting research as to the efficacy of pain control between the 2 administration routes for postoperative pain. The patient population mainly consisted of patients having various elective surgeries. These patients were only receiving acetaminophen for postoperative pain control. None of these patients were receiving narcotics or multimodal analgesia for pain control.

Methods: A literature search was conducted between January and February 2016 using CINAHL, PubMed, MEDLINE, Cochrane Library, and Google Scholar. Terms searched included intraoperative acetaminophen, preoperative oral acetaminophen, and/or postoperative pain. The articles dated 2001 to 2015. Approximately 567 results were obtained. Inclusion criteria was articles less than 15 years old, patients receiving general anesthesia, and human studies that totaled 218 articles. Five articles met inclusion criteria: 2 systematic reviews and 3 meta-analyses.

Results: Postoperative pain management is one of the main concerns for the anesthesia provider and patient during the perioperative process. With certain patient populations growing, such as those with obesity and/or sleep apnea, administering safe anesthesia while providing adequate pain control remain a high priority. Acetaminophen is a great component of multimodal pain management that can help reduce narcotic usage and hence the negative side effects that come along with its administration.

Conclusions: The evidence suggests oral acetaminophen is not inferior to intravenous acetaminophen during the perioperative period for postoperative pain control. More studies need to be conducted where both formulas and administration routes are compared in a double-blinded study without the addition of adjunct medications in order to gauge the efficacy of both modalities.

A60

Understanding Motivations and Barriers of CRNAs Involved in Global Health: A Qualitative Descriptive Study

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Introduction: Surgical care provided through short-term medical missions (STMMs) is an important component of primary healthcare. The healthcare needs in developing countries abound and Certified Registered Nurse Anesthetists (CRNAs) are equipped with the knowledge and skills to help address this disparity. The goal of this research was to address the gap of knowledge regarding motivations and barriers specific to CRNAs' participation in STMMs.

Methods: This was a qualitative, descriptive design. Narrative-based data were gathered through purposive sampling. Semistructured interviews were recorded and transcribed. Manual analyses of the data, done by the authors, utilized Colaizzi's method as a guide. In order to discover commonalities among the CRNA participants' interviews, significant statements were coded and then placed in themes, then finally categories.

Results: After analyzing the interviews, 38 codes were created related to the motivation of a CRNA to attend an STMM. Nineteen codes defined the barriers to a CRNA participating in an STMM. The codes were condensed further into themes. Motivating factors had 7 themes: selflessness, readiness, personal/professional growth, influenced by others, impact, gain perspective, and teamwork. Barriers had 5 themes: personal discomfort, weakness of the organization, obligations, apathy, and misplaced humanitarianism. Major categories were generated from the themes. Motivating factors for a CRNA can be placed into 4 categories: values, growth, readiness, and teamwork. Barriers can be divided into 2 categories: internal and external.

Conclusions: The results of this study yield a greater understanding of what can draw increased participation in STMMs from CRNAs. This may lead to more effective recruitment and satisfaction of CRNA participants in STMM work. Recruiting CRNAs into STMM work will provide the opportunity for the nurse anesthetist to uphold core values of quality, professionalism, compassion, collaboration, wellness, and diversity while positively promoting the profession. Most importantly, CRNA participation will result in a positive impact on global health equity for people worldwide.

Source of Funding: AANA Foundation.

LiOH CO₂ Absorbers – From Aerospace to Operating Suites: A Literature Review on This Novel Technology

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Introduction: Carbon dioxide (CO₂) absorption is an integral aspect of the anesthesia circle system used in the daily administration of well over 20 million general anesthetics annually. These absorbers serve the functions of permitting rebreathing to allow for the conservation of anesthetic gases and volatile inhalation agents and preventing operating room pollution. First developed for use in the closed circuit system by Dennis E. Jackson in 1915, CO₂ absorbers are not new to the field of anesthesia. Over a century later, these absorbents continue to evolve, as they are refined with the aim of actualizing a product that is both maximally functional and can provide a higher margin of patient safety.

Literature Review Analysis: An electronic search was conducted using the Cumulative Nursing and Allied Health Literature (CINAHL), PubMed, MEDLINE, Cochrane library, Web of Science, and Scopus databases. The only search limit was the English language. The following search terms were applied in the electronic search: LiOH absorber, lithium-based absorbent, CO₂ absorber, and anesthesia. The search initially resulted in 181 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: What are the unique characteristics that set LiOH absorbers apart from traditionally used soda lime and premium CO₂ absorbers? What are the advantages and disadvantages of the LiOH absorber when compared with traditional absorbers?

Implement Evidence: Twenty sources met the inclusion criteria. The literature showed that the primary distinction between LiOH absorbers and other types of absorbers is the uniqueness of its chemical reaction and subsequent byproduct formation. There have been documented advantages cited for LiOH absorbents to include the production of virtually no toxic byproducts such as Compound A and CO, a greater absorption capacity than soda lime, and a higher level of safety for use at all fresh gas flow rates. Noted disadvantages are the initial increased cost of the product and the absence of color change indicator with one particular brand of LiOH absorbent, requiring FiCO₂ monitoring for determining exhaustion.

Conclusions: Documented use of LiOH absorbers in the anesthesia community has been noted in the literature. The evidence on the chemical profile of this novel absorber indicates that it possesses an increased safety advantage when compared with other absorbers and could prove to be more cost effective over the long haul. Despite this data, there is an increased initial monetary investment and a need for anesthesia provider education regarding the clinical nuances between the 2 currently manufactured LiOH absorbers. Future studies are warranted on the adoption of LiOH absorbers in the clinical setting with a focus on provider education and cost analysis associated with replacing traditional absorbents.

A Tour of Autonomic Reflex Activity Relevant To Clinical Practice

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Introduction: The autonomic nervous system (ANS) has at its disposal a wide range of reflex responses designed to maintain homeostasis. The reflex arc is the functional unit allowing us to continuously and unconsciously adapt to challenges relevant to our internal and external milieus. Pathology, polypharmacy, and surgical manipulation challenge the integrity of these mechanisms. Providing high quality, patient-centric care necessitates understanding the ANS, its associated reflex arcs, and factors that modify it.

Literature Review Analysis: This review includes reflex arcs associated with baroreceptor and chemoreceptor activity, autoregulation, and direct modifiers like the Bainbridge and Bezold-Jarisch reflexes. Oculocardiac events, swallowing impairment, and pathophysiology due to diabetes, spinal cord injury and ANS imbalance are reviewed and explored relevant to anesthetic care. Pharmacological modification of ANS function is extensively critiqued. Local reflex activity, like hypoxic pulmonary vasoconstriction and global activity, such as vasovagal reactions and sympathovagal imbalance are analyzed. Classic, sentinel and contemporary citations make this review state-of-the-art.

Implement Evidence: The anesthetist regularly encounters comorbidities such as diabetes and hypertension, patient age extremes, and unique patient and surgical factors that perturb ANS reflex arcs. Drugs that we administer, or those that patients take on an acute or chronic basis, may greatly modify ANS function. Applying knowledge of the complex physiologic and pathophysiologic processes to the patient that we are caring for is essential in developing and implementing patient-centric care.

Conclusions: The ANS conveys impulse signals from the vasculature and organs via nerves to the CNS, most notably the medulla, hypothalamus and pons. The reflex arc is completed via an efferent loop. These impulses, rarely consciously perceived, elicit a host of automatic responses serving to maintain homeostasis. Imbalance or dysfunction in this intricate network of reflex activity may occur as a result of disease, drugs, surgical interventions, or unique patient factors. Knowledge of the structure and function of the ANS reflexes is vital to crafting a patient-centric approach to our anesthetic care.

Adductor Canal Versus Femoral Nerve Block After Total Knee Arthroplasty

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Introduction: Postoperative management of total knee arthroplasty (TKA) is best facilitated with the use of peripheral nerve blocks, such as femoral nerve block, to manage pain while offering a multitude of benefits such as hastening hospital discharge, facilitating postoperative ambulation, improved cost effectiveness, and reduced opioid utilization. Currently, the adductor canal block is an alternative to the femoral nerve block for providing postoperative analgesia, improved mobility, and increased quadriceps strength that may reduce the risk of falls.

Literature Review Analysis: Four randomized control trials analyzed quadriceps strength through maximum voluntary isometric contraction utilizing a dynamometer instrument and concluded a significant increase in strength and superiority in individuals receiving adductor canal block (ACB) compared with femoral nerve block (FNB). Mixed results among studies displayed no difference for ACB or an augmented ability to ambulate through a variety of tests performed. Improved ambulation and mobility may translate to decreased hospital stay and costs. Adequate postoperative analgesia managed with a multimodal regimen may aid in ability to ambulate and may be measured through opioid consumption. There were no significant results among groups for differences in opioid consumption.

Implement Evidence: The review of literature supports the utilization of ACB for TKA as a suitable alternative to FNB in reducing patient costs and length of stay similar to the femoral nerve block. The ACB is able to provide significant increases in quadriceps strength, which may augment ability to ambulate quicker and reduce incidence of falls in comparison with the FNB. Studies of the ACB did not provide significant results in regard to reducing opioid consumption; however, the utilization of a multimodal regimen may overcome the difference in analgesia requirements compared with the FNB.

Conclusions: Further research needs to assess the ACB regarding incidence of falls, postoperative analgesia, and impact on ambulation after TKA to determine greater benefits compared with FNB. Location of pain may lead to implementation of a sciatic nerve block to improve analgesia. Current results suggest that the ACB may provide similar effects as the FNB on decreasing hospital length of stay, reducing patient costs through improving ambulation, and reducing analgesia requirements. Improved quadriceps strength seen with the ACB may decrease risk for falls for improved patient safety, quality, and cost-effective healthcare.

An Evidence-Based Review Examining Pharmacological Methods for Prevention of Pruritus Caused by Intrathecal Opioids in Parturients Undergoing Cesarean Delivery

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Introduction: Neuraxial anesthesia with the addition of opioids is the preferred technique for cesarean delivery due to the safety of the technique compared with general anesthesia along with the efficacy of pain control. However, pruritus associated with neuraxial opioids is considered one of the most distressing side effects and is a source of dissatisfaction for patients. The incidence of pruritus has been reported to be as high as 100%. This review examines the efficacy of different medications on the prevention of pruritus.

Literature Review Analysis: An online database search of PubMed, Cochrane Database of Systemic Reviews, CINAHL, and Google Scholar revealed 127 potential evidence sources. Ten randomized controlled studies met the inclusion criteria. Mixed opioid agonist-antagonists and dopaminergic receptor antagonists were found to be effective. Antihistamines, opioid antagonists, and NSAIDs were not found to be effective in the prevention of pruritus. There were conflicting results regarding the efficacy of serotonin receptor antagonists and GABAA receptor agonists for the prevention of pruritus caused by intrathecal opioid administration.

Implement Evidence: The findings of this review were used to develop protocols for pain management for postoperative cesarean deliveries that receive intrathecal opioids. Recommendations were based on the efficacy of the mixed opioid agonist-antagonist, nalbuphine.

Conclusions: A great source of dissatisfaction among new mothers is the inability to bond due to the itching caused by the intrathecal opioid. Pruritus is sometimes considered more distressing than pain. Relief of pruritus in this subset of patients will lead to a better experience for the mother and family.

An Evidence-Based Review of the Impact of the Practice Doctorate on Roles and Employment of the Advanced Practice Nurse

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Introduction: There has been a growth in programs offering the doctor of nursing practice degree (DNP) mainly due to the American Association of Colleges of Nursing's call to have a terminal, practice-based doctoral degree for APNs. These nurses have the potential for significant impact on the healthcare system. With adoption of the Affordable Care Act, the DNP prepared nurse may have an expanded role in clinical areas while also maintaining a vital role in leadership and administration of healthcare.

Literature Review Analysis: The search for evidence published prior to 2016 was conducted using PubMed, Cumulative Index for Nursing and Allied Health Literature, MEDLINE, and Google Scholar. Four descriptive studies met the inclusion criteria. Two sources were surveys, one was a semi-structured interview, and the fourth used convenience sampling. The evidence overall suggests that DNP-prepared nurses practice in various healthcare settings; however, evidence regarding specific positions and practice settings or types of changes as a result of the influx of the DNP-prepared nurse into the healthcare environment is lacking.

Implement Evidence: There is little evidence addressing the impact of the DNP degree on roles and employment of the APN. Findings from this evidence-based review help to identify areas for future research. We will disseminate the information from the evidence in order to spur more research. More research is warranted regarding DNP-prepared nurses in faculty, leadership, clinical and administrative roles.

Conclusions: The evidence generally suggests that DNP-prepared nurses practice in various healthcare settings. The evidence regarding specific positions and practice settings and the impact of the influx of the DNP-prepared nurse into the healthcare environment is lacking. Based on these findings, studies of roles, employment opportunities, and associated impact on the healthcare system are warranted.

An Evidenced-Based Review of the Effectiveness of Employer-Provided Wellness Programs for Hospital Employees

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Introduction: Health and wellness promotion has become a focus for employers. In order to ensure or increase wellness among the workforce, a growing number of employers are turning to wellness programs and initiatives as a strategy to accomplish this goal. The Affordable Care Act (ACA) seeks to accelerate the growth of wellness programs through grants, rewards, and technical assistance. As a result of wellness programs, employers hope to see a healthier and more productive workforce. We examined the evidence supporting the effectiveness of employer-provided wellness programs for healthcare employees.

Literature Review Analysis: The evidence search was conducted using PubMed, Cochrane Database of Systematic Reviews, and Business Source Complete. Evidence (2011-2015) was sought based on the recent implementation of the ACA. Insufficient evidence was found pertaining to wellness programs and solely healthcare employees. The search was expanded to include other employer types but included employees with a similar education as healthcare employees. Evidence addressing these programs commonly lack rigid designs, and economic outcomes are difficult to monetize. The authors examined results and impact of wellness programs on health-related outcomes and/or the economic outcomes. Overall the evidence suggested wellness programs had a positive effect on employee wellness.

Implement Evidence: The findings from this evidence-based review have been presented at the quarterly partners meeting of Advanced Anesthesia Solutions, a small anesthesia management company in Kingsport, Tennessee, where an author (ND) is a partner. The results were presented for consideration for implementation of a company-sponsored wellness program or health initiative for employees.

Conclusions: The existing evidence supports wellness programs for healthcare employees. Higher quality research is needed on the current strategies and impact of wellness programs. Future studies require stronger research designs to examine the value of these programs in reducing healthcare costs or creating a more productive and healthy workforce. Wellness programs promise to increase health promotion and reduce healthcare costs.

Anesthesia Provider Models: Patient Outcomes and Economics

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Introduction: The organization and structure of modern anesthesia care has evolved to produce 3 professions of providers. There is, however, no standardized provider model within which the 3 provider types work. Debate over the safety and efficacy of CRNAs working outside the supervision of a physician has been ongoing for more than a century. Legislative changes in 2001 led to an increase in independent CRNA practice and allowed for better evaluation and comparison of the various provider models.

Literature Review Analysis: Three studies regarding patient outcome comparisons between provider models are reviewed: the first of which concluded anesthesiologist direction of CRNAs' reduced 30-day mortality and failure-to-rescue rates; the second of which concluded there is no difference in mortality rates between medical direction and medical supervision of CRNAs; the third of which concluded the independent CRNA model has equally low mortality to supervision models, both of which have lower mortality than the anesthesiologist-only model. Two studies analyzing the economics of provider models are reviewed: the first of which concluded that anesthesiologists are cost effective based on a study showing mortality rate differences among providers; the second of which concluded that the most cost-effective model in all settings is independent CRNAs.

Implement Evidence: Evidence from this literature review is imperative in both understanding and progressing current healthcare legislation and reform regarding independent CRNA practice. Critical analysis of the literature is necessary to recognize limitations of studies; in some cases revealing that reported results have insurmountable limitations and are not appropriate for legislative purposes. Progress hinges on educating CRNAs, the public, healthcare administrators, and politicians regarding the safety and economic efficacy of CRNAs. This literature review provides such groups with increased access and understanding of the current anesthesia landscape and its impact on the healthcare system.

Conclusions: The unsubstantiated requirement for medical direction and supervision models has persisted for over 100 years. Current evidence supports that independent CRNAs produce patient outcomes that are, at a minimum, equal to anesthesia provider models involving anesthesiologists. Evidence also suggests independent CRNAs are the most cost-effective model in all healthcare settings and likely the only independently sustainable model in low-volume patient settings. Current and future societal needs are that of expanded healthcare coverage, decreased healthcare costs, and maintained safety efficacy, all of which are provided by independent CRNA practice.

A68

Apneic Oxygenation; A Method to Prolong the Period of Safe Apnea

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Introduction: Difficult airway management is one of the most challenging tasks for anesthesia professionals, representing 27% of all adverse respiratory events, 93% of which are unanticipated. Conventional preoxygenation techniques provide 4 to 8 minutes of safe apnea in healthy adults; this time frame may not be sufficient in all populations. A proposed alternative by the Difficult Airway Society is utilization of apneic oxygenation as an adjunct to traditional preoxygenation techniques in order to maintain oxygenation for an extended apneic period.

Literature Review Analysis: The empirical evidence of apneic oxygenation has been studied utilizing several different techniques, which all support prolonging the period of safe apnea by extending the time to desaturation. Two randomized controlled trials evaluated the efficacy of apneic oxygenation in morbidly obese patients, both identified a statistical significance ($P < 0.05$ and $P = 0.001$), concluding that apneic oxygenation can improve the safety of airway management in the obese population. Three observational studies demonstrate how apneic oxygenation prolonged the safe apnea period between 45 and 65 minutes. One observational study examined apneic oxygenation in pediatrics, concluding it may provide up to 10 minutes of safe apnea time in this population.

Implement Evidence: The Difficult Airway Society and Obstetric Anesthetists Association recommends the utilization of apneic oxygenation in high risk patients. Apneic oxygenation should be considered in patients who are prone to rapid desaturation, those who present with a difficult airway, or when an unanticipated difficult airway arises. Recommendations are to utilize nasal prongs or a nasopharyngeal catheter to insufflate O₂ during the apneic period. Apneic oxygenation is a safe and cost-effective intervention that can be readily implemented by anesthesia professionals.

Conclusions: All studies reviewed concluded that insufflation of oxygen during apnea has shown to increase the apneic window by delaying desaturation. Prolonging the apneic window could change the nature of airway management in patients at a high risk for desaturation or those who present with a difficult airway. Despite the precautions taken to minimize risks with intubation, prediction of the difficult airway remains a challenge for anesthesia professionals, making apneic oxygenation a significant advancement in the safety of airway management.

Are Viscoelastic Tests a Superior Assay Compared With Conventional Coagulation Tests in Acute Trauma: A Literature Review

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Introduction: The need for a rapid and global assessment of coagulation prompted the search for a better assay. Rapid thromboelastography (r-TEG) appears to be one potential solution, providing a more complete assessment of coagulation with rapid, real-time results compared with conventional coagulation testing. However, lack of familiarity with reading and utilizing results, conflicting evidence about the validity of results, and time constraints have limited r-TEGs use by CRNAs. This literature review attempts to establish if strong evidence exists to support recommendations that r-TEG is a superior test for rapid identification of coagulopathy.

Literature Review Analysis: An inquiry of relevant evidence-based research literature was conducted online via SCOPUS, PubMed and CINAHL. Articles that were peer-reviewed, full-text online, and published in English within the last 5 years met inclusion criteria. Search terms used alone or in combination included r-TEG, rapid TEG, thrombelastography, thromboelastography, trauma, coagulation test, point-of-care, and transfusion criteria. Eight articles meeting inclusion criteria were selected and analyzed.

Implement Evidence: Implementing the use of r-TEG during acute trauma has been challenging. Lack of familiarity with bedside test result interpretation and time constraints are key factors that prevent r-TEG use. A quick algorithm guide to understanding results and therefore blood product administration may help. Additionally incorporation of an educational supplement may help CRNAs become more accustomed to proper use of results and equipment and help reduce morbidity and mortality related to hemorrhage and coagulopathy in the trauma patient.

Conclusions: Review of the current literature demonstrates that there is a lack of the following: consistent research findings, standardized result analysis, staff capable of interpreting r-TEGs, evidence that r-TEG blood transfusion protocols reduce morbidity and mortality, and cost benefit analysis. These findings necessitate that large prospective, multicenter randomized controlled trials are conducted to address these issues. Additionally, personnel need to become more accustomed utilizing r-TEG in acute trauma. These issues must be faced before r-TEG can be considered a superior test for evaluating coagulopathy and serve as the principal guide for blood product transfusion.

A70

Beta Blocker Therapy for the African American

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Introduction: Currently, the practice of pharmacology is primarily tailored to dose response relationships and effective doses that are appropriate for most, with acceptance that all patients respond differently and individually to standard doses, while taking into account weight, gender, and age. With the advancement of pharmacogenomics and the migration of different ethnicities and cultures to the Americas, it is important to begin to develop pharmacogenomic-based practices that are also tailored to common genetic characteristics of diverse ethnic populations.

Literature Review Analysis: African American genetic data is about 24% European and 76% African ancestry; however, increased heterozygosity exists in African American DNA and genes have been influenced by both genetic admixture and natural selection. Study suggests caution be used when grouping African Americans with Africans or Europeans in efforts to anticipate pharmacologic effects. Beta blockers showed a 60% reduction in hazard risk of rehospitalization or death in Caucasians and only a 33% reduction of risk in African Americans. It was concluded that the African American heart failure population demonstrated evidence that beta adrenergic receptor polymorphisms and its associated kinases do affect the signaling pathway and its responses to beta blockade and are a notable components to differences in treatment outcomes among Caucasians and African Americans.

Implement Evidence: The development of medication regimens consisting of effective dosages and frequencies of commonly prescribed heart failure and antihypertensive medications with combination therapy, such as hydralazine and isosorbide dinitrate as mentioned in the A-HeFT trials, may help achieve improved mortality in the African American population and may even provide better anesthetic and surgical outcomes when implemented during perioperative management.

Conclusions: “Cookie cutter” anesthesia has no place in the modern world of medicine and evidence-based practice. As races commune, admixture becomes more prevalent, and it is essential for anesthesia providers to be cognizant of patient populations, their genetic backgrounds, and predispositions in order to provide safe, effective care perioperatively, all while advocating for competent, individualized primary health management. Patient tailored anesthesia and pharmacogenomic disease management will afford patients better surgical and anesthetic outcomes when presenting for surgery.

A71

Cannabis Products as Adjuvant Therapy in Chronic Pain Management

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Introduction: The provision of adequate analgesia for patients with chronic pain presents a marked challenge to the anesthetist. Multimodal approaches are often the most successful, as many of these patients are opioid-tolerant. Cannabis products offer a promising role as an adjuvant chronic pain management therapy.

Literature Review Analysis: The purpose of this review of literature is to explore the implementation of cannabinoids as part of a multimodal chronic pain management plan. PubMed and CINAHL databases were used to search for randomized controlled trials, systematic reviews, or meta-analyses regarding cannabis and chronic pain management. Fifteen articles on these subjects were initially identified. Studies on acute pain, studies published more than 6 years ago, and studies written in a language other than English were then excluded. Six articles remained for review and critique.

Implement Evidence: Cannabinoid products display moderate efficacy in treating chronic pain conditions, especially those associated with neuropathic pain. However, the use of cannabinoids is not without certain risks and side effects, specifically gastrointestinal and central nervous system disturbances of varying severity. Providers should consider patients' preexisting comorbidities prior to initiating cannabinoid therapy.

Conclusions: As anesthesia providers gain the ability to prescribe cannabinoids, proper drug education combined with clinical judgment will allow the provider to discern appropriate candidates for cannabinoid therapy.

A72

Certified Registered Nurse Anesthetists (CRNAs) and Student Registered Nurse Anesthetists (SRNAs) Must Become Cultural Competent to Decrease Health Disparities and Improve Health Outcomes

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Introduction: Research indicates that minorities in the United States are plagued by healthcare disparities. Cultural and linguistic barriers in addition to subtle or subconscious bias and presupposition during clinical encounters contribute to health disparities. As a result, Certified Registered Nurse Anesthetists (CRNAs) and student registered nurse anesthetists (SRNAs) must become cultural competent to decrease health disparities and improve health outcomes.

Literature Review Analysis: A retrospective research found that African Americans waited 31% longer than whites for chest pain, a symptom that heralds acute coronary syndrome. A secondary data analysis indicates that minority parturients are at higher odds of receiving general anesthesia in comparison with whites despite general anesthesia's higher rates of maternal mortality. Three articles underline the importance of incorporating cultural competence into nursing education. One article revealed how Kaiser Permanente School of Anesthesia introduced cultural competency into its program curriculum. One article delineates high-fidelity simulation to show its effectiveness in preparing SRNAs to provide congruent, efficient, and culturally competent care.

Implement Evidence: Nurse anesthesia programs require attainment of knowledge and necessary skills for patient safety, critical thinking, communication, and anesthetic management. CRNAs and SRNAs must be capable of providing individualized anesthetic management and culturally competent anesthetic care. Accomplishing these goals include having well developed modules intertwined into the program's curriculum. Cultural competency training modules should allow students the opportunity to apply learned cultural knowledge to enhance cultural competent communication skills.

Conclusions: After an in-depth review of the literature, cultural competence emerged as a social solution that has the promise and capacity to help reduce health disparities affecting minorities within the United States. Causes of current healthcare disparities include failures in the healthcare system, cultural and linguistic barriers, and subtle bias and prejudice during the clinical encounter. Among methods that must be implemented to reduce healthcare disparities, enhancing the cultural competence of future clinicians such as SRNAs is a major proponent of these tactics.

Choice of Anesthetic Technique for Cancer Patients

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Introduction: More and more current research is showing perioperative anesthesia has long-term implications for cancer patients and their occurrence of metastases who are undergoing surgery for tumor removal. Surgery is a mainstay treatment for patients who have solid tumors, and much of the current literature is focusing on aspects that may lead to reoccurrence and metastasis of tumor cells. Of particular interest is the perioperative encounter and whether anesthetic technique influences rates of metastasis due to anesthesia agents impacting the natural killer (NK) defense mechanism and causing varying stress responses to the body, separate and unrelated to the stress of surgery.

Literature Review Analysis: Metastasis is related to NK inhibition and potentiation of tumorigenic growth factors: hypoxia inducible factor -1 α (HIF-1 α) and insulin-like growth factor (IGF). High levels of HIF-1 α is associated with poor prognosis for patients with cancer and overexpression of IGF contributes to the progression of cell cycle and inhibition of cellular apoptosis. Volatile agents reduce NK cell cytotoxicity, cause up-regulation of HIF-1 α and IGF, and may induce resistance to chemotherapy. In contrast, total intravenous anesthesia (TIVA) maintained with propofol suppressed tumor growth, preserved cytotoxic T lymphocyte activity, and inhibits HIF-1 α production. Opioids inhibit immune function and are proangiogenic, augmenting tumor growth. Regional anesthesia, alongside the sparing use of opioids, maintains immune function and reduces the risk of tumor metastasis.

Implement Evidence: Most of the recent literature shows a suggestion of anesthetic technique affecting long-term survival of cancer patients due to rates of metastasis. No direct correlation has been evidenced between anesthetic type, and no official statement regarding which anesthetic type is more beneficial than the other for cancer patients. However, with increasing evidence showing positive outcomes for the use of regional anesthesia and TIVA maintained with propofol infusion versus volatile anesthetics, it should certainly be a factor for anesthesia providers when choosing an anesthetic plan their patients.

Conclusions: While current literature supports regional anesthesia and TIVA for cancer patients undergoing solid tumor surgery, more studies need to be conducted, including meta-analyses, prior to suggesting a culture change in the administration of anesthetics. However, anesthesia providers can consider the current literature and utilize it in their clinical judgement when providing anesthesia to their patients.

A74

Clevidipine as a Superior Choice for the Intraoperative Management of Blood Pressure in a Cardiac Case: A Literature Review

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Introduction: Clevidipine is the latest generation dihydropyridine calcium channel blocker. This medication binds to the L-type calcium channels in a voltage dependent manner. Clevidipine works by decreasing afterload and reducing systemic vascular resistance, thus increasing cardiac output. It is rapidly metabolized by hydrolysis of the ester linkage by blood and extravascular tissue esterases. Contraindications to using clevidipine include patients with allergies to soybeans, soy products, and egg products; patients with pathologic lipid metabolism; acute pancreatitis; and severe aortic stenosis.

Literature Review Analysis: Many studies showed that in a hypertensive patient, clevidipine adequately kept blood pressures within a predetermined range, and adverse events were not statistically significant. Clevidipine was shown to have no significant heart rate increase. Clevidipine, in comparison with other medications used in cardiac anesthesia, was found as effective in maintaining appropriate blood pressures when compared with nitroglycerin or sodium nitroprusside. It was also shown to be more effective in keeping intraoperative blood pressure within a predetermined range and had fewer side effects when compared with sodium nitroprusside. When it came to serious adverse events, clevidipine was no more causative than any other antihypertensive.

Implement Evidence: It is evident that having better intraoperative control of the patient's blood pressure can lead to shorter hospital stays, less cost to the hospital and to the patient, and even better patient outcomes while recovering. Aronson et al found that the time the patient spent intubated was inversely related to how effective the antihypertensive medication was at maintaining and decreasing blood pressure variability. The greatest predicted cost reductions were found in patients that were treated intraoperatively with clevidipine during cardiac anesthesia when compared with sodium nitroprusside and nitroglycerin.

Conclusions: Clevidipine was shown to be superior to other antihypertensives used for blood pressure management in cardiac anesthesia. It was shown to be safe and efficient at maintaining an adequate blood pressure and had limited adverse effects.

Complications Occurring When Morbidly Obese Patients Undergo Deep Sedation Gastrointestinal Endoscopy in Ambulatory Surgery Centers

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Introduction: Anesthesia providers often provide deep sedation using propofol for gastrointestinal (GI) endoscopic procedures. An increasing number of these patients are obese with associated comorbidities. Support systems to manage related adverse events are likely needed if these patients undergo GI endoscopy in freestanding ambulatory surgery centers. The authors examined the literature for complications, management, and outcomes for individuals with a body mass index (BMI) > 35 undergoing propofol deep sedation to determine safe practices in this setting.

Literature Review Analysis: The search for evidence using Cochrane Library, PubMed, EBSCOhost, and Google Scholar resulted in 52 potential evidence sources. Seven prospective and retrospective cohort studies met the inclusion criteria. Propofol administration strategy, provider expertise, hypoxemia tolerance, and criteria for airway intervention and adverse event reporting were confounding variables and not standardized between studies. Significant increases in airway maneuvers, sedation-related complications, and hypoxemia was associated with BMI \geq 30, physical status \geq 3, and obstructive sleep apnea. Despite these findings, the researchers concluded that deep sedation with propofol, regardless of BMI, for GI endoscopic procedures is safe and effective.

Implement Evidence: The findings of this evidence-based review will be used by one of the authors (CLS) at her practice at an ambulatory surgery center. The information will be used to develop alternative airway management techniques for subjects with BMI \geq 30 undergoing deep sedation with propofol undergoing GI endoscopic procedures. The findings will also be used in monthly staff in-services, written guidelines, and to help justify purchasing additional airway management equipment. In addition, the findings will help develop future research projects in this area.

Conclusions: Future studies are needed focusing on creation of effective screening tools, improved airway management devices, and sedation techniques for morbidly obese subjects undergoing GI procedures. Large multicenter trials are vital to optimize care of these patients using deep sedation in GI endoscopy.

A76

Creating an Open-Source Anesthesia Electronic Medical Record

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Introduction: Currently there are no widely available open-source anesthesia electronic medical records (AEMRs) specifically for nurse anesthetists. Our goal was to create an open-source, widely-available AEMR that can be downloaded and installed on a tablet computer (the Apple® iPad). For simplicity and ease of use, its focus will be on solo or small practice nurse anesthetists operating in environments with limited or no network and computing resources other than the iPad. One patient, 1 nurse anesthetist, and 1 iPad is the motto for the AEMR.

Literature Review Analysis: The literature review revealed no other open-source AEMRs and points to the need for increasing the rate and quality of documentation. In addition, AEMRs allow for incorporation of checklists and clinical decision support.

Implement Evidence: We will use FileMaker® to create an AEMR that can provide basic functionality for entering, storing, and transmitting patient data for an anesthetic. We will observe HIPAA and other regulatory concerns as well as transmitting quality data.

Conclusions: By downloading our free open-source Anesthesia EMR solution, nurse anesthetists will be able to create a digital anesthesia record and meet all pertinent requirements for data from third parties.

A77

Decreased Postoperative Cognitive Dysfunction Using Near Infrared Spectroscopy in the Elderly Orthopedic Surgery Population

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Introduction: Elderly patients receiving anesthetics for surgery have been found to have delayed or impaired memory, perception, and information processing, becoming known as postoperative cognitive dysfunction (POCD). The incidence of POCD with surgery may approach a 50% occurrence rate. Near infrared spectroscopy (NIRS), which measures regional cerebral oxygenation (rSO₂), has been used for the real-time assessment of cortical tissue oxygenation. Upon establishing a baseline rSO₂, NIRS can be utilized to indicate brain tissue oxygen hemoglobin desaturations, which may be an early indicator of POCD.

Literature Review Analysis: A PubMed search from January 2005 to June 2016. Three peer-reviewed studies were investigated for evidence supporting rSO₂ monitoring with NIRS to prevent POCD in elderly patients undergoing orthopedic surgery. Intraoperative rSO₂ bilateral asymmetry can warn of postoperative memory decline; rSO₂ desaturation leads to psychological symptoms and memory deterioration 3 months postoperatively (Salazar et al, 2014). Low rSO₂ values were associated with cognitive dysfunction occurring preoperatively and postoperatively in hip fracture patients over 60 years old (Papadopoulos et al, 2012). An rSO₂ decrease of 11% was demonstrated to predict the occurrence of POCD 7 days postoperatively in patients who underwent total hip arthroplasty (77% specificity, 86% sensitivity) (Lin et al, 2013).

Implement Evidence: Desaturation in rSO₂ detects changes in cerebral blood flow, which may detect cerebral ischemia. Cerebral ischemia may occur with rSO₂ decline >20%, baseline <50%, or left and right side discrepancies. Unmonitored ischemia may remain totally undiagnosed. The literature strongly suggests the benefit of NIRS for use in the elderly orthopedic surgery avoids the possible occurrence of POCD. These untoward effects may lead to decreased self-confidence, increased difficulty in employment, early retirement or termination, and lead to increased stress to family, relatives, or the social welfare support systems.

Conclusions: The NIRS device has potential for improving the anesthesia care plan. Intraoperative NIRS may predict POCD. In addition, the application of NIRS as a standard of anesthetic management may have implications for the provider to mitigate the incidence of POCD rates in other elderly patients or those at risk for cerebral ischemia. Preliminary studies suggest correcting decreased rSO₂ values with higher FIO₂, increasing blood pressure or transfusion of PRBC (increased oxygen carrying capacity) may prevent ischemia.

A78

Disruptive Innovation: The Use of Arteriovenous Anastomoses for Mild Hypothermia Rewarming

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Introduction: Patients undergoing general anesthesia are susceptible to perioperative hypothermia and adverse patient outcomes. Conventional interventions can be used to prevent and treat hypothermia during the perioperative period such as forced-air blankets, warm cotton blankets, and warmed IV fluid administration. In the last few decades, a device that combines circulating warm water and the application of subatmospheric pressure applied to either a hand or foot by using arteriovenous anastomoses (AVA) has been developed to directly warm the core temperatures from the periphery.

Literature Review Analysis: A literature review focused on the use of negative pressure rewarming and forced-air rewarming to treat/prevent mild hypothermia. These keywords were used: forced air warming, Bair Hugger, 33-35°C, negative pressure rewarming, and AVA rewarming. Databases included EMBASE, PubMed, Trip Database, and Anesthesia & Analgesia. Inclusion criteria were any subject who experienced mild hypothermia defined as between 33°C and 35.9°C, with the return to normothermia defined as $\geq 36^\circ\text{C}$.

Implement Evidence: The use of an AVA rewarming device would be an invaluable intervention for patients in the perioperative period to either prevent/treat hypothermia or to maintain normothermia. The device could be applied to a single hand or foot, which would be advantageous for patients undergoing procedures that require a large area of exposure to the cold environment of the operating room, such as an exploratory laparotomy, open heart surgery, etc. The ability to rewarm a mildly hypothermic subject to normothermic within 15 to 20 minutes could eliminate the negative consequences of shivering.

Conclusions: The preliminary research supports promise in the use of AVA devices with a continuously circulating warm water system (42-45°C) in combination with negative subatmospheric pressure (30-40 mm Hg) to treat mild hypothermia (33-35°C) more rapidly than conventional rewarming devices. The use of AVA vasculature could be used as an effective intervention for rewarming; however, the type of heat source, amount of thermal load, and amount of subatmospheric pressure applied to the AVA site are important factors in determining the effectiveness and rate of rewarming mildly hypothermic subjects.

Effect of Cricoid Pressure on Laryngoscopic View, Airway Obstruction, and Aspiration Prevention

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Introduction: This evidence-based practice analysis is to provide empirical data on cricoid pressure (CP) application, effect on laryngeal view, esophageal displacement preventing complete occlusion, airway obstruction, and prevention of aspiration. Ineffective outcomes and harm resulting from various methods and forces were evaluated. Over 100 million patients in the United States undergo surgical procedures yearly. Roughly 0.15% of adults will aspirate upon induction of anesthesia. In 2010, the American Heart Association no longer recommended use of CP during rapid sequence induction (RSI) and cardiac arrest.

Literature Review Analysis: Cricoid pressure remains widely practiced despite the lack of randomized control trials (RCTs) and scientific evidence validating original research. Various studies showed 5% of the population correctly identified recommended CP force in the awake patient of 10 newtons (N) then increasing to 30 N once the patient is unconscious. The range of CP force applied was 3.7 to 98.1 N. Laryngeal view deteriorated in 63% of subjects when 30 to 40 N of force was applied. Utilizing the percentage of glottic opening score resulted in an 89% improvement of view when performing the bimanual method. Using computed tomography (CT) to observe effects of CP, 92% of patients had esophageal displacement in either cervical extension, flexion, or both.

Implement Evidence: Evidence shows CP during RSI negatively impacts the result of an otherwise uneventful, safe, and successful intubation significantly. Studies suggest CP is ineffective in preventing aspiration, decreases lower esophageal sphincter tone, and induces difficult ventilation. Additional aggressive and consistent teaching of proper application and technique should be enforced for healthcare providers. Standardized aspiration protocols with medications, proper patient positioning, and utilizing appropriate mask/bag pressures should assist in alleviating the need of CP during laryngoscopy.

Conclusions: Other CP risk include unstable cervical spine injury, esophageal rupture, cricoid fracture, and laryngeal trauma. Fear of litigation to withhold CP during RSI or in patients with uncontrolled gastric reflux may be an indicator for the lack of new RCTs. The level I, II, and III studies presented provided a strong basis on negative outcomes resulting from CP. Various methods were utilized in a variety of samples that provided a wide range of validation. The research suggests CP lacks effectiveness due to inconsistent technique and force, airway obstruction, and incomplete esophageal occlusion.

A80

Gabapentin for Attenuation of Hemodynamic Response During Laryngoscopy and Tracheal Intubation

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Introduction: In 80% of patients, laryngoscopy and tracheal intubation is associated with an exaggerated hemodynamic response that can evoke life-threatening complications including myocardial ischemia, infarction, dysrhythmias, posthypertensive cardiac collapse, aortic dissection, rupture of aortic aneurism, increased intracranial pressure, and cerebral vascular bleeding. This evidence-based practice analysis was conducted in order to assess safety and effectiveness of a second generation anticonvulsant drug gabapentin in attenuation of the hyperdynamic response to laryngoscopy and tracheal intubation.

Literature Review Analysis: Every study included in the analysis concluded that significant blood pressure attenuation after gabapentin pretreatment prior to anesthesia induction was observed during and after laryngoscopy and tracheal intubation. P values below 0.001 were demonstrated. Gabapentin doses as low as 600 mg produced reliable results with minimal side effects. Most research studies concluded that gabapentin was just as effective in heart rate attenuation following laryngoscopy and tracheal intubation. P values below 0.002 were demonstrated. Gabapentin attenuated hemodynamic response to laryngoscopy and intubation in a dose-dependent manner. Population in the trials included patients undergoing coronary artery bypass graft, eye, microlaryngoscopic, and general surgical procedures.

Implement Evidence: The results support preoperative administration of 600 mg of gabapentin 2 hours before induction of anesthesia to attenuate increases in blood pressure and heart rate during laryngoscopy and tracheal intubation. Administration of 600 mg of gabapentin the night before surgery and another 600 mg of gabapentin 2 hours prior to induction of anesthesia should be considered in high risk patients, including patients with advanced coronary artery disease, aortic dissection, neurologic injury, seizure disorder, head trauma, and intracerebral hemorrhage.

Conclusions: Outcomes of this evidence-based practice analysis demonstrated that preoperative administration of gabapentin significantly attenuates increases in blood pressure and heart rate in response to laryngoscopy and tracheal intubation and may help prevent life-threatening complications that are associated with it. Therefore, administration of gabapentin 600 mg to 1200 mg preoperatively should be considered as a safe, highly effective, and inexpensive option to attenuate blood pressure and heart rate increases during airway manipulation, especially in high risk patients with multiple comorbidities.

A81

Implementation and Evaluation of the Obstetric Hemorrhage Patient Safety Bundle

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Introduction: Despite increases in technology, there is an upward trend in severe morbidity and mortality in the maternal population in the United States. This disturbing trend has steadily climbed to the rate of 17.8 pregnancy-related deaths per 100,000 live deliveries. Hemorrhage is a leading cause of morbidity and mortality in an otherwise healthy parturient. A national effort is underway to address this concern for maternal safety. The Council on Patient Safety for Women's Health is a national partnership with representation from the national organizations of 17 different groups of healthcare providers.

Literature Review Analysis: After an exhaustive review of the literature, this national partnership has developed evidence-based guidelines and recommendations to improve the safety of obstetric care, and it "bundled" them for implementation across the country. To promote early recognition and treatment of hemorrhage, guidelines are organized into components: readiness, recognition, response, and reporting. A hemorrhage cart is recommended to provide ready access to equipment and medications. Drills are recommended to be part of the assessment of process outcomes. Other aspects of care include standardized definitions of hemorrhage, quantification of blood loss, and a hospital-specific algorithm is necessary to map the emergency response.

Implement Evidence: The project includes all phases of evidence-based practice implementation of the complex obstetric hemorrhage bundle by a multidisciplinary group that includes members from obstetrics and gynecology, nurse midwifery, anesthesia, blood bank, laboratory, and administration. Since a coordinated, swift response by the obstetric hemorrhage response team can be lifesaving, a major emphasis of this project is to provide a sustainable method for team building for the obstetric emergency response team (OERT). Hemorrhage drills were used to assess systems problems that resulted in a delay in treatment.

Conclusions: The debriefing process for the drills was used to facilitate team building and communication for the OERT. High-fidelity simulation is an important means of providing education for OB care staff. It can also be a method of accurately assessing the changes in processes. Monthly high-fidelity simulation drills were used to evaluate processes at a community-sized facility. Notable improvements were made in the efficiency of recognition and response, speed of obtaining blood products from Transfusion Services, and overall team functioning.

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Implementation of an Education Program for an Ultrasound-Guided Liposomal Bupivacaine Transverse Abdominis Plane (TAP) Block Protocol for Open Abdominal Procedures

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Introduction: The use of TAP blocks as part of a multimodal postoperative pain management strategy for open abdominal procedures has gained recent favor in anesthesia practice to reduce overreliance on opioid therapy. Formulation of liposomal bupivacaine (Exparel®), a sustained delivery local anesthetic, has further enhanced attraction to this analgesia technique. However, many anesthesia practitioners (APs) lack familiarity with TAP blocks and liposomal bupivacaine use. This may serve as a potential barrier to AP adoption of the technique and with achieving optimal pain relief and satisfaction for the patient.

Literature Review Analysis: Review of literature was performed evaluating current evidence on TAP blocks, liposomal bupivacaine, and education strategies. Databases searched include PubMed, CINAHL, and TRIP. Use of TAP blocks for open abdominal surgery in a majority of trials resulted in significant decreases in pain scores, total opiate consumption, and time to first opiate rescue with minimal side effects. Liposomal bupivacaine use in field blocks, such as TAP blocks, has also shown efficacy with reducing pain scores and total opiate consumption for a variety of abdominal surgeries, presenting potential economic and clinical benefits. Education for APs is most effective when adult learning theory, active learning, and simulation principles are utilized.

Implement Evidence: Anesthesia practitioners were educated on ultrasound-guided TAP block placement and the use of liposomal bupivacaine. Primary outcomes included a pre-post assessment of knowledge and confidence. Increases in median knowledge scores (n=13; pretest score=5, IQR=1; posttest score=8, IQR=0; p=.002) and confidence scores (n=11; pretest score=0.65, IQR=0.30; posttest score=0.96, IQR=0.10; p=.005) was observed. As a secondary outcome, competency was assessed using a standardized grading tool and all APs were able to place a simulated TAP block with minimal guidance.

Conclusions: Implementation of a multistrategy education program utilizing simulation results in a significant increase in knowledge, confidence, and competency in APs for the placement of ultrasound-guided TAP blocks using liposomal bupivacaine. This analgesia technique and local anesthetic preparation has demonstrated efficacy in a multimodal pain management plan to reduce opioid use and its associated complications. It may also improve overall patient pain relief and satisfaction, while potentially decreasing hospitalization stay and costs.

Improving the Orientation Process for New CRNAs at an Urban Academic Medical Center

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Introduction: In preparation for an anticipated growth of 21% in 2015 and 15% in 2016, the authors reviewed the on-boarding process for new CRNAs at an urban academic medical center. Rapid expansion of any department can make existing processes vulnerable. CRNAs provide a vital service to patients, and it is important to ensure that newly hired CRNAs feel supported in their first few months of joining a new department. Two complementary activities related to on-boarding will be discussed. The orientation process was reviewed and targeted educational initiatives were developed where gaps were identified. During the same time, a formal peer-to-peer mentoring program was initiated and evaluated.

Literature Review Analysis: A small focus group was interviewed about the on-boarding process and preliminarily improvements were identified for the current on-boarding process. Additionally, a formal survey was electronically distributed that had a 54% response rate (n= 49) from CRNAs. A majority of respondents (58%) felt that current length of orientation was satisfactory; however, key areas for improvement were identified. As a parallel activity, a formal peer-to-peer mentoring pilot program was also introduced. The positive benefits of mentoring relationships in the work environment have been well described in the literature. The mentor role can be multilayered, but the primary role is to help junior department members' transition into a new practice setting. In a complex healthcare system environment, this transition can take between 6 months to 1 year.

Implement Evidence: Targeted education and case specific orientation were designed to fill gaps identified in the focus group and formal survey. The peer-to-peer mentoring program paired 17 new staff members with 17 CRNAs. The relationship rules were left relatively unstructured, and an interim focus group and postimplementation survey were conducted. In the survey, groups agreed that the time they invested was valuable (83% mentor group vs 100% mentee group). Across groups, 100% agreed that it was a valuable experience to serve both as a mentor and to be mentored. A majority of mentor respondents (92%) thought having a mentor when they first started would have been beneficial.

Conclusions: A structured orientation process for new employees can decrease anxiety, increase staff satisfaction, and ease transition into a high stakes job environment that can influence recruitment and retention. Mentorship as part of an on-boarding process is also a valuable tool and method to provide a support system for a new CRNA. The major benefits we saw in this careful examination of our on-boarding process were providing supplemental key portions of information missed during orientation, and both mentor and mentee pairings found engagement in the program a valuable use of time. Departments should consider implementing a formal orientation program for CRNAs or reviewing their current program.

Source of Funding: Internal Department of Anesthesiology funding.

Inpatient Respiratory Monitoring: Implementation at a Large Military Treatment Facility

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Introduction: Adverse patient outcomes and unexpected deaths have been attributed to respiratory depression. Continuous respiratory monitoring (CRM) technologies, such as pulse oximetry and capnography, are useful when monitoring patients at risk for respiratory depression; however, these technologies require education in their use and implementation. CRM was recently initiated on inpatient units at Naval Medical Center San Diego; however, clinical observation revealed nursing and support staff lacked the knowledge, experience, and confidence necessary to effectively implement CRM. As a result, a significant knowledge deficit related to CRM existed and became a process improvement priority.

Literature Review Analysis: Adverse patient outcomes and unexpected deaths have been attributed to respiratory compromise. Literature suggests vital signs taken intermittently, as opposed to continuously, may have poor predictive value in detecting individuals at risk for respiratory depression. The combination of pulse oximetry and capnography allows more effective and efficient recognition of respiratory depression and patient deterioration. An understanding of physiology, pathophysiology, and appropriate utilization of CRM are essential in minimizing the risk for complications. Educational programs for medical professionals, such as a CRM curriculum, have shown improved patient outcomes and increased patient acceptance.

Implement Evidence: Outlines were preliminarily reviewed and approved by content experts. Podcast drafts were disseminated initially to ward clinical nurse specialists, and advanced practice registered nurses for review. An evaluation tool was developed to accompany the CRM podcasts and to elicit feedback from reviewers. This tool was designed to collect feedback on multiple subjects such as content, objectives, organization, and style, as well as scores on the technical, visual, and auditory aspects of each podcast. Applicable changes based on feedback were implemented before professionally recording and deploying the final podcasts.

Conclusions: The CRM curriculum, grounded in Mosby's Nursing Skills, aids in the standardization of nursing education. A standardized curriculum allows clinical support staff to consistently anticipate and respond appropriately to the needs of patients requiring CRM. The CRM educational podcast curriculum provides a sustainable method of education in a fluid environment of care. This contribution to process improvement encourages the prevention of negative outcomes through further education and training that will ultimately improve the quality and consistency of patient care throughout Navy Medicine.

Intraosseous Versus Central Venous Catheter Access in the Trauma Patient

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Introduction: Trauma patients require rapid venous access for the administration of fluid, emergency medications, blood, antibiotics, and anesthetic medications. In these situations, gaining intravenous (IV) access via a peripheral IV catheter can be a lengthy and sometimes impossible process due to the presence of hypovolemia and collapsed peripheral blood vessels. When gaining venous access via a peripheral IV is deemed impossible, or an inefficient use of time, other interventions such as central venous catheters (CVC) or intraosseous (IO) access can be utilized.

Literature Review Analysis: The empirical evidence was explored to determine if the utilization to explore IO access is advantageous when compared with CVC utilization in the trauma patient. Common themes were identified: first-time insertion success, insertion times, and complication rates favoring IO utilization. First-time insertion was found to be more successful via the IO route from 80.6% to 93% compared with the CVC route 60% to 80%. Insertion times were consistently faster with IO insertion compared with CVC with times of 2 minutes (± 0.8 minutes) and 8 minutes (± 2.2 minutes), respectively. Complication rates were found to be favorable when comparing CVC, 14% to 15% and IO, 1.38%.

Implement Evidence: When peripheral IV access is deemed difficult or impossible, the immediate utilization of IO vascular access is faster, more successfully achieved, and is associated with fewer complications than CVCs. The availability of IO supplies in every anesthesia provider's trauma cart will lead to more efficient vascular access. The anesthesia provider avoids complications with CVCs when utilizing IO devices. The implementation of IO access will lead to improved patient outcomes for quality, cost-effective, safe healthcare.

Conclusions: In the trauma patient, gaining timely vascular access is one of the most important life-saving actions for the anesthesia provider. The utilization of IO vascular access is an underutilized effective method of fluid and medication administration. Vascular access is pertinent to the anesthesia provider due to life-saving medications, which can be infused faster intraosseously versus CVC. The empirical evidence supports the utilization of IO devices to provide faster and efficient vascular access in improving patient outcomes.

Ketamine Gargle for the Prevention of Postoperative Sore Throat

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Introduction: A common complication following tracheal intubation is a postoperative sore throat that creates patient dissatisfaction. A sore throat results due to inflammation and injury to the mucosa and most commonly occurs 2 to 6 hours postoperatively. Patients that develop a sore throat experience discomfort, and many do not find adequate relief with current pharmacological methods. Patients who complained of postoperative sore throat stayed 14 minutes longer in the postanesthesia care unit and were discharged 51 minutes later than those without a sore throat.

Literature Review Analysis: A randomized, double-blind study with 60 patients concluded that 24 hours following tracheal intubation, 50% of patients in the placebo group complained of a sore throat, whereas 13.3% of patients in the ketamine group complained of a sore throat. A prospective, randomized, placebo-controlled, single-blind study with 46 patients concluded that patients in the placebo group were found to have a higher incidence of developing a postoperative sore throat up to 24 hours following intubation ($p < 0.01$). A prospective, randomized, placebo-controlled, single-blind study with 40 patients concluded that 24 hours following tracheal intubation, 60% of patients complained of a sore throat in the placebo group compared with 25% of patients in the ketamine group.

Implement Evidence: Research supports administration of a 40-mg or 50-mg ketamine gargle in reducing the prevalence and severity of a sore throat for up to 24 hours following tracheal intubation. A ketamine gargle is easy to administer prior to induction of anesthesia resulting in improved patient satisfaction and comfort in the postoperative period. A ketamine gargle is a safe method of treatment with minimal systemic absorption. Implementing this new method of treatment into clinical practice will increase patient satisfaction and result in decreased healthcare cost.

Conclusions: Administration of a ketamine gargle in the preoperative period significantly reduces the prevalence and severity of a postoperative sore throat. The anesthesia profession is focused on improving clinical outcomes, increasing patient satisfaction, and cost-effective care. A ketamine gargle can change the future of anesthesia practice, allowing patients to awaken from anesthesia without a sore throat resulting in a pleasant anesthetic experience. The benefits of a ketamine gargle make it an attractive option for reducing the prevalence and severity of a sore throat.

A87

Laryngeal Mask Airway Use in Morbidly Obese Patient Undergoing General Anesthesia

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Introduction: The use of a laryngeal mask airway (LMA) in obese patients is controversial. A recent legal case involving the use of an LMA with an obese patient who aspirated found the anesthesia providers to be negligent. LMAs are used frequently in outpatient anesthesia due to ease of placement, efficacy, and ability to decrease turnover time. An evidence-based review was conducted to address if an LMA was a safe and efficacious airway device to an endotracheal tube in the obese.

Literature Review Analysis: A search from 2005 to 2015 was conducted using Pubmed and Cochrane Database of Systematic Reviews with 2 sources meeting inclusion criteria. The Cochrane systematic review (SR) contained 2 studies with 232 obese participants comparing an LMA to an endotracheal tube in general surgery cases. The second source was a randomized controlled trial crossover design comparing 2 types of LMAs in 50 obese participants undergoing elective surgery. The incidence of hypoxemia, change of airway device, laryngospasm, bronchospasm, and aspiration was recorded. The SR found the LMA group had a mean SaO₂ of 2.54% higher saturation, but the quality of the evidence was low. No aspirations were reported in either source, but these were not powered to detect this complication.

Implement Evidence: Implementation into nurse anesthesia practice would require every anesthesia provider to know that a legal case has now been documented that does not support the use of LMAs in the obese or morbidly obese population due to the risk of aspiration. Although a rare complication of anesthesia, a provider must balance this with the current absence of clinical data to support otherwise.

Conclusions: This Cochrane SR is the only review that addresses the use of an LMA versus an endotracheal tube in the obese. Although there is a legal case now to not support the use of an LMA in an obese patient, the clinical support in safety and efficacy of its use remains an anesthesia provider's best clinical judgment.

A88

Literature Review on Alpha-2 Adrenoceptor Agonist Adjuvants To Local Caudal Anesthetics in Pediatric Patients

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Introduction: The purpose of this literature review was to explore the current research available to help answer the following PICOT question: In pediatric patients undergoing surgery, does the addition of an alpha-2 agonist agent to a caudal anesthetic block improve intraoperative and postoperative outcomes?

Literature Review Analysis: Critical appraisal of articles was completed using the Johns Hopkins Nursing Evidence-Based Practice Appraisal Tools, which allowed for evidence to be appraised in a streamlined and systematic manner. Upon completion, 11 articles were identified as high quality resources that would be helpful in answering the PICOT question. Both dexmedetomidine and clonidine were found to prolong the duration of a caudal anesthetic block and were associated with minimal adverse events when compared with a control or a variety of other adjuvant medications.

Implement Evidence: The use of caudal blockade is a very common, dependable, and safe anesthetic technique that is employed regularly in pediatric surgical cases. The major drawback of the caudal anesthetic technique is its relatively short duration of action. Thus, a variety of pharmacologic adjuvants have been found efficacious in prolonging the duration of analgesia when added to a local anesthetic caudal block. This abstract will help providers use research findings to make more informed decisions about which adjuvants to use in their caudal blocks, as certain adjuvant agents are effective in providing adequate pain relief but also produce a variety of undesirable side effects.

Conclusions: The current evidence proves that the addition of an alpha-2 agonist agent to a caudal anesthetic block in pediatric surgery cases improves intraoperative and postoperative outcomes without an increase in the incidence of untoward side effects. However, heterogeneity exists among the studies, and gaps in the literature are evident. There is also an obvious lack of studies that conduct a side-by-side comparison of dexmedetomidine and clonidine, thus I drafted a proposed evidence-based practice project that compares the 2 medications.

Management of Patient With Blood Refusal During Anticipated High Blood Loss Procedures: A Literature Review and Intervention Evaluation

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Introduction: Currently, there is not a consensus on how to provide anesthesia care for the blood refusal patient during a surgery where high blood loss is anticipated. Although there are several surgical techniques identified that can minimize blood loss including electrocautery, the use of topical hemostatic agents and experienced surgeons (Mason and Tran, 2015), the goal of this literature review is to focus on anesthetic interventions and grading the interventions based on efficacy, cost effectiveness, and ease of use.

Literature Review Analysis: A literature review was conducted using the following databases: Wiley Online, PubMed, CINAHL, and Scopus. Keywords for the search included bloodless anesthesia, patients who refuse blood products for surgery, cost effectiveness of alternatives to blood transfusion, factor VIIa, cell saver, Jehovah's Witness, and bloodless medicine. From the 17 articles we included in our literature review, we identified 6 interventions and developed a point system to grade each intervention based on its ease of use, cost effectiveness, and efficacy, with a score of 1 being the least desirable and 3 being the most.

Implement Evidence: Utilizing the information found in the literature review can be very helpful to ensure quality and efficacious care for a blood refusal patient undergoing a high blood loss surgery. The patient would benefit from a preoperative anesthesia appointment to establish modalities that the patient is agreeable to, as well as for the administration of iron and erythropoietin, if needed. Intraoperatively, giving tranexamic acid early and initiating acute normovolemic hemodilution, cell saver, and controlled hypotension can be advantageous. Developing a thorough anesthesia plan implementing these interventions can lead to better patient outcomes and improved quality anesthesia care.

Conclusions: The literature review and subsequent grading system concluded that tranexamic acid was most effective with a grading score of 9, followed by anesthetic technique with a score of 7. Erythropoietin and iron supplementation preoperatively, normovolemic hemodilution technique, and cell salvage all had a grading score of 6. Recombinant factor VIIa was graded least effective with a grading score of 5 due to the high cost and the lack of evidence proving the intervention's efficacy in treatment of hemorrhage not associated with hemophilia (Bain et al, 2014; Rujirojindakul et al, 2013; Simpson et al, 2012).

Manometer Pressure Need for accurate ETT measurement

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Introduction: Only a manometer is the best evidence-based practice for preventing overinflation or underinflation of the endotracheal tube (ETT) cuff. However, manometer measurement of the ETT cuff pressure has not been adopted into practice. Current estimation techniques of ETT cuff pressure are subjective procedures of measurement. The purpose of this study was to determine the effects an informational intervention has on anesthesia providers' opinion about the need for a standard of care for ETT cuff pressure measurement.

Literature Review Analysis: Researchers suggest that using a manometer for assessing cuff pressures is the most accurate practice to prevent overinflation- or underinflation of the ETT cuff (Dobrinek and Landgrebe, 2007; Ganner, 2001; Galinski et al, 2006; Morris et al, 2007; Parwani et al, 2007; Stoelting and Miller, 2000; Sultan et al, 2011). Inaccuracies have been documented in spite of the continued and long-standing practice of using estimation techniques for cuff inflation. Side effects of the overinflation and underinflation of the ETT cuff include tissue damage, postoperative sore throat, and aspiration (Leedy and Ormrod, 2005; Nguyen et al, 1999). Underinflation that allows for aspiration can also lead to nosocomial pulmonary infections (Tobin and Grenvik, 1984), inadequate positive pressure ventilation, hypoxia, and hypoventilation (Galinski et al, 2006).

Implement Evidence: The purpose of this study was to determine the effects an informational intervention has on anesthesia providers' opinion about the need for a standard of care for ETT cuff pressure measurement. A pretest/posttest quasiexperimental design was used that included 31 voluntary participants. Results revealed that a significant change in perception of the participants' knowledge about the accuracy of estimation techniques, pretest to the posttest, $z = 4.179$, $p < .001$. Also, this intervention reflected a significant change in the providers' perception toward using a manometer to attain the most accuracy in ETT cuff pressure, $X^2(6) = 18.035$, $p = .006$.

Conclusions: In conclusion, the informational intervention on ETT cuff measurement that was distributed to this group of anesthesia providers yields significant results. The anesthesia administration initiated a practice change and ordered ETT manometers. The anesthesia providers in this study now are provided with the equipment to accurately measure ETT cuff pressures, and decrease the risks of patient harm due to inaccurate ETT cuff pressure.

Metastatic Breast Cancer: A Comparison of Anesthetic Management Modalities Evaluating Recurrence Risk

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Introduction: The majority of breast cancer is classified as invasive and typically requires some form of surgical excision combined with other modalities of treatment. The surgical stress response and its activation of the sympathetic nervous system and neuroendocrine system is recognized as a contributor to perioperative immunosuppression and may promote metastasis. The addition of regional anesthesia/analgesia to general anesthesia reduces the requirements of volatile anesthetics and opioids and, in turn, may help preserve immune function and reduce recurrence rates in the breast cancer population.

Literature Review Analysis: The purpose of this literature review is to investigate the effect of anesthetic technique on breast cancer recurrence and whether the use of regional anesthesia decreases the risk of metastasis by attenuating the surgical stress response and minimizing general anesthesia. The literature presented in this review was selected from a comprehensive search in the PubMed database. Key terms used for the search included breast cancer recurrence, anesthetic technique, regional anesthesia, surgical intervention, and mastectomy. Three articles were selected based on sample size, in vivo studies, and presentation in the English language.

Implement Evidence: The postoperative period is the most susceptible for metastasis to occur due to altered tumor microenvironment by surgical and medicinal immunosuppression. General anesthesia may encourage metastasis by manipulating the environment and behavior of malignant cells, while paravertebral methods may hinder the progression of metastasis. Since the immune system remains impaired for several days to weeks postsurgery, providers should consider the addition of regional anesthesia to reduce the use of general anesthesia and opioids.

Conclusions: The researchers of each study proposed that further investigation be carried out to validate the hypothesis of anesthetic technique influencing breast cancer outcome. As breast cancer continues to threaten the female population, future studies are necessary to give more insight on the phenomenon of cancer recurrence. This is a novel area of study and prospective, well-planned trials are required before any change in clinical practice can occur. Overall, these studies' trending results strengthened the association between anesthetic technique and breast cancer outcome.

A92

Methods to Decrease Constipation in Patients Undergoing Orthopedic Surgery

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Introduction: Constipation is a troubling side effect occurring in approximately 81% of noncancer subjects taking opioids. About 40% to 90% of postoperative orthopedic patients often experience opioid-induced constipation. Providers often prescribe various treatments for the prevention of constipation including bran supplements, laxatives, proper nutrition, adequate hydration, and physical activity. We examined evidence addressing this PICO question: What pharmacologic and nonpharmacologic methods decrease the incidence of postoperative constipation in patients undergoing nonabdominal surgery?

Literature Review Analysis: The search (1990-2015) for evidence was conducted using PubMed, Cochrane Database of Systematic Reviews, Google Scholar, and Guidelines.gov. The inclusion criteria included full text systematic reviews and studies appearing in peer-reviewed journals or on professional or governmental websites. Sources including palliative care subjects were excluded. Three randomized controlled trials, a quasi-experimental study, and a prospective observational study met the criteria. All of the sources suffered problems related to instrument reliability, blinding, randomization, and sample size. Support was lacking for the use of fiber, stool softeners, and senna. Peripherally acting mu opioid receptor antagonists, such as methylnaltrexone, may be effective.

Implement Evidence: The author (VR) was invited to contribute these findings to the Society of Hospital Medicine's clinical practice guideline, Reducing Adverse Drug Events Related to Opioids Implementation Guide. This is a professional medical society representing more than 14,000 of the 44,000 practicing hospitalists in the United States. The findings of this review were incorporated into this clinical practice guideline and is available for download on their website.

Conclusions: Postoperative opioid-induced constipation is not drug-specific or a dose-dependent phenomenon. The finding from this evidence-based review intends to present effective modalities in improving postoperative opioid-induced constipation in the orthopedic population.

Methylene Blue as a Treatment for Vasoplegia

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Introduction: Vasoplegic syndrome (VS) is characterized by its heralding complications of persistent and diffuse vasodilatation that is minimally responsive to vasopressors. In order to achieve end-organ perfusion and correct low systemic vascular resistance, treatment for VS should target its multifactorial causes. Specifically, the pathologic activation of intrinsic vasodilatory pathways mediated by nitric oxide (NO) can result in VS. This review assesses whether methylene blue (MB) is an effective treatment for hypotension refractory to vasopressors.

Literature Review Analysis: A literature search was limited to peer reviewed articles published in English subsequent to 2010. Keyword searches included the terms methylene blue and vasoplegia. A meta-analysis of randomized controlled trials evaluated MB as a treatment for VS in the setting of postcardiopulmonary bypass, sepsis, and liver transplantation. All articles explain the effect of MB on microcirculation. By directly inhibiting NO synthase, MB inhibits formation of cyclic guanosine monophosphate and avoids subsequent smooth muscle relaxation. Furthermore, MB also competitively binds to enzyme-soluble guanylate cyclase (sGC) to prevent interleukins and oxygen-free radicals from triggering the vasodilatory enzymatic cascade.

Implement Evidence: This review raises awareness for the defining characteristics of VS: hypotension (mean arterial pressure <50 mm Hg), increased cardiac index (>2.5 L/min/m²) and low systemic vascular resistance (<800 dynes·sec/cm⁵). Since VS is associated with a 50% mortality rate, identifying MB administration as a treatment option is clinically significant. However, there is no evidence-based dosing regimen and prophylactic versus postoperative treatment must be further explored. Therefore, this review encourages prospective randomized controlled studies with large patient populations to assess MB.

Conclusions: The evidence reviewed supports that VS should be treated on a microcirculatory level to antagonize the causing factor, not a resulting physiologic response. MB inhibits NO synthase and sGC to prevent the hemodynamic derangement of VS. Although MB has been proven to increase systemic vascular resistance, evidence has not demonstrated improved oxygen delivery or decrease in mortality. As a result, MB should not be used as a first line treatment at this time. Rather, MB administration is a viable treatment for hypotension after vasopressors are proven ineffective.

Ondansetron Alone Versus Ondansetron-Dexamethasone Combination for Prevention of Postoperative Nausea and Vomiting: Literature Review

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Introduction: This review of the literature was undertaken to determine whether ondansetron-dexamethasone combination (ODC) more effectively treated postoperative nausea and vomiting in patients who received general anesthesia better than ondansetron alone (O). According to Kovac, PONV is estimated to occur between 25% to 35% in surgical patients (2013). Patients who experience PONV have longer stays in the postoperative recovery areas and lower patient satisfaction scores. Ondansetron is a 5-HT₃ receptor antagonist used for the treatment of PONV. Dexamethasone is a glucocorticoid and its effects on PONV are not fully understood, but there is suggestion it augments the effects of 5-HT₃ receptor antagonists.

Literature Review Analysis: Six studies were included in the evaluation process. All 6 studies were randomized controlled trials, with 4 out of the 6 being double blinded. Patients were evaluated for PONV at different intervals across the studies. Times ranged from 1 hour out to 48 hours postoperatively. The occurrence of PONV in the O group between 0 and 6 hours postoperatively across studies ranged from 23.3% to 33.3%. In the ODC group, incidences of PONV at the 0 to 6 hour time were 12% and 16.67%. At 24 hours postoperatively, the occurrence of PONV in the O group ranged from 24% to 56.67%; for the ODC group, the range was 8% to 20%. A reduction of PONV with the use of ODC was demonstrated across all studies.

Implement Evidence: This review looked at the difference between PONV in patients who received O or ODC. The literature review findings revealed that patients who received the ODC had lower incidences of PONV. PONV has a multifactorial etiology. Ondansetron is generally given at the end of the anesthetic unless the provider feels the case has a short enough duration for it to be given beforehand. Dexamethasone, a glucocorticoid, which treats PONV with roughly equal effectiveness as O, does not have a fully understood mechanism of action. But ODC has a greater effect than each medication given individually.

Conclusions: The ODC was shown to reduce the presence of PONV in each of the studies reviewed. The benefits were most notable at the 24-hour postoperative mark. When assessing the presence of PONV, the 0 to 6 hour time frame, the reduction between the 2 groups was around 50%. At the 24 to 48 hour time frame, the reduction was even greater between 60% to 75%. It was thought that this difference at the 24-hour mark was due to the length of action of the dexamethasone. This difference in rates of reported, or observed, PONV should give providers pause and should offer the opportunity to consider the ODC as a viable treatment option for patients.

Perioperative Duloxetine for the Prevention of Chronic Postsurgical Pain

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Introduction: One of the leading causes of disability in the United States is chronic pain that can be due to persistent surgical pain. Acute postoperative pain increases the risk of developing chronic pain and is a result of peripheral tissue injury causing peripheral and central sensitization. Traditional methods for pain relief include the utilization of opioids that produce unwarranted effects such as vomiting, nausea, pruritus, and constipation. Preemptive multimodal analgesia is gaining favorability as it targets different areas of the pain pathway and acts synergistically.

Literature Review Analysis: Duloxetine, a selective serotonin and norepinephrine inhibitor (SSNRI), is an antidepressant known for its analgesic effects in chronic neuropathic pain conditions and investigated as a preemptive adjunct to opioids to prevent the development of chronic pain. Three randomized controlled trials examine groups receiving duloxetine prior to surgery and after compared with those receiving a placebo regimen. Results in the duloxetine groups yielded reduced opioid consumption, longer time to rescue analgesics, decreased pain scores, improvement in baseline function, and a reduced incidence of chronic pain. An animal study demonstrated duloxetine's ability to reverse mechanical allodynia and have antihyperalgesic effects in rats and mice.

Implement Evidence: This evidence-based practice analysis report examines the efficacy of duloxetine administered in the perioperative setting. Administering 30 to 60 mg oral duloxetine 2 weeks to 2 days prior to the procedure and continuing the regimen for 3 to 6 months had successful results in decreasing postoperative pain, opioid consumption, and increased baseline function. The goal of multimodal preemptive analgesia is to prevent the development of central sensitization even if peripheral sensitization is already present. Acute and chronic postoperative pain were decreased significantly.

Conclusions: Chronic pain arising from postsurgical pain is becoming increasingly common among patients in the United States. Innovative techniques emphasize primary prevention of chronic pain by preventing acute pain. Multimodal pharmacologic agents target different areas of the pain pathway to improve pain control. Duloxetine shows a promising effect on pain modulation and can help prevent the development of central sensitization. It is a useful adjunct to opioids and can reduce its consumption, therefore decreasing adverse effects such as nausea, vomiting, constipation, and pruritus.

Protective Ventilation Strategies During One-Lung Ventilation: Is Less Really More?

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Introduction: Conventional ventilation (CV) strategies that are used during two-lung ventilation (TLV) are often used during one-lung ventilation (OLV). There is growing evidence, that CV is associated with postoperative pulmonary complications (PPCs) when used during OLV. Reduced tidal volumes (Vt) and increased positive end-expiratory pressure (PEEP) during OLV has been adopted, but until recently, evidence to support its use during OLV has been lacking. The purpose of this review was to examine the difference between PV and CV in regard to PPCs and clinical outcomes.

Literature Review Analysis: An online search was conducted using UpToDate, PubMed, CINAHL, and MedlinePlus between the years of 2010 and 2016. Key terms included one-lung ventilation, protective ventilation, and postoperative complications. Inclusion criteria included randomized controlled trials (RCTs), humans, adults, and the English language. Criteria that were excluded were articles that assessed airway pressure release ventilation, high frequency jet ventilation, patients on cardiopulmonary bypass, and studies that concentrated on intraoperative oxygenation rather than postoperative complications. PV was compared with CV, in regard to postoperative patient outcomes, in the 4 RCTs included in review.

Implement Evidence: Three out of 4 studies suggest that the benefits of a PV strategy included a decreased incidence of reintubation, acute respiratory distress syndrome (ARDS), and inflammation. Duration of both postoperative intubation and time in the intensive care unit were also decreased. Although there was no increase in length of hospital stays in these studies, 1 patient in the CV group died from ARDS, perhaps indicating an increase in mortality associated with CV. The PV strategy utilized a Vt of 5 to 6 milliliters per kilogram with PEEP of 5 centimeters of water during OLV.

Conclusions: Oxygenation takes priority during OLV, but PPCs is often an overlooked factor. The consensus of recent research indicates that PV during OLV is beneficial in preventing PPCs. One small study did not support PV during OLV, suggesting that more research is needed to support PV. As enhanced recovery after surgery (ERAS) protocols are becoming an increasingly more integral part of the anesthetic care plan, protocols should be guided by these results.

A97

Reducing Bacterial Contamination From Stopcock Use: A Review of the Literature

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Introduction: Intraoperative stopcock contamination has been detected in up to 23% of cases using traditional open-lumen 3-way stopcock sets and is associated with increased incidences of postoperative infections and patient mortality. This systematic review of the literature was conducted to determine whether the incidence of bacterial contamination is reduced with the use of novel catheter designs with built-in protection caps compared with conventional 3-way stopcocks in adult patients undergoing surgery.

Literature Review Analysis: Peer-reviewed journals were searched using CINAHL EBSCO, Cochrane Library, and PubMed for articles published between 2006 and 2016. Keywords searched included stopcock, contamination, and infection. A total of 6 peer-reviewed randomized controlled trials met inclusion criteria, were in English, and were deemed to be topic-specific. Findings suggest that the use of disinfectable, needleless closed catheter devices (DNCCs), blood conservation systems (BCSs) with closed infusion lines, catheter care bundles (such as HubScrub or DOCit), and other injection devices with built-in protection caps all reduce the incidence of bacterial contamination when compared with conventional open-lumen 3-way stopcock sets.

Implement Evidence: It is clear from the findings of this evidence-based review that open-lumen stopcock sets are associated with higher incidences of bacterial contamination than some available closed catheter devices. Information about contamination rates and the cost of the associated bacterial infections should be offered to hospital administrators in charge of ordering medical equipment in an effort to increase the purchasing of equipment with lower contamination rates. Education should then be given to anesthesia providers about the use of these new closed catheter devices and built-in protection caps.

Conclusions: The evidence presented in these randomized controlled trials suggests that DNCCs, BCSs, catheter care bundles, and devices with built-in protection caps are associated with a lower incidence of bacterial contamination than open-lumen 3-way stopcocks. The use of these devices in lieu of the traditional stopcock could decrease the incidence of bacterial contamination, infection, and patient mortality.

Systematic Review of the Role of Ocular Tonometry in the Prevention of Postoperative Visual Loss

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Introduction: Visual loss is a potential postoperative complication, closely associated with surgeries performed in the prone and steep Trendelenburg positions. There is evidence to suggest that these positions induce an increase in intraocular pressure. Current research indicates that there is a critical threshold where a rise in arterial pressure is inadequate in preserving ocular perfusion. A systematic review was conducted to establish the correlation between different positions and a rise in intraocular pressure and to describe the feasibility of intraoperative intraocular pressure monitoring. The ultimate goal is prevention of postoperative visual loss.

Literature Review Analysis: A systematic review was conducted utilizing the CINAHL and Proquest databases to find literature relevant to the relationship between intraocular pressure and surgical position. Analysis of search results indicated that perfusion to the core ocular structures is only autoregulated until a critical threshold is reached. Patients who experience elevated intraocular pressure are at risk of ischemia to these structures. Additionally, analysis indicated causal relationships between patient positioning and intraocular pressure, with patients positioned in the prone and steep Trendelenburg positions being more likely to experience critically elevated intraocular pressure readings. The search results also indicated that it is indeed feasible to monitor intraocular pressure in a variety of positions, without significant patient risk.

Implement Evidence: All patients at risk of developing postoperative visual loss should have a visual assessment performed, utilizing the same protocol that will be used to assess vision postoperatively. Patients should also receive enough information to provide informed consent prior to high-risk procedures. The most efficacious approach to POVL is prevention. Once a critically elevated intraocular pressure is identified, topical medications such as Cosopt may be used. In steep Trendelenburg-positioned patients, a supine reperfusion interval may be used. Staging of lengthy procedures, minimizing bleeding, favoring colloid fluids, and avoiding hypotension have also been described, to name a few strategies.

Conclusions: The results of the systematic review support the feasibility and routine use of perioperative tonometry during high-risk surgical procedures. Relating the most recent research concerning autoregulation of ocular perfusion with the possible critical increases in IOP in the prone and steep Trendelenburg positions naturally leads to the conclusion that there is indeed a role for routine tonometry during these positions. Future research initiatives should be directed toward finding the best ways to implement routine tonometry protocols, possibly through development of evidence-based guidelines or creation of a targeted prevention checklist.

A99

**The Effect of Preoperative Information on Patient Satisfaction After Second Eye Cataract Surgery:
A Literature Review**

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Introduction: Cataract surgery is the most common ocular surgery worldwide, yet there is minimal research addressing how preoperative education affects postoperative satisfaction in patients undergoing second eye cataract surgery. Postoperative satisfaction can be measured by factors such as reduced pain, fear, and anxiety, as well as overall patient experience postprocedure. A literature review was conducted to examine the evidence addressing the effects of preoperative education on postoperative satisfaction in patients undergoing second eye cataract surgery.

Literature Review Analysis: Search engines included PubMed (MEDLINE), CINAHL, OVID, Cochrane Collaboration, Cochrane Library, National Guideline Clearing House, and Google. Keywords were cataract, second eye cataract, monitored anesthesia care (MAC), patient education, and patient satisfaction. Peer reviewed, full text articles written between 2000 and 2016 that discussed preoperative education/counseling in patients 65 and older were included. Articles were excluded if cataract surgery was done without topical anesthesia or monitored anesthesia care. Six of 31 articles were eligible for synthesis.

Implement Evidence: Psychological preparation, as well as preoperative counseling/education, reduced anxiety and improved overall patient experience and satisfaction.

Conclusions: There is a lack of evidence that correlates preoperative counseling and patient satisfaction after second eye cataract surgery. Preoperative teaching/counseling may improve patient satisfaction, reduce anxiety, and decrease fear in patients undergoing second eye surgery.

A100

The Effect of Thoracic Paravertebral Nerve Blocks on Postoperative Opioid Consumption After Breast Surgery

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Introduction: Postoperative pain control for patients who have undergone breast surgeries has traditionally been managed with intravenous and oral opioids and is often related with several undesirable side effects such as nausea, vomiting, sedation, respiratory depression, and constipation. This retrospective literature analysis sought to evaluate if thoracic paravertebral blocks in women undergoing breast surgeries reduced postoperative opioid consumption in the first 24 hours. The possible role of paravertebral blocks may result in better outcomes, faster recovery, and shorter hospital stays for patients.

Literature Review Analysis: Six peer reviewed articles were chosen for analysis. A systematic search of literature was conducted using an electronic database search, which included CINAHL, the Cochrane Database of Systematic Reviews, Scopus, MEDLINE with Full Text, ScienceDirect, and Google Scholar. These consisted of prospective, single or double blinded, randomized, and placebo controlled clinical trials. All literature was evaluated for methodology including critical analysis of statistical analysis.

Implement Evidence: Clinical recommendations include paravertebral blocks under ultrasound and nerve stimulated guidance. For less invasive procedures such as simple mastectomy we recommend a single level T4 injection. For more complex procedures such as radical mastectomy, a multilevel T1-T5 injection is recommended. Local anesthetic includes ropivacaine, 0.5%, 0.3 mL/kg, with a maximum dose of 150 mg.

Conclusions: Based on the literature analysis, the evidence shows thoracic paravertebral blocks significantly reduce postoperative opioid consumption in the first 24 hours after breast surgery. Additional findings included decreased hospital stay, fewer opioid related side effects, and greater patient satisfaction.

A101

The Effects of Ondansetron on Attenuating Spinal Anesthesia-Induced Hypotension and Bradycardia in Obstetric and Nonobstetric Subjects: A Systematic Review and Meta-analysis

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Introduction: Hypotension and bradycardia are common sequelae to spinal anesthesia. The postulated mechanisms for spinal-induced hypotension (SIH) have been attributed to venous and arterial vasodilation, venous pooling, decreased venous return, and a lack of compensatory response. Bradycardia most likely results from increased parasympathetic tone and the Bezold-Jarisch reflex. Stimulation of peripheral serotonin receptors 5-hydroxytryptamine (5-HT₃ type) elicit the Bezold-Jarisch reflex. Ondansetron, a 5-HT₃ antagonist, may be useful in attenuating SIH and bradycardia.

Literature Review Analysis: A systematic review and meta-analysis of the effect of IV ondansetron on the attenuation of SIH and bradycardia was performed. Databases used in our literature search included MEDLINE (PubMed), Google Scholar, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the Cochrane Review Database. Studies were assessed for methodological quality according to the Cochrane Handbook for Systematic Reviews. Publication bias was evaluated using graphical funnel plot and Egger's test of visual asymmetry. Thirteen randomized controlled trials met the inclusion criteria and were included in the meta-analysis. The selected studies included over 1,200 patients who received ondansetron versus placebo prior to spinal anesthesia.

Implement Evidence: Ondansetron given prior to spinal anesthesia reduced SIH and favored a reduction in bradycardia. Due to a large amount of heterogeneity in the SIH data, a subgroup analysis was conducted. Studies involving cesarean section delivery were analyzed separately from other operative procedures. In addition, different dosing of ondansetron was analyzed. Subgroup analysis demonstrated the most significant attenuation occurred with 4 mg dosing and the obstetric population. Remaining heterogeneity may be related to definitions of hypotension, varying doses of local anesthetic, and differences in fluid loading.

Conclusions: Pretreatment with ondansetron, 5 minutes prior to spinal anesthesia, significantly mitigated hypotension in subjects undergoing elective cesarean delivery. Ondansetron also favored a reduction in the associated bradycardia. The authors recommend that future studies focus on strictly controlling the definitions of hypotension and bradycardia, the dosage of bupivacaine, and the type/timing of fluid loading so as to make the results more widely applicable. A cost analysis between the use of ondansetron and the rescue medications would also be of benefit.

A102

The Impact of Cuffed Versus Uncuffed Endotracheal Tubes on the Incidence of Tracheal Tube Exchange and on Postextubation Airway Morbidity in Pediatric Patients Undergoing General Anesthesia

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Introduction: A thorough understanding of anatomical structures and developmental changes unique to the pediatric airway is essential for safe clinical care of children undergoing anesthesia. Early advanced airway recommendations in patients younger than 8 years of age included the use of appropriately sized uncuffed endotracheal tubes. This standard practice was largely based on the belief that cuffed endotracheal tubes were associated with trauma to the developing airway mucosa caused by oversized outer tube diameter, poorly designed cuffs, incorrectly positioned tubes, and overinflating of the cuff.

Literature Review Analysis: The systematic literature review revealed 8 studies meeting all inclusion criteria where patients were randomized to receive either a cuffed or uncuffed endotracheal tube. Pediatric patients requiring long-term intubation and mechanical ventilation in the intensive care unit were not included in this review. The outcomes measured were the proportion of patients requiring a tracheal tube exchange and the incidence of postextubation airway morbidity, defined as croup and/or stridor. A meta-analysis showed that the cuffed endotracheal tube group was 92% less likely to require an exchange compared with the uncuffed tube, and there was no statistically significant difference in airway morbidity between cuffed and uncuffed groups.

Implement Evidence: Both cuffed and uncuffed endotracheal tubes are acceptable for use in pediatric patients undergoing general anesthesia. However, there are many advantages associated with the correct use of a cuffed endotracheal tube, including the reduced risk of repeated airway instrumentation. The microcuff endotracheal tube is safe for use in pediatric patients. The shortened high-volume, low-pressure polyurethane cuff is located distally on the tube in order to accommodate the short pediatric trachea. In addition, appropriately measured clear depth markings ensure proper placement of the endotracheal tube.

Conclusions: It is essential to minimize laryngotracheal trauma associated with pediatric endotracheal intubation. Repeated airway instrumentation is an independent risk factor associated with increased postextubation airway morbidity, including cough and stridor. If used properly, the microcuff endotracheal tube is a safe alternative to uncuffed endotracheal tubes. Prior to cuff inflation, an audible air leak should be present at 20 cm H₂O. Subsequently, the cuff should be inflated with the minimal volume of air required to seal the trachea while ensuring the intracuff pressure does not exceed 20 cm H₂O.

A103

The Safety and Efficacy of Tranexamic Acid Use in Total Knee Arthroplasty

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Introduction: Patients undergoing total knee arthroplasty (TKA) have an increased risk for considerable blood loss and subsequent blood transfusions. Several interventions frequently utilized to decrease morbidity associated with blood loss include using a tourniquet, controlled hypotension, blood salvage and intravenous or topical antifibrinolytics, including tranexamic acid (TXA). Many of these interventions have other inherent risks for increasing morbidity. This evidence review examined the safety and effectiveness of intravenous tranexamic acid given perioperatively to patients undergoing TKA.

Literature Review Analysis: Databases reviewed for evidence (2014-2015) included PubMed, Cochrane Library, Cochrane Central Register of Controlled Trials, ACP Journal Club, SUM search, and GOOGLE Scholar. A total of 182 potential sources were found with 7 randomized controlled trials (RCTs) meeting the inclusion criteria. These RCTs examined TXA use in TKA with and without a tourniquet along with varied dosage equivalents and times of administration. Although moderate heterogeneity was present regarding blood loss and the incidence of transfusion, the evidence was consistent in demonstrating a decrease in both of these outcomes. There was no increased incidence of thromboembolic events.

Implement Evidence: The findings of this review will be presented to the anesthesia department at the Hospital for Special Surgery in New York, New York, for consideration of practice implementation and to reinforce the anesthesia practitioner's use of TXA. These findings will also be presented to their research department to help identify potential further areas of research regarding TXA in TKA.

Conclusions: This evidence strongly supports the safe and effective use of intravenous TXA in TKA. Larger multifacility trials are required to better establish the most efficacious and cost-effective dose of TXA, especially when used in high risk patients.

A104

The Use of Sugammadex in Rocuronium Induced Refractory Anaphylaxis: A Literature Review

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Introduction: Anaphylaxis during general anesthesia is a life-threatening event, caused often by the ammonium ion of neuromuscular blocking agents (NBA), specifically rocuronium. Recent case reports have shown that sugammadex, an NBA reversal agent, may provide an adjunct therapy to rocuronium induced refractory anaphylaxis. A literature review was used to answer the following PICO question: In adults with refractory (ie, intractable) anaphylaxis to rocuronium, does the use of sugammadex in conjunction with standard treatment allow for improved hemodynamic recovery versus standard treatment alone?

Literature Review Analysis: An evidence search was conducted with CINAHL, MEDLINE, and Cochrane. Inclusion criteria were articles from the last 10 years in peer-reviewed journals, with anaphylactic reactions to rocuronium only. Keywords included rocuronium, anaphylaxis, and sugammadex. Nine case studies, 2 case control studies, 2 randomized controlled trials (RCT), and 2 experimental models were included. Ultimately, the results were inconclusive. While individual case studies substantiated the beneficial effect of sugammadex, case control studies discredited any universal applicability of results. Moreover, while experimental models showed an antiallergenic benefit of sugammadex, RCTs of human skin and blood cells proved only partial antiallergenic effect.

Implement Evidence: Current treatment measures for anaphylaxis include epinephrine, crystalloid/colloid bolus, antiinflammatories, and removal of offending agent. The pharmacokinetics of sugammadex to encapsulate and remove rocuronium from blood thus provides a modality for the treatment of rocuronium-induced anaphylaxis. However, before application to practice, more information must be obtained. Specifically, the optimal dosage and timing of administration must be found. The safety profile of sugammadex must also be determined, as this drug itself has been found to have anaphylactic inducing properties.

Conclusions: This review examined the use of sugammadex as an adjunct to standard care for rocuronium induced anaphylaxis. Case studies showed hemodynamic recovery after sugammadex bolus, while case control studies precluded universal applicability of results. Animal studies provided an in vitro explanation of the antiallergenic properties of sugammadex, while RCTs only showed benefit when rocuronium and sugammadex were administered into blood concurrently. As such, use of sugammadex in anaphylaxis should be limited to provider judgment, in which no therapy has proven beneficial to save the patient's life.

A105

Thromboelastogram and Replacement Therapy in Trauma Surgical Patients

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Introduction: Blood component replacement in trauma patients has been long debated. Trauma patients are often coagulopathic upon admission, requiring massive transfusion leading to multiple organ failure, increasing the mortality rate. The coagulation status is typically assessed with measurement of the prothrombin time, international normalized ratio, and the partial thromboplastin time. These tests fail to detect coagulopathy. Thromboelastogram (TEG) provides a comprehensive picture of coagulation including speed of clot formation, strength and quality of the clot, kinetics of clot growth, and breakdown of the clot.

Literature Review Analysis: A review of the current literature was conducted to assess the value of TEG in trauma patients. Consistent themes included prediction of mortality, massive transfusion, guidance of blood product administration, and detection of trauma induced coagulopathy. An 11% reduction in mortality was noted when TEG guided transfusion therapy. Forty-four percent of TEG-detected hypocoagulable trauma patients required massive transfusion. The superiority of TEG to conventional coagulation tests was demonstrated in its ability to rapidly and independently predict transfusion of platelets, cryoprecipitate, plasma, and red blood cells. TEG detected hypocoagulability in 17.8% of 118 trauma patients that displayed increased transfusion requirements and mortality.

Implement Evidence: Recommendations for the CRNA is to implement TEG testing when caring for a trauma patient. Evaluation of TEG parameters will aid the CRNA in clinical decision-making and allow a more individualized approach to the anesthetic care. The CRNA will be further informed of massive transfusion need, trauma induced coagulopathies, and specific blood product requirements with the utilization of TEG. Early detection of hyperfibrinolysis allows the CRNA to treat with antifibrinolytics. Utilization of TEG by the CRNA in the perioperative period contributes to mortality reduction.

Conclusions: Hemorrhage is the leading cause of preventable death in trauma patients, thus it is imperative for CRNAs to detect coagulopathy and intervene accordingly. Current literature demonstrates TEG's ability to predict and reduce mortality, predict massive transfusion, and identify coagulopathy. A reduction in blood product administration was illustrated in the research and stems from early identification of coagulopathy, replacement of platelets, and clotting factors. The empirical evidence strongly supports the utilization of TEG in trauma patients for improved patient safety and quality care.

A106

Use of Standardized Patients

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Introduction: The aim of this review was to examine current research related to the incorporation of simulation technology into nontechnical skill training of nurse anesthesia providers.

Literature Review Analysis: A systematic review of literature using the PUBMED and SCOPUS databases was undertaken with focus on the importance of anesthetic preoperative assessment skills, the use of simulation pedagogy in training anesthesia provider's, and improving perioperative patient outcomes.

Implement Evidence: The literature review demonstrates that virtual patient simulation offers a safe, effective learning environment that fosters a high level of critical thinking, offering experience to the student, without any subsequent risk to the patient. In addition, virtual patient simulation offers cost saving benefits to universities related to fewer resource constraints.

Conclusions: Review of the literature suggests that simulation technology offers an exciting, promising future in training nurse anesthesia students. As our aging population presents with numerous comorbidities and challenges to the anesthesia provider, preoperative assessment and optimization is vital to reducing morbidity and mortality and improving patient satisfaction. The results of a 5-point Likert scale survey of students using the USC Open Patient Beta program reveal the potential benefits, as well as current limitations of the software. Students strongly supported the concept of standardized patients, while highlighting a need for further development.

A107

Utilization of Ketamine in Traumatic and Nontraumatic Brain Injuries

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Introduction: One and a half million Americans sustain traumatic brain injuries yearly, resulting in 80,000 to 90,000 people with permanent disabilities and 50,000 fatalities. Cerebrovascular accident is the third leading cause of death and the most common reason for complex chronic disability internationally. The optimal anesthetic centers in maintaining cerebral hemodynamics and intracranial pressure (ICP). This evidence-based practice research evaluates ketamine in regard to cerebral hemodynamics including ICP, mortality, and length of stay in an intensive care unit (ICU), which has historically been excluded from neurosurgery.

Literature Review Analysis: A prospective control trial in a pediatric ICU with mechanically ventilated patients concluded that after administering ketamine to those with sustained elevations of ICP, whom were resistant to first-tier therapies, there was a significant decrease in ICP. A systematic review of 5 prospective controlled studies examined the relationship between ketamine and comparator induction agents and reported no differences in mean arterial pressure and cerebral perfusion pressure. A systematic review that reported mortality data on 680 patients found no difference in 28-day mortality in patients who were intubated with either ketamine or etomidate; the same systematic review also found no difference in length of stay in an ICU.

Implement Evidence: Evidence reveals the utilization of ketamine in mechanically ventilated traumatic and nontraumatic brain injured patients maintains cerebral hemodynamics such as cerebral perfusion pressure and mean arterial pressure, as well as maintaining and reducing intracranial pressure. Compared with commonly used neurosurgical anesthetics, propofol, etomidate, barbiturates, and opioids, ketamine shows hemodynamic stability and decreases the risk of cerebral ischemia, without increasing mortality. Ketamine is a safe anesthetic agent and should be utilized in neurologically compromised patients.

Conclusions: Ketamine's action as a hemodynamically stabilizing dissociative anesthetic, analgesic, anxiolytic, amnestic, and bronchodilator with minimal respiratory complications, make it ideal for traumatically and nontraumatically brain injured patients. The empirical evidence shows promising results of cerebral hemodynamic stabilization comparable with commonly used anesthetic agents, as well as neuroprotective properties, maintenance of ICP, and reports of significantly decreased ICP in patients with documented intracranial hypertension without increasing mortality and ICU length of stay.

A108

Utilization of Low Volume/High Concentration Ropivacaine for Interscalene Block

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Introduction: Interscalene brachial plexus blockade (ISB) is associated with diaphragmatic paresis, respiratory distress, and local anesthetic toxicity. Current evidence shows the utilization of lower volumes and higher concentrations, particularly 5 mL to 10 mL of 0.5% to 0.75% ropivacaine for an interscalene block with ultrasound guidance reduces the occurrence of phrenic nerve and stellate ganglion local anesthetic blockade. This reduces diaphragmatic paresis and respiratory distress while providing similar analgesic efficacy with fewer risks of local anesthetic toxicity than current standard practice.

Literature Review Analysis: Nine research studies suggest injections of 10 mL or less of 0.5% to 0.75% ropivacaine for ISB are equivalent in analgesic properties with fewer complications compared with high volume, low concentration injection of local anesthetic for ISB. Seven research studies demonstrated a successful ISB in volumes as low as 5 mL or less. Ultimately, it is suggested that lower volumes, 5 to 10 mL of higher concentration 0.5% to 0.75% ropivacaine for ISB, reduce the occurrence of phrenic nerve and stellate ganglia blockade. This decreases the incidence of diaphragmatic paresis, respiratory distress, and local anesthetic toxicity complications while providing equally efficient perioperative analgesia in comparison with current ISB instillations.

Implement Evidence: Administration of 0.5% to 0.75% ropivacaine for ISB will allow implementation to patient populations with high comorbidities related to respiratory disease. In addition, patients who present with reductions in respiratory compliance such as obesity and elderly will benefit from low volume/high concentration local anesthetic injection with ultrasound guidance for ISB in providing safe quality care. Adverse events associated with traditional high volume/low concentration local anesthetics will be decreased with the new implementation of low volume/high concentration local anesthetic for ISB.

Conclusions: A low volume technique for an ISB may be an efficient option for patients who are undergoing shoulder or upper extremity surgery in comparison with a standard high volume ISB. In addition, utilization of a low volume technique was associated with less local anesthetic related complications in comparison with a standard ISB. The clinical comparison of a standard vs low volume technique could ultimately provide improved patient outcomes by reducing the occurrence of known ISB complications, while providing the same analgesic properties as a standard high volume technique.

A109

A Case Report on a Patient Undergoing Deep Brain Stimulation Microelectrode Implantation

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Introduction: Parkinson disease is a neurodegenerative condition in which dopaminergic cells are damaged, creating abnormal activity in specific brain nuclei. Patients experience a resting tremor, muscle rigidity, postural instability, and difficulty maintaining fluid coordination. A deep brain stimulator (DBS) is an effective treatment for advanced Parkinson disease to control motor symptoms unrelieved by medication. An implantable generator is attached to an electrode that is used to deliver stimulation to the area of the brain that controls movement. Placement of a DBS can pace specific brain nuclei with a constant, steady electrical frequency that overrides the erratic activity.

Literature Review: Placement is accomplished in 3 stages on different days. In the first phase, fiducials are screwed into the skull. These act as markers or points of reference for magnetic resonance imaging which is then used to map the brain to create a trajectory. In the second phase, a microelectrode is inserted, typically under local anesthesia. The patient is completely awake to ensure that not only the electrical current dose is effective, but also adverse side effects are minimized. In the third phase, a pulse generator is placed into the subclavicular region, and the connector wire is tunneled subcutaneously along the neck from the brain electrode to the pulse generator.

Description of Case: The objective of this presentation is to describe the anesthetic management and implications on a 66-year-old male who underwent a left unilateral deep brain stimulation lead placement. The anesthetic plan was an awake craniotomy with local infiltration and then sedation after lead placement is confirmed. Key anesthetic points will be explained in full including positioning considerations, airway management, hemodynamic control, seizure prevention, and limiting microelectrode recordings interference through anesthetic choice.

Conclusions: Although a monitored anesthesia care (MAC) approach with local infiltration is the prevailing method for deep brain stimulator insertion, further research is needed on the efficacy and safety of implementing other anesthetic techniques. An awake craniotomy during the first half of the procedure typically rules out candidates with conditions like severe anxiety, claustrophobia, and developmental delays. Future recommendations consist of achieving an asleep-awake-asleep technique utilizing dexmedetomidine, propofol, and/or remifentanyl.

A110

Acute Cardiac Tamponade Following Central Line Placement in a 6 Month Old

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Introduction: A 6-month-old infant undergoing port placement developed clinical instability requiring CPR. An 8.82-kg female with multiple congenital anomalies, presented for a biopsy of hepatic lesions and bone marrow, PE tube placement, and port-a-cath. Her history included an adrenal mass, hepatic lesions, cerebellar hypoplasia, ventriculomegaly, midface hypoplasia, seizures, and pulmonary artery stenosis. The patient's surgical/anesthesia history included a Nissen/gastrostomy tube and imaging. An IV induction took place, intubation with a 3.0 cuffed ETT, and an additional 22G PIV was placed.

Literature Review: A literature review was conducted using the resources of the Eskin Digital Library at Vanderbilt University Medical Centers. PubMed database was used. The keywords searched were: cardiac tamponade, central line complications, acute, anesthesia, pediatric, neonatal, neonate, and infant.

Description of Case: After port placement, the patient developed hypoxia and bradycardia treated with IV epinephrine. Bilateral breath sounds were confirmed; fluoroscopy indicated no pneumothorax. Transthoracic echocardiogram revealed pericardial effusion. Pediatric cardiology evaluation was requested for pericardiocentesis, while multiple doses of IV epinephrine and eventually chest compressions were administered for persistent hypoxia, bradycardia, and hypotension. Pericardiocentesis with withdrawal of 60 mL of blood resulted in prompt return of clinical stability. Trauma blood was administered given continued output via pericardial drain. Arterial access was obtained, and the patient was transported to the pediatric intensive care unit.

Conclusions: Cardiac tamponade resulting from central line insertion is rare; it occurs in up to 3% of newborn cases; fatal perforations occur in 1%. Most common complications involve guidewire-aided insertion, with blind needling of a chest vein. Perforations occur regardless of the size, material, location of the catheter tip, or access route. Reportedly, there are no differences between survivors and nonsurvivors relative to gestational age at birth, birth weight, or days to pericardial effusion diagnosis (ie, early vs late perforation). However, mortality was significantly less in patients who underwent immediate pericardiocentesis.

A111

Case Report: Necrotizing Fasciitis and Neuropathic Pain

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Introduction: Neuropathic pain (NP) is a multifaceted pain disorder that roughly affects 7% to 8% of population-based studies (Haanpaa and Treede, 2011). Neuropathic pain is defined as “pain arising as a direct consequence of a lesion or disease affecting the somatosensory system” (Dworkin et al, 2010). Currently, there is no customary approach for controlling this debilitating syndrome in which only an overwhelming 30% to 50% of patients see a reduction in pain with first-line medications (Wallace, 2007). Treatment modalities are aimed at using evidenced-based research for increasing quality of life and eliminating different sources of discomfort for these patients.

Literature Review: Neuropathic pain has been studied with numerous randomized controlled trials (RCTs) and it is evidenced that pharmacotherapy is ineffective, and greater than half of this population of patients continue to experience unsuccessful pain relief. Taverner (2014) emphasizes that the essentials of successful pain management is early detection by using a neuropathic assessment tool such as the Douleur Neuropathique 4 (DN4) or the Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS). Inclusion of these neuropathic assessment tools will identify these patients earlier and facilitate pain management and increase quality of life.

Description of Case: A 29-year-old female with a long-standing history of chronic pain status postnecrotizing fasciitis in 2011 of the entire abdominal wall, trunk, and genitalia was consulted for neuropathic pain. The goal for this patient is the transition of intravenous (IV) narcotics to oral narcotics. On postoperative day 33, this patient was unable to wean from IV to oral narcotics. The patient was admitted for an elective surgery for repair of rectovaginal fistula, labioplasty revision of tracheal scar, and digital rectal disimpaction. The patient’s medical history includes necrotizing fasciitis secondary to a fall and scratched tailbone in 2011, left upper arm deep vein thrombosis in 2011, medical induced coma for sepsis that included prolonged intubation, which resulted in tracheostomy along with multiple blood transfusions.

Conclusions: In summary, NP is a chronic pain syndrome that has palliative measures but no real cure. Multiple treatment modalities are available, but sadly ineffective. More RCTs need to be conducted on controversial treatments such as ECTs; however, given the nature of the treatment, it could be considered inhum. In the upcoming election, medical marijuana (Amendment 2) is on the ballot for the state of Florida, and upon review of RCTs, cannabinoids has proven to be a safe and effective treatment of neuropathic pain. Further RCTs need be conducted to evaluate the most effective route of administration of cannabinoids in NP.

A112

Case Report: Perioperative Fluid Management

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Introduction: Perioperative fluid management plays an integral role in patient outcomes. Understanding the fluid dynamics between capillary tissue and glycocalyx is an integral part of fluid management. The following case report serves to illustrate management of fluid replacement in an 82-year-old man undergoing a radical cystectomy and left nephrectomy with ileal conduit placement. This case report demonstrates the importance of dynamic monitoring methods to evaluate fluid management. Goal-directed fluid management effectively targets fluid management to meet the individual patient's needs.

Literature Review: Databases searched for evidence pertaining to goal-directed fluid management included PubMed, CINAHL, and Embase. Keywords used singly and in combination were goal, directed, therapy, transesophageal Doppler, glycocalyx, stroke volume variation, and LiDCO. Inclusion criteria were any topic relating anesthetic management of fluid replacement with patient outcomes.

Description of Case: An 82-year-old man underwent a radical cystectomy, left nephrectomy, and ileal conduit placement. Fluid management was guided by serial ABGs, replacement of estimated blood loss, and the CVP. Serial ABGs revealed a persistent metabolic acidosis with pH 7.2 to 7.3. The initial CVP was 4 mm Hg and remained stable at 6 to 8 mm Hg during the procedure. Hemodynamics was supported throughout the procedure with ephedrine, phenylephrine, calcium gluconate, and sodium bicarbonate. Total fluid intake for the 3-hour procedure was 5,000 mL including packed red blood cells and albumin 5%. Estimated blood loss was 1,200 mL and urine output was 25 mL. The patient had an uncomplicated postoperative course in the ICU and was discharged on day 7 from the floor.

Conclusions: While there are no definitive conclusions from the literature recommending a specific regimen, it is clear that individualized goal-directed fluid therapy based on the patient's responsiveness is of most value. All evidence supports that CVP measurements are not an accurate method to measure fluid status. Future practice in fluid replacement should examine techniques such as the esophageal Doppler, LiDCO, and FloTrac as patient specific tools for fluid management

A113

Expansion of Anesthesia Care and Surgical Services in Bhutan

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Introduction: Access to surgical services and obstetrical care is limited in Bhutan due to the lack of anesthesia providers in this country of 700,000. As of September 2014 there were 10 nurse anesthetists and 5 anesthesiologists to provide anesthesia services throughout Bhutan. The Ministry of Health (MoH) and Khesar Gyalpo University of Medical Sciences of Bhutan (KGUMSB) in conjunction with Jigme Dorji Wangchuck National Referral Hospital (JDWNRH) and Health Volunteers Overseas (HVO) implemented 3 initiatives to increase the number of anesthesia providers to expand access to surgical care in Bhutan.

Literature Review: In the last 10 years, significant improvements in global health have occurred with the treatment of infectious and noncommunicable diseases. But an estimated 5 billion people in mostly low and middle income countries do not have access to safe affordable surgical care. A combination of lack of operating rooms, equipment, supplies, surgeons, and anesthetists contribute to the lack of access to surgical care. The Lancet Commission on Global Surgery (Meara et al, 2015) recommends that nurse anesthetists be educated in their home countries to increase the number of anesthesia providers.

Description of Case: In 2013 and 2014, 3 programs were initiated by the MoH, KGUMSB, JDWNRH and HVO to increase the number of providers and quality of anesthesia care in Bhutan. Program 1: Two cohorts of nurses were enrolled in nurse anesthesia certificate programs at Siriraj and Ramathabadi Hospitals in Bangkok. Program 2: The first cohort of bachelor of nurse anesthesia students was started in July 2014 through KGUMSB. Projected completion for the 4 students is June 2016. Program 3: An anesthesiology residency program was approved by KGUMSB. The first anesthesiology resident started in July 2014. All programs have been supported by 1 to 2 anesthesia volunteers each month that provide their expertise through HVO.

Conclusions: The number of surgical cases in Bhutan in 2002 was 4,422 in all hospitals and 2,610 at JDWNRH. In 2014 the total was 23,459 for all hospitals in Bhutan and 10,371 at JDWNRH. Current anesthesia providers include 5 anesthesiologists, (2 are expatriates) 1 anesthesiology resident, and 25 nurse anesthetists. A plan to increase physician and nurse anesthesia providers has been implemented in Bhutan using: 1) faculty resources at KGUMSB, 2) educational programs in Thailand, and, 3) dedicated HVO volunteers with expertise in anesthesia to improve anesthesia care and surgical access in Bhutan.

Source of Funding: Lucie Young Kelly Faculty Leadership Award, University of Pittsburgh School of Nursing.

A114

Local With Epinephrine Induced Acute Intraoperative Pulmonary Edema

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Introduction: Normal pulmonary lymphatics is described using the Starling equation. This equation represents the net flow of fluid across the capillary membrane; flow typically favors movement of fluid out of the capillary membrane and into the interstitial space. The flow of fluid into the interstitial space is rapidly evacuated back to the heart due to normal negative pressure within this space. Any disruption to the normal flow can result in pulmonary edema. Although rare, epinephrine can result in acute pulmonary edema. A case report is presented as well as appropriate treatment options.

Literature Review: A literature review was conducted using the following phrases in PubMed: intraoperative pulmonary edema and local with epinephrine. Inclusion criteria included those articles that determined the intraoperative pulmonary edema was the result of epinephrine within the local. Exclusion criteria included articles that did not use epinephrine in the local or did not identify the cause of the pulmonary edema to be related to its use. Case reports only were identified in the literature; there were no experimental articles. The articles identified offer an explanation to their findings as well as recommendations for management.

Description of Case: A 30-year-old male, ASA 1, presented for an elective tympanoplasty to repair an idiopathic tympanic perforation. General anesthesia was induced and endotracheal intubation was completed without complications. Shortly after the surgeon injected 5 mL of 1% lidocaine with epinephrine 1:100, bradycardia was noted on the monitor (25 BPM), atropine was administered, and the blood pressure reading was noted to be >200/100. Labetolol was used to treat the elevated blood pressure. Blood pressure and heart rate normalized and surgery continued; 30 minutes later, the patient was noted to have pink frothy sputum in the endotracheal tube, and a diagnosis of pulmonary edema was made. The patient was given Lasix, extubated, and discharged the following day.

Conclusions: Intraoperative pulmonary edema is a rare and adverse event following the administration of local with epinephrine. A literature review was conducted and similar case reports were identified. Of particular interest is that most of the surgeries identified were those involving ear, nose and throat cases. Epinephrine even in small "safe" doses can cause acute pulmonary edema. Acute hypertension resulting after the injection of local with epinephrine should be treated with a direct acting vasodilator/alpha antagonists that is short acting. Avoidance of beta-blockers is essential as it could further decrease the compensatory tachycardia and inotropic effects and result in worsening of pulmonary edema.

A115

Malignant Hyperthermia Case Review: Ryanodex Treatment for 8-Month-Old Male Undergoing Urology Procedure

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Introduction: A pediatric patient presented for orchiopexy. The patient had 1 prior anesthetic that was uneventful at another hospital. During incision closure, the CRNA identified the patient's ETCO₂ had significantly increased; heart rate and temperature was elevated. A differential diagnosis of malignant hyperthermia (MH) was made.

Literature Review: A literature review was conducted using the resources of the Eskin Digital Library at Vanderbilt University Medical Centers. PubMed Database was used. The keywords searched were: malignant hyperthermia, postoperative period, postoperative, infant, child, adolescent, childhood, pediatric, baby, babies, children, and English. Results were narrowed to those at birth to 18 years.

Description of Case: The patient, a very active 8-month-old male, was met in the preoperative area and brought back to OR suite. He was inhalationally induced with nitrous, oxygen and sevoflurane, PIV was started, and LMA was placed. The patient was hemodynamically stable during incision and repair. During closure, the patient was noted to have an increase in ETCO₂, temperature, and heart rate. He was taken off PSV-Pro and hand ventilated; patient's ETCO₂ rapidly increased from 78 to 109. The provider immediately ventilated the patient with a hyperventilation with manometer/pressure relief valve and 100% FiO₂. MH algorithm was initiated and MH was treated. Pediatric crisis manual was utilized. Once the patient was hemodynamically stable, he was taken intubated and sedated to the PICU.

Conclusions: The patient was hemodynamically stable overnight; no significant increases were noted on his urine/blood myoglobin or CPK laboratory tests. He was extubated the following day. The anesthesia team followed up with family and provided MH education from the website for the Malignant Hyperthermia Association of the United States. The patient was discharged on postoperative day 2.

A116

Multiple Lung Mass Resection of Bilateral Lungs for Metastatic Osteosarcoma

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Introduction: A 23-year-old male presented for bilateral thoracotomies for removal of pulmonary nodules resulting from metastatic osteosarcoma. Multiple pulmonary nodules including 4 masses of the left lung lobes and 1 mass of the right lower lobe. Significant history included metastatic masses to the lungs, left humerus, and femur. The patient was scheduled for a left thoracotomy on day 1 and right thoracotomy on day 2. Thoracotomies can be challenging for anesthesiologists due to the ventilation perfusion mismatching and hypoxic pulmonary vasoconstriction caused by both one-lung ventilation and positioning.

Literature Review: Osteosarcoma is the most common primary bone tumor. Osteosarcoma occurs rarely in children younger than 5 years. Osteosarcoma is slightly more common in males, particularly in the 15- to 19-year-old age group. The distal femur is the most frequent site of primary disease, followed by the proximal tibia and then the proximal femur, hip, and proximal humerus. The most common site of metastasis is the lungs, followed by bone. With isolated pulmonary metastases, prognosis is significantly influenced by the number of pulmonary nodules and whether there is unilateral or bilateral pulmonary disease. In particular, having more than 1 pulmonary nodule at relapse conveys a worse prognosis.

Description of Case: On day one for left thoracotomy, the patient was placed in right lateral position for left thoracotomy. After an uneventful mass removal, the patient was extubated in the OR. The following day, the patient was brought to the holding room displaying signs of dyspnea and shortness of breath. After arterial line placement and 1.00 O₂ for 5 minutes, a blood gas analysis showed PaO₂ of 302. After placement in left lateral position with right lung deflated, ABG showed PaO₂ of 58 with O₂ saturations of 72%. Five centimeters of water of continuous positive airway pressure (CPAP) was placed to the right lung with improvement in PaO₂ and saturations. The patient was successfully extubated in the OR. After a stay in PACU for observation, the patient was discharged to general care and discharged home in 5 days.

Conclusions: With careful planning and consideration it can be deemed successful to undergo consecutive day thoracotomies for multiple tumor removal. Careful vigilance and monitoring is necessary to promote advocacy of patient safety. Knowing what resources are available at your facility is crucial. Without the ability to CPAP the lung on surgical day 2, we would have most likely aborted the procedure since conventional methods for CPAP were not available. Communication with the surgical team was also crucial to increase the margin of safety for a successful surgical procedure.

A117

Pediatric Case Management for MRI Guided Laser Ablation

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Introduction: Our patient was a 16-year-old female with a history of refractory epilepsy and right-sided mesial temporosclerosis scheduled to undergo MRI guided laser ablation. Procedure stage 1 was a nonsedated CT scan followed by Stealth guided bone marker placement under general anesthesia. Procedure stage 2 was general anesthesia for burr hole, placement of bone anchor, and insertion of fiberoptic laser ablation catheter. In order to provide a single continuous anesthetic, she was then transported under general anesthesia to the radiology suite. Utmost care was given during transport to ensure that the position of the fiberoptic cable was not disturbed and depth of anesthesia was maintained.

Literature Review: A review of the literature using PubMed was performed with different combinations of the following keywords: pediatric, minimally invasive neurosurgery, MRI guided laser ablation, intractable seizures, and medically refractory epilepsy. Only a few articles were initially found but similar articles were able to be retrieved from the original search. We narrowed this down to 4 key journal articles as references for the case report.

Description of Case: The patient underwent a single continuous anesthetic for all procedures and varying procedure locations. Following the operative course, the patient was transported under general anesthesia on propofol infusion to the radiology suite. The operative team retained care responsibility until full transfer and positioning in the MRI scanner. The patient's head remained in the same position while carefully placing the MRI cage over the patient's skull. This presented challenges because of the fragility of the fiberoptics. MRI guided ablation occurred to the satisfaction of the surgical team. Bone anchor and catheter were removed per surgical team using a single suture to closure. The patient fully emerged in the radiology area, and a neurological examination was completed prior to transport back to the operative recovery room.

Conclusions: No anesthesia complications were noted, and the patient was discharged home on postoperative day 1. In debriefing with the anesthesia team, there were several factors to consider. The patient's down ear needs to have ear protection placed at the beginning of case in the operating room suite. Prior arrangements need to be made for utilization of an MRI safe stretcher to avoid multiple patient transfers. At the 3-month follow-up visit, the patient was seizure free and an EEG revealed no seizure activity.