

2015 Poster Abstracts



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A1

Accuracy of Point-of-Care Capillary Blood Glucose Measurements in Anesthetized Patients

Amy E. Wells, RN; Lindsay K. Siebenaler, RN; Chelsie M. Larsen, RN; Mary E. Marienau, CRNA, PhD; Timothy B. Curry, MD, PhD; Leslie J. Donato, PhD; Brad S. Karon, MD, PhD; Daryl J. Kor, MD; Michael J. Brown, MD

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Introduction: The use of glucose meters with capillary (finger stick) samples in anesthetized patients has not been well validated. In order to evaluate the accuracy of Nova StatStrip glucose measurements using capillary blood in patients undergoing surgical procedures under general anesthesia, we measured glucose using the StatStrip blood glucose meter system with both capillary and arterial blood and using a laboratory reference test.

Methods: Two hundred subjects undergoing surgical procedures under general anesthesia who had arterial lines placed as part of their clinical care were studied. Paired capillary and arterial blood measurements were drawn at 2 time points, one within 30 minutes of anesthesia and another at least 60 minutes later. A finger capillary glucose was measured using the Nova StatStrip glucose meter. A 3-mL syringe of whole arterial blood was obtained from the arterial line for measurement of both Nova StatStrip blood glucose and reference whole blood glucose using a Radiometer ABL90 blood gas analyzer.

Results: A total of 367n samples were collected on 193 patients that had capillary glucose meter (CGM), arterial glucose meter (AGM), and reference whole blood glucose (RWBG) available. Median (interquartile range, IQR) bias between CGM and RWBG was -4.0 (-8.5 to -0.0) mg/dL. Median (IQR) AGM bias was -5.0 (-9.0 to -1.0) mg/dL ($p=0.3934$). Using ISO 15197:2013 guidelines for glucose meter accuracy (± 15 mg/dL for reference glucose < 100 mg/dL and $\pm 15\%$ for reference glucose ≥ 100 mg/dL), 342/367 (93%) of CGM values met accuracy criteria, compared with 352/367 (96%) of AGM values. CGM bias ranged from -54 to 19 and AGM bias from -47 to 15 mg/dL, with rare capillary ($n=5$) and arterial ($n=5$) glucose meter samples differing from RWBG by >30 mg/dL.

Conclusions: StatStrip capillary blood glucose just failed to meet ISO 15197:2013 accuracy guidelines for self-monitoring of blood glucose. Although using arterial whole blood samples StatStrip did meet ISO 15197:2013 accuracy guidelines, caution should be taken when using either capillary or arterial whole blood glucose meter values in the OR, as both overall negative bias and rare outliers were observed.

Source of Funding: This study was funded by the Mayo Clinic Department of Laboratory Medicine and Pathology.

A2

Anesthesia and Alzheimer Disease: Effects of Sevoflurane on Tau Protein Kinase II

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Introduction: Neurodegeneration is the fourth leading cause of death in industrialized nations. Alzheimer disease (AD) is the most common type of neurodegeneration. This research examines the effects of sevoflurane on tau protein kinase II (TPK II) in PC-12 cells in vitro by the measuring the alteration of messenger ribonucleic acid (mRNA). This enzyme is responsible for the phosphorylation of tau. The major histological alterations of brain tissue in AD are beta-amyloid plaques and neurofibrillary tangles (NFT). NFT, a key characteristic in AD development, are caused by the hyperphosphorylation of tau.

Methods: PC-12 cells, harvested from rat adrenal pheochromocytomas, are a well-accepted model for experiments involving nerve cells due to the histological resemblance to human neurons. Cells were cultured aseptically and incubated in a regulated environment. Cell number and viability were established visually with a hemocytometer and chemically confirmed with CellTiter-Blue assays. Quantitation of mRNA was performed utilizing reverse transcription with a real-time polymerase chain reaction (RT-PCR). Lactate dehydrogenase and Lowry protein assays were utilized to control variations in cell damage.

Results: Analysis of the qRT-PCR data demonstrate a fold change of 2.86 in the treated group. This indicates a 286% increase in expression of TPK II mRNA in samples treated with 1% sevoflurane for 1 hour, compared with the 100% expression level in the control group. CellTiter-Blue analysis of control and treated samples showed no statistical difference ($p > 0.05$) in cell viability between groups.

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A3

Baseline Measure of Nurse Anesthetists' Communication Behavior

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Introduction: Miscommunication is implicated in most perioperative safety breakdowns. Conflict and variables associated with cultural differences in professions' communication styles often contribute to the problem. We measured latent variables associated with face negotiation using Practices in the Operating Room Survey (PRIOR) in a sample of CRNAs. These were previously described for surgeons and anesthesiologists. Our results can now be combined with those data to design appropriate interdisciplinary educational strategies with an aim to improve interprofessional perioperative communication.

Methods: The PRIOR was electronically distributed to a sample of 3,000 CRNAs; 664 total responded. Demographic data indicated the majority were <54 years of age (44%), female (53%) and Caucasian (94%). One hundred ninety were incomplete and eliminated from the analysis. The remaining 474 cases were subject to exploratory factor analysis (EFA) using SPSS 22.0. Inclusion in the EFA was set at .40. After an initial EFA, 9 items were eliminated from the data set due to low factor loadings on any factor (>.40). After elimination of these items, a second EFA was conducted using principal components and varimax rotation.

Results: The second EFA resulted in an 8-factor solution with 54% of the variance explained. Six of the 8 factors confirmed the factor structure found in data collected from physicians using the PRIOR. The 6 factors correlated with conflict management styles (avoid, dominate, integrate) and self-construal (independence and interdependence). Two other factors emerged from the data collected from CRNAs that were not previously found in physician data. One factor included items that combined all 3 dimensions of face-concern (self, other, mutual). The final factor that emerged from EFA was a combination of dominate and avoid abstract. The highest percent of agreement indicated by highest mean score correspond to independent and integrate.

Conclusions: CRNAs' highest mean score was self-construal associated with independent decision making (preferring autonomy), followed by use of integrating (listening, respecting feelings) as conflict management style, and preference for interdependent communication. The fourth factor, a unique combination (self, other and mutual face) reflecting a CRNA concern for image might be construed as role of peacemaker or overall interest in teamwork and benefit of all surgical team members. Teamwork relies on effective communication; intercultural conflict competency training could be based on these findings.

Source of Funding: Funding for this research came from a grant from the American Association of Nurse Anesthetists Foundation. Additional administrative and technical support was provided by the East Carolina College of Nursing Office of Research and Creative Activities.

A4

Call-Shift Fatigue and Use of Countermeasures and Avoidance Strategies by Certified Registered Nurse Anesthetists: A National Survey

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Introduction: Fatigue from extended call shifts is associated with decreased patient safety and negative health consequences. The purpose of this study was to survey Certified Registered Nurse Anesthetist (CRNA) members of the American Association of Nurse Anesthetists (AANA) on their frequency of call-shift fatigue, fatigue symptoms, medical errors associated with fatigue, and use of fatigue countermeasures and avoidance strategies. A secondary aim was to identify predictors of call-shift fatigue.

Methods: A 26-item anonymous electronic survey invitation was sent to 2,500 randomly selected AANA members. Descriptive and inferential statistics were used to examine the results. Logistic regression was used to identify predictors of call-shift fatigue. Open-ended questions that inquired about fatigue were coded using the constant comparison method.

Results: Of 325 CRNAs who provided data, 82% reported experiencing call-shift fatigue, 87% used fatigue countermeasures, 77% used fatigue-avoidance strategies, and 28% reported committing a medical error because of fatigue. Predictors included hours to recovery from a call shift (odds ratio [OR] = 1.08, 95% confidence interval [CI] = 1.04-1.12), working 5 to 6 calls per month (OR = 3.78, CI = 1.17-12.23), working 7 or more calls per month (OR = 4.87, CI = 1.93-12.33), use of fatigue countermeasures (OR = 5.44, CI = 2.15-13.77), and fatigue symptoms (OR = 2.19, CI = 1.03-4.67).

Conclusions: Call-shift fatigue is a common problem among practicing CRNAs and is associated with decreased patient safety and negative health consequences. Administrators and leaders in the anesthesia community should consider these results when developing policies and guidelines for CRNA call-shift duration and frequency.

A5

Comparison of Resuscitative Protocols Using Lipid Emulsion for Wellbutrin Overdose in a Swine Model

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US Army Graduate Program in Anesthesia Nursing

Introduction: Wellbutrin is a lipophilic atypical antidepressant prescribed to treat a broad range of healthcare concerns including depression, PTSD, alcoholism, and tobacco addiction. As these are common in the military population, the potential for widespread misuse is a legitimate concern for healthcare providers. Toxic doses of Wellbutrin can cause cardiac toxicity resulting in difficult and prolonged resuscitation that is almost always fatal. Standard ACLS protocols alone are not effective in resuscitating individuals presenting with Wellbutrin toxicity. No studies have determined the optimal combination of lipid rescue and traditional ACLS therapy for treatment of Wellbutrin overdose.

Methods: We evaluated the effectiveness of ACLS protocol with or without lipid rescue on return of spontaneous circulation (ROSC)/survival in Wellbutrin toxicity in a swine model. Subjects were randomly assigned to 1 of 8 groups as follows: CPR only (control), vasopressin only, lipid only, epinephrine only, vasopressin + lipids, vasopressin + epinephrine, epinephrine + lipids, and epinephrine + vasopressin + lipids. A dose of Wellbutrin sufficient to induce a nonperfusing cardiac rhythm was administered, and CPR with or without treatment was initiated following 2 minutes of arrest.

Results: Our findings indicate that the odds of survival when epinephrine was administered alone or in any combination was 22× higher compared with no epinephrine administered (95% confidence interval). Further survival analysis suggests that time to ROSC was shortest when epinephrine was combined with lipids. We also showed that the fastest mean time to return of spontaneous circulation (ROSC) was with an epinephrine and lipid combination at 7 minutes, while the second fastest mean time was the epinephrine only group at 10.33 minutes.

Conclusions: These data suggest that epinephrine administration is essential to survival in Wellbutrin toxicity. The fastest ROSC was seen with the combination of epinephrine and lipids followed by epinephrine alone. Our data also suggest that lipid alone and lipid with vasopressin results in very low survival. There is a growing body of knowledge about the efficacy of lipid emulsion treatment in acute lipophilic drug overdose. However, until now, the optimal combination of lipid with ACLS protocols for treating Wellbutrin-induced cardiac toxicity had not been investigated. Additional research investigating optimal drug dosing, timing, and various lipid concentrations is recommended.

Source of Funding: This study is funded by TriService Nursing Research Program and was conducted at the Naval Medical Research Unit.

A6

Confidence of Care: An Anesthesia Intervention to Decrease Adult Preoperative Anxiety

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Introduction: Preoperative anxiety has been shown to be present in up to 84% of surgical patients and can lead to increases in perioperative morbidity and mortality. Current standard-of-practice is same-day assessment and consultation by the anesthesia provider. The purpose of this project was to evaluate the impact of early anesthesia preoperative consultation in decreasing preoperative anxiety levels in adult surgical patients and to identify the role other factors may play in contributing to or reducing preoperative stress.

Methods: This study used a 2-group, nonexperimental, causal comparative research design, utilizing convenience sampling to examine preoperative anxiety in 138 adult participants scheduled for surgical procedures. Both groups received a standard-of-care preoperative anesthesia consultation either prior to the day of surgery or on the day of surgery from their anesthesia provider. Data were collected via a single self-administered anonymous questionnaire including the Amsterdam Preoperative Anxiety and Information Scale on the day of surgery. Differences between groups were analyzed.

Results: Anxiety levels were significantly lower in patients who received a consultation and education from their anesthesia provider prior to the day of surgery ($p < 0.001$). No statistically significant gender differences in preoperative anxiety levels existed. In addition, 94.3% of patients stated they would prefer to speak to the actual anesthesia provider who will perform their anesthetic. Patients younger than 50 years old had higher anxiety levels than those who were older than 50 years old ($p < 0.018$). Hispanic patients also showed higher anxiety levels than other ethnicities ($p < 0.003$).

Conclusions: Patients who speak to their anesthesia provider prior to the day of surgery are more likely to have lower anxiety than those who do not ($p < 0.001$). Early intervention strategies should be explored and implemented into practice whenever possible. Age and ethnicity may also play a role in preoperative anxiety levels. Based on the results of this study, future studies focusing specifically on age or ethnicity as they relate to anxiety may be warranted. Strategies to address other areas that may contribute to anxiety/stress could also aid in reducing preoperative anxiety in patients.

A7

Continuous Adductor Canal Versus Continuous Femoral Nerve Blocks With Single Injection Sciatic Block: A Comparison of Opioid Consumption Following Total Knee Arthroplasty

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Introduction: Total knee arthroplasty (TKA) is presumed to be one of the most painful surgical procedures for an individual to undergo. Peripheral nerve blocks are often used for pain management in conjunction with multimodal techniques in an effort to reduce opiate use and its associated side effects during the postoperative period. This research investigates the impact of single injection sciatic block (SISB) with either a continuous adductor canal block (CACB) or continuous femoral nerve block (CFNB) on opioid consumption during the first 24 hours following TKA surgery.

Methods: A retrospective review of 181 charts was conducted on patients who underwent TKA over 2 time periods. Participants that met inclusion criteria were divided into 2 groups: Group A participants received an SISB with CFNB and Group B participants received an SISB with CACB. Opioid consumption for each patient was measured and converted into morphine equivalents (ME) allowing for comparisons between groups using a 2-tailed t-test.

Results: We enrolled 181 patients in which 18 were analyzed. Morphine equivalent (ME) usage in group A was 30.92 mg (\pm 8.801 standard error) compared with 51.23 mg (\pm 10.14 standard error) in group B. There was no statistical difference in ME consumption ($P = 0.1611$) between the 2 groups.

Conclusions: While there appeared to be a clinical difference in opioid consumption between the 2 groups, due to the small sample size and a large variation in opioid use, statistical analysis showed no statistical difference between the groups. Further research with a larger sample size is recommended to support favoring a particular continuous nerve block over another for treatment of postoperative pain.

A8

Does Lidocaine Reduce the Release of Interleukin-6 in MC1R siRNA Transfected Melanocytes in Cell Culture?

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Introduction: Little objective research is available linking red hair, the phenotype for the mutant MC1R, and increased anesthetic requirements. An experimental design was developed to examine the effects of inflammation and lidocaine on mouse melanocytes *in vivo*. Control melanocytes and siRNA MC1R transfected melanocytes were exposed to endotoxin and lidocaine. Experiments revealed that in the absence of a fully functional MC1R, interleukin-6 is increased despite treatment with lidocaine. This finding offers new insight as to why people with red hair may respond differently to lidocaine.

Methods: Due to a lack of mouse melanocytes with the necessary MC1R mutation, siRNA transfection was used to simulate the biological response of a dysfunctional receptor. Transfection resulted in a 44.6% knockdown of MC1R expression. Melanocytes were cultured and plated on a 48-well plate and allowed to incubate for 24 hours. Thereafter, half of the wells were transfected with MC1R siRNA and incubated for 24 hours. Lipopolysaccharide and lidocaine were administered to both groups of cells. After incubation of 24 hours, a mouse IL-6 assay was completed to test differences in cytokine secretion from both groups.

Results: A standard curve was created using a mouse IL-6 ELISA assay kit. A correlation coefficient $r^2=0.9935$ was calculated using a linear regression analysis in GraphPad Prism. Each value represents a mean value \pm SEM for $n=5$. The results, in pg/mL, are as follows: control group treated with LPS 2.0 $\mu\text{g}/\mu\text{L}$ and 1 μM lidocaine (185.7 ± 30.05), and Transfected group treated with LPS 2.0 $\mu\text{g}/\mu\text{L}$ and lidocaine 1.0 μM (626.6 ± 125.7). Statistical significance was found after performing a Tukey's multiple comparisons analysis between all groups. The release of IL-6 was significantly higher in the transfected group, yielding a 337.4% increase in interleukin-6 secretion in siRNA MC1R melanocytes.

Conclusions: Lidocaine did not reduce the release of IL-6 in siRNA melanocytes. Studies reviewing chronic pain disorders show the presence of elevated levels of proinflammatory markers, such as IL6. A functional MC1R downregulates this inflammatory cascade and limits cytokine production. Therefore, mutated MC1R would be limited in this capacity. The increase in cytokine release, as revealed in our experiment, offers one explanation why people with red hair have an altered response to lidocaine and further supports MC1R's role in inflammation modulation.

Source of Funding: All funding for this experiment and materials were provided by Webster University departments of Biological Sciences and Nurse Anesthesia.

A9

Effects of Intraosseous and Intravenous Administration of Hextend® on Time of Administration and Hemodynamics in a Swine Model

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United States Army Graduate Program in Anesthesia Research

Introduction: There is not sufficient data from previous studies to conclude if the intravenous route is superior to the intraosseous route in restoring hemodynamics when using volume expanders. The goal of this study was to determine if there was a significant difference in infusion of intraosseous and intravenous Hextend on hemodynamics following hemorrhage.

Methods: This study was a prospective, experimental mixed (within- and between-) subjects design. Eighteen Sus scrofa Yorkshire-cross swine weighing between 67 kg and 80 kg were assigned by number using computer-generated randomization and placed into 3 experimental groups. Exsanguination to 30% blood loss, equivalent to a class II hemorrhage, was performed. Vitals signs and hemodynamics were monitored preexsanguination and postexsanguination.

Results: Posthemorrhage data collection points revealed no significant differences in hemodynamic parameters between tibial intraosseous and intravenous groups. A significant difference was revealed in comparing systolic blood pressure and mean arterial pressures between the control group against the administration of Hextend via both tibial intraosseous and intravenous routes.

Conclusions: Our results determined that the intravenous and intraosseous delivery of Hextend were analogous. Data analysis of hemodynamics consistently revealed no significant differences between intraosseous and intravenous routes in Hextend administration.

Source of Funding: Intramural support was provided by the United States Army Graduate Program in Anesthesia Nursing.

A10

Effects of the ResQPod® on Kinetics, Hemodynamics of Vasopressin, and Survivability in a Porcine Cardiac Arrest Model

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US Army Graduate Program in Anesthesia Nursing

Introduction: Out-of-hospital cardiac arrests affect over 400,000 people in the United States annually, and the impedance threshold device (ITD) was developed to improve survivability during CPR.

Ventilation through an ITD purportedly improves hemodynamics and survivability and is given a class IIb recommendation by the American Heart Association/American College of Cardiology for adult cardiac arrest. While the results of an ITD on return of spontaneous circulation (ROSC) and drug kinetics are inconclusive, no studies have been conducted to determine the effects of an ITD with vasopressin. Our study compared kinetics and hemodynamics of vasopressin and ROSC with and without an ITD, specifically the ResQPod.

Methods: This was a prospective, between subjects, experimental design comparing ROSC, time to ROSC, hemodynamics, and pharmacokinetics with and without the use of a ResQPod ITD. Swine were randomly assigned to 3 groups: CPR and defibrillation alone ($n = 7$), vasopressin with ResQPod ($n = 7$), and vasopressin without ResQPod ($n = 7$). Swine were anesthetized and placed in cardiac arrest for 2 minutes before CPR was initiated. Following 2 minutes of CPR, vasopressin 40 IU was administered intravenously, and serial blood samples were collected over 4 minutes. Plasma vasopressin concentrations were analyzed using HPLC-MS/MS. A MANOVA, chi-square, and odds ratio were used to analyze the data.

Results: ROSC for CPR and defibrillation alone, without ResQPod, and with ResQPod was 0%, 100%, and 71%, respectively. Chi-square test indicated differences between the CPR and defibrillation group vs both with and without ResQPod ($p=0.001$), but none in the with and without ResQPod groups ($p=.529$). The odds of survival were 6.8 times more likely without ResQPod ($p=.24$). A MANOVA indicated no difference in C_{max} , T_{max} , or time to ROSC between these 2 groups ($p=.186$). The mean and standard deviations for C_{max} were 100 ± 33 pg/mL for the ResQPod compared with 70 ± 28 pg/mL in the group without the ResQPod. The mean and SDs for the T_{max} with ResQPod were $1.7 \pm .69$ minutes compared with 1.8 ± 1.3 minutes to the no ResQPod group. A Repeated ANOVA indicated no significant difference in mean concentrations over time or hemodynamics between the 2 groups ($p > 0.05$).

Conclusions: Previous research relative to the use of ResQPod has been inconclusive. The data from this study strongly suggest there is no difference in ROSC, time to ROSC, hemodynamics, and pharmacokinetics in the groups with and without the use of a ResQPod. Even though there is limited evidence of the effectiveness of the ResQPod, the US military spent over \$17 million on the device in 2012. A cost-benefit analysis should be conducted to determine the effectiveness on human subjects. Although generalizations may not be made from our study to humans, the cardiovascular anatomy and physiology of the swine are very similar.

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

A11

Evaluation of the Anxiolytic and Antidepressant Effects of Asiatic Acid, a Compound From Gotu Kola or *Centella asiatica*, in the Male Sprague Dawley Rat

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Introduction: Anxiety disorders affect over 16% of the adult population, and there is an increasing trend in the use of herbal medications to self treat this disorder. Commonly used herbal remedies may have significant interactions on the administration of anesthesia. Asiatic acid (AA), a compound from the popular Indian herb *Centella asiatica*, was shown to have an inhibitory effect on acetylcholinesterase and selective GABA_B receptor agonist activity. AA at 30 mg/kg was demonstrated to improve memory in the rat model and may be useful in the treatment of generalized anxiety disorder. Further studies are warranted to determine the efficacy of prolonged treatment for anxiety.

Methods: Fifty-four male Sprague Dawley rats were divided into 5 groups: vehicle (DMSO), asiatic acid (AA), midazolam, or a combination of flumazenil + AA or midazolam + AA, and injected intraperitoneally 30 minutes prior to testing. All animals received equivalent intraperitoneal volumes consisting of 2 separate 1-mL injections, for a total volume of 2 mL. The rats were tested on the elevated plus maze (EPM) for 5 minutes. All testing occurred between 3:00 PM and 9:00 PM over 4 consecutive days to control for the circadian rhythm of the animals. Data were analyzed using a 2-tailed multivariate analysis of variance (MANOVA) and a LSD post hoc test.

Results: Analysis of the ratio of open-arm time to total time in the EPM showed significant increases in time spent in the open arms by the rodents in the midazolam + AA group compared with the vehicle group, AA group, midazolam group, and flumazenil + AA group. Analysis of mobility in the EPM showed significant decreases in the mobility of rodents in the AA, midazolam, and the midazolam + AA group compared with the vehicle group. In addition, significant differences in levels of mobility were found between the flumazenil + AA group and the midazolam + AA group. Differences between the AA group and the midazolam + AA group were not statistically significant. Analysis of mean maximum speed in the EPM showed significant decreases in the speed of rodents in the AA and midazolam + AA group compared with the vehicle group.

Conclusions: There is possible synergistic or additive effect between AA and midazolam, with AA action at unidentified receptor sites such as the central motor centers and peripheral neuromuscular junctions. Further studies are recommended to determine the efficacy of prolonged treatment for anxiety and depression, as well as using additional anxiety tests such as light-dark exploration and open field test in the rat model.

Source of Funding: American Association of Nurse Anesthetists (AANA) Foundation has supported this work.

A12

Is Combat Exposure Predictive of Higher Preoperative Stress in Military Members?

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TriService Nursing Research Program

Introduction: The preoperative experience is a unique phenomenon and may be perceived as extremely stressful. Research suggests patients exhibiting higher degrees of stress in the preoperative setting experience significantly more adverse perioperative morbidity. Anecdotal reports from military anesthesia providers suggest US military service members with a history of combat exposure may be more difficult to anesthetize and exhibit higher degrees of preoperative stress. The purpose of this study was to determine predictive relationships between the number of combat experiences and the preoperative psychological and physiological stress response in US military personnel on the day of surgery.

Methods: Design - Prospective, descriptive study conducted at Naval Hospital Camp Pendleton. Population - Active duty military members, 18 to 45 years of age, undergoing elective surgery (N = 120). Subjects were dichotomized into 2 groups: combat exposure (CE) group or noncombat exposure (NCE) group. Measurements - Basic demographics, military background, Patient Health Questionnaire-4, Post-traumatic Stress Disorder Checklist-Military, Walter Reed Army Institute of Research-Combat Exposure Scale, Visual Analogue Scale-Stress, Multiple Affect Adjective Checklist-Revised, and salivary alpha-amylase. Analysis - Standard and hierarchical multiple linear regression analyses were conducted.

Results: Negative emotions on the day of surgery were explained by combat exposure, trait anxiety and depression, and PTSD symptoms ($F(4, 71) = 5.302, p < .05, R^2 = .230$). Specifically, combat exposure accounted for an additional 5.5% of variability in MAACL-R mean dysphoria values, ie, overall negative emotions on the day of surgery. Trait depression was the most predictive variable in overall negative emotions on the day of surgery when controlling for anxiety, depression, PTSD, and combat exposure.

Conclusions: Combat exposure significantly contributed to negative emotions preoperatively. Specifically, combat exposure explained an additional 5.5% of the variability in the overall felt negative emotions reported on the day of surgery. Interestingly, depression may be a better predictor of preoperative stress, and PTSD may not be a reliable predictor of preoperative stress on the day of surgery.

Source of Funding: TriService Nursing Research Program Graduate Grant.

A13

The Effect of Psychosocial Factors on Acute and Persistent Pain Following Childbirth

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Introduction: Persistent postsurgical pain has been extensively studied, and persistent pain after childbirth has received attention in the last decade. Little is known, however, about the role psychosocial factors play in the development of pain following childbirth. The purpose of this study was to determine the effect of baseline depression, catastrophizing, anxiety, and social support on both acute and persistent pain after childbirth in a population of low-income women.

Methods: Baseline measures of the psychosocial variables were obtained during the last month to 6 weeks of pregnancy in 50 low income women receiving prenatal care at a university-based obstetric clinic in Jacksonville, Florida. Delivery and acute pain data were obtained from the electronic medical record. Follow-up surveys were sent to participants approximately 6 weeks following delivery, and they were asked to complete and return them when their newborn was 2 months old.

Results: Persistent pain (>0 on a 0 to 10 visual analog scale) after childbirth was present in 72% of the participants in this study (range = 1 to 10, mean = 3.17, SD= 2.02). Of those participants reporting persistent pain, 15 (37.5%) reported mild pain, 13 (32.5%) reported moderate pain, and 1 (2.5%) reported severe pain. Acute pain was significantly correlated with persistent pain ($r = .74, p < .001$), but no significant relationship was found between delivery mode, race, or age on either pain measure. Baseline and follow-up depression were both significantly related to persistent pain ($r = 0.38, p = 0.02$ and $r = 0.50; p = 0.03$, respectively). Follow-up anxiety was also significantly correlated with persistent pain ($r = 0.69; p = 0.001$).

Conclusions: Acute pain, depression and anxiety were related to persistent pain 2 months after childbirth. The incidence of persistent pain was much higher than reported in past studies. Further research should be conducted to determine the effect of socioeconomic status on acute and persistent pain after childbirth, in addition to testing interventions to decrease acute pain and depression in this vulnerable population.

Source of Funding: This study was funded by the Tri-Service Nursing Program HT9404-12-1-TS04.

A14

The Effects of Proximal and Distal Routes of Intraosseous Epinephrine Administration on Resuscitation and Survival in a Swine Model of Ventricular Defibrillation

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Introduction: Studies suggest there is a difference in the peak plasma concentration of epinephrine administered in proximal versus distal intraosseous (IO) infusion sites. There are limited data on whether proximal and distal IO routes of epinephrine infusion affect resuscitative outcome. This compared the occurrence of return of spontaneous circulation (ROSC), time to ROSC, and 30-minute survival outcome by group in a swine model of ventricular fibrillation (VF).

Methods: This prospective experiment used 32 swine assigned to 4 groups: humeral IO (HIO) (n=8), tibial IO (TIO) (n=8), IV (n=8), and control (n=8). Swine were anesthetized and VF induced. Chest compressions (BLS) began 4 minutes postarrest. Defibrillation (360 J) occurred 6 minutes postarrest and every 2 minutes thereafter. Epinephrine (0.01 mg/kg) was given after defibrillation and every 4 minutes thereafter. Resuscitation continued until ROSC or 26 postarrest minutes elapsed. Control swine received BLS and defibrillation but no epinephrine. Animals achieving ROSC were observed for 30 minutes.

Results: Among 32 swine enrolled, 31 swine completed the study. Within the experimental groups, 4 of 8 HIO (50%), 4 of 7 TIO (57%), and 5 of 8 IV (62%) swine achieved ROSC. No control, 0 of 8 (0%), swine achieved ROSC. Survival to 30 minutes post-ROSC was achieved by 13 of 31 (41.9%) swine. There was no significant difference in ROSC between the HIO, TIO, and IV groups ($P>0.05$). There was no significant difference between the HIO, TIO, and IV groups relative to time to ROSC ($P>0.05$). There were no significant differences between the HIO, TIO and IV groups relative to 30-minute survival ($P>0.05$). There were significant differences between the HIO, TIO, and IV groups and the control relative to ROSC, time to ROSC, and 30 minute survival ($P<0.05$).

Conclusions: Proximal and distal IO infusion sites perform equally well when compared with the IV route of infusion and each other. The data suggest the route of IO infusion of epinephrine does not affect resuscitative outcome in a swine model of VF.

Source of Funding: This study was funded by a postdoctoral fellowship grant from the American Association of Nurse Anesthetists Foundation.

A15

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

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US Army Graduate Program in Anesthesia Nursing

Introduction: Over 900 cardiac arrests occur every day in the United States. When a patient is in cardiac arrest, it is essential to establish rapid and reliable vascular access. The American Heart Association recommends that if intravenous (IV) access is not available, then drugs should be administered via the intraosseous (IO) route. The purposes of this study were to compare return of spontaneous circulation (ROSC), the concentration maximum (Cmax), and time to maximum concentration (Tmax) among swine administered 40 units of vasopressin via the tibial intraosseous (IO) and the intravenous (IV) route after 2 minutes of cardiac arrest.

Methods: This was a randomized prospective, experimental study. Swine (n = 21) were equally assigned to 3 groups: vasopressin administered via the tibial IO route, IV route, or a control group that received no vasopressin. Swine were placed into arrest. After 2 minutes of arrest, all groups received CPR for 2 minutes; vasopressin 40 units were then administered to the IV and IO groups. Samples were collected over 4 minutes for analysis of Cmax and Tmax of vasopressin levels in the blood. Pigs in all groups were defibrillated every 2 minutes until ROSC or for 20 minutes if no ROSC. A MANOVA and chi-square were used to detect a significant difference between groups in the IV and tibial IO groups.

Results: There was no statistical difference in mean time to ROSC between the IO and IV groups; mean time to ROSC for the tibial IO group was 8.3 minutes and the IV group was 9.01 minutes (p = 0.665). All subjects in both the IO and IV groups had ROSC; none in the control (CPR defibrillation) group survived. The Cmax was significantly higher in the IV group compared with the IO group: IV was 70,717 pg/dL; IO was 38,630 pg/dL (p = 0.021). There was no significant difference in the mean Tmax of vasopressin; IV route was reached at 1.7 minutes vs the tibial IO group of 2.4 minutes (p = 0.20). There was a significant difference between both IV and IO groups compared with the control relative to ROSC (p = .001).

Conclusions: The tibial IO is an effective method of administering vasopressin. Although the Cmax was higher in the IV group compared with the tibial IO group, all swine in these groups survived or achieved ROSC. The investigators interpret that the Cmax was high enough to be effective as evidenced by all subjects achieving ROSC.

Source of Funding: TriService Nursing Research Program.

A16

Time of Administration and Hemodynamics in a Swine Model Comparing Sternal Intraosseous and Intravenous Access

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Introduction: Uncontrolled hemorrhage is the leading cause of death in military and civilian trauma. Approximately 20% of combat casualties killed in action were because of mass blood loss. Establishing rapid and reliable vascular access is critical for patients in hypovolemic shock. Many civilian and military experts recommend a 500-mL Hextend bolus be administered through an intravenous (IV) 18-gauge needle or via an intraosseous (IO) needle as initial treatment for patients in hypovolemic shock. The purposes of this study were to compare administration time of Hextend and the hemodynamics of IV and IO routes in a class II hemorrhage swine model.

Methods: This was a prospective, experimental study. Adult swine were assigned to sternal IO (n = 7), IV (n = 7), and control group (n = 7). Swine were anesthetized, and 30% of their blood volume (class II hemorrhage) was exsanguinated. Vital signs and hemodynamic data were collected before and after the hemorrhage. After the hemorrhage, 500 mL of Hextend was administered via either the IO sternal or IV route with the aid of a pneumatic pressure bag at 300 mm Hg. The control group received the same treatment with the exception of Hextend administration. Data were then collected every 2 minutes for 8 minutes.

Results: A multivariate analysis of variance (MANOVA) showed significant differences between the sternal group and the IV and control groups relative to weight, pulse, and systolic blood pressure prior to hemorrhage ($p < 0.05$). Hence, a delta score was calculated for vital signs and hemodynamics to account for these differences. A repeated MANOVA of the delta scores indicated that there were no significant differences between the IV and sternal IO groups ($p > 0.05$), but there were significant differences between these 2 groups compared with the control group ($p < 0.05$). An independent t-test showed no significant differences in time to administer Hextend: sternal IO (8 minutes 55 seconds \pm 2 minutes, 32 seconds) vs IV group (10 minutes, 16 \pm 2 minutes, 46 seconds) ($p > 0.05$).

Conclusions: The sternal IO was faster than the IV group for the time to administer Hextend but it was not statistically significant. There were no differences in changes of vital signs or hemodynamics between the sternal IO and IV groups indicating that both routes were effective compared with a control group that received no fluids. The sternal IO insertion took less than 10 seconds. Even a skilled provider would take life-saving time to start an IV. Based on the results of this study, the sternal IO route should be considered as a first choice in establishing vascular access. The sternal IO is an effective and easy method of administering Hextend.

Source of Funding: This study has been funded by the TriService Nursing Research Program.

A17

A Career Advancement Model for Certified Registered Nurse Anesthetists

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Introduction: CRNAs safely administer over 34 million anesthesia cases annually within the United States and are a critical part of the patient's surgical experience. Additional responsibilities and an increased workload placed on CRNAs has led to unclear roles and expectations and conflicting levels of independence. Motivating CRNAs to their full potential can decrease stress caused by lack of autonomy and increase job satisfaction and retention. Although there is evidence about career advancement models (CAMs) for other advanced practice providers and registered nurses, currently, there are no models specific to CRNAs.

Methods: The Delphi method was used to create a CAM for CRNAs. A convenience sample of 10 CRNAs in leadership positions were solicited for their input. Three rounds of anonymous surveys were sent to the participants. Each survey contained 10 multiple-choice questions that explored the participant's views and thoughts about the proposed model. After each round of the survey, the CAM was revised based on the participant's input.

Results: The initial survey had 100% participation from the respondents and the followup had 90% participation. Participants agreed on a 4-level model. Each level has specific criteria in 1 of the 4 domains (clinical experience, educational level, committee/organization participation, and research). Fifty percent believed that clinical experience should have more importance than educational level. Ten percent felt that education should have more importance than clinical experience. When participants were asked if they would incorporate a pay raise into each level, 45% agreed they would; 33% said they would not. Fifty-six percent agreed that a CAM for CRNAs would help distinguish CRNAs from other anesthesia care providers. Fifty-six percent responded that they would use the CAM for annual staff reviews and 22% stated they would not.

Conclusions: The adoption of a CAM for CRNAs should be considered as a method to increase job satisfaction and retention. The proposed model was reviewed by CRNA leaders who agreed that a CRNA CAM should be implemented in their workplace and may be used as one method to distinguish CRNAs from other anesthesia providers.

A18

A Comparative Study of the Pharmacokinetics and Pharmacodynamics of Sternal Intraosseous and Intravenous Vasopressin Administered During Cardiac Arrest in a Porcine Model

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Introduction: Establishing vascular access in a critically compromised cardiovascular patient can be difficult and time consuming. Intraosseous (IO) access has the advantages of speed of placement, effectiveness, and safety. This led to its use in prehospital settings and in special operations medicine by all military branches. Vasopressin significantly improves cerebral and myocardial blood flow without increasing myocardial oxygen consumption. The goal of this study was to determine the effectiveness of sternal intraosseous administration of 40 units of vasopressin during cardiac arrest.

Methods: Twenty-one male Yorkshire-cross swine weighing 60 kg to 80 kg were used in this prospective, experimental, between subjects design. Seven subjects were assigned to each group: intravenous (IV) vasopressin, IO vasopressin, or control (CPR and defibrillation only). All subjects were anesthetized, ventilated, instrumented, and fully monitored. Ventricular fibrillation was induced and resuscitation was based on AHA guidelines. Following vasopressin, arterial blood samples were collected to assess the pharmacokinetics; return of spontaneous circulation was used to assess the pharmacodynamics.

Results: A Fisher exact test was used to evaluate survivability of the 3 groups. When compared with the control group's survivability associated with vasopressin, regardless of route of administration, was significant ($p < .001$). There was no difference between the IV and IO groups and survivability ($p = .89$). A multivariate analysis of variance (MANOVA) with a Wilks lambda was used to determine if there were significant differences in the pharmacokinetics between the groups. There was no statistical difference between concentration maximum (Cmax), time to maximum concentration (Tmax), or mean concentration over time when comparing the IV vasopressin group with the IO sternum vasopressin group at any time point.

Conclusions: Few studies have compared the pharmacokinetic and pharmacodynamic properties of vasopressin administered via sternal IO versus IV in a cardiac arrest model. Sternal IO vasopressin performed as well as IV in reference to Cmax, Tmax, mean concentration over time, and return of spontaneous circulation. This study demonstrates the efficacy of sternal IO vasopressin in cardiac arrest. Furthermore, IO access should be instituted early during resuscitative measures in order to prevent delays in administration of medications.

Source of Funding: TriService Nursing Research Program.

A19

A Comparison of Alka-Seltzer Gold and Nauzene to Bicitra on Known pH Solutions

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Introduction: Citric acid/sodium citrate or more commonly known as Bicitra is routinely given to labor and delivery patients who are about to undergo a cesarean delivery. This is due to Bicitra being a nonparticulate antacid and having a quick onset of action. This study was to analyze alternative options to Bicitra. Alka-Seltzer Gold (sodium bicarbonate, potassium bicarbonate, anhydrous citric acid) as well as Nauzene (sodium citrate dihydrate) were tested. The comparison was made on known pH measurements.

Methods: Serial pH measurements were performed using these liquid antacids with 5 different volumes of acid solutions simulating stomach contents. First Alka-Seltzer Gold was added to 4 ounces of water per the medication directions and allowed to dissolve. This solution was then added to the hydrochloric acid and the resultant pH measured. For the second set of measurements Nauzene, 30 mL as per the dose, was added to hydrochloric acid and the resultant pH measured. Each medication was tested with the above stated volumes and pHs. These measurements are compared with a previous study with Bicitra.

Results: The 1.0 pH group tested with Alka-Seltzer Gold showed a change from pH 4.0 with a volume of 25 milliliters to pH 1.2 with a volume of 500 milliliters. The 1.0 pH group tested with Nauzene showed a change from pH 4.6 with a volume of 25 milliliters to pH 1.3 with a volume of 500 milliliters. The 2.0 pH group tested with Alka-Seltzer Gold showed a change from pH 4.9 with a volume of 25 milliliters to pH 3.4 with a volume of 500 milliliters. The 2.0 pH group tested with Nauzene showed a change from pH 5.3 with 25 milliliters to a pH 3.5 with 500 milliliters.

Conclusions: The data from this study show that there are alternatives to the use of Bicitra. Other nonparticulate antacids such as Alka-Seltzer Gold and Nauzene can be used to adequately lower the pH level of the stomach in an emergent situation. The results in this study were compared with the results obtained in the study, "The Effect of Sodium Citrate with Citric Acid on the pH of Acidic Solutions," by B. DePuydt, Shea, JP, Monaghan, WP and Shores, presented at the 78th Annual Meeting of the American Association of Nurse Anesthetists, August 6-10, 2011, Boston, MA. The results of the 2 studies were very similar. Results with Nauzene were slightly more effective than the results of Alka-Seltzer Gold.

A Comparison of Outcomes Between Epidural Catheter Replacement Versus Intrathecal Catheter Placement in Obstetrical Patients Following Accidental Dural Puncture

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Introduction: This article examined retrospective data from obstetric patients experiencing known accidental dural puncture to determine if there was a difference in the prevalence of postdural puncture headache (PDPH) between patients managed with intrathecal catheter placement and those whose epidural was replaced at a different level following dural puncture. A literature review was performed to examine noninvasive treatment options for postdural puncture headache, and recommendations were made for a proposed treatment protocol for postdural puncture headache.

Methods: Two years of data concerning unintentional dural puncture cases were examined, and their management and outcomes were compared. A chi-square test and odds ratio were selected by the statistician as the 2 most appropriate methods to evaluate the differences in outcomes between the 2 groups. A literature review was performed using Scopus and Pubmed to evaluate noninvasive treatment options for postdural puncture headache.

Results: During this period, 33 patients met inclusion criteria. Of the 13 patients who had their epidural catheter replaced, 11 (84.6%) experienced a PDPH and 9 (69.2%) required an epidural blood patch (EBP). Of the 20 patients who had an intrathecal catheter placed at the time of inadvertent dural puncture, 12 (60%) experienced a PDPH and 9 (45%) required an EBP for treatment. Intrathecal catheter placement did not offer a significant lower incidence of PDPH or EBP. However, evaluation with the odds ratio showed that patients who had their epidural replaced had a 3.67 times higher risk for PDPH and a 2.75 times higher risk of requiring an EBP.

Conclusions: Intrathecal catheter placement did not significantly decrease the incidence of PDPH or EBP. However, the odds ratio supported the findings of previous authors who advocate for the use of intrathecal catheters. Several medications (including pregabalin, gabapentin, and theophylline) appear promising in the successful treatment of PDPH. However, further research is necessary to determine ideal dosing parameters and treatment combinations, as well as the safety of these medications in the obstetric population and in conjunction with other medications used in the obstetric unit. Larger randomized, controlled studies are suggested to correct for bias and to provide strength to the findings.

A21

A Hot Topic: A Flammability Assessment of Preoperative Skin Preparation Solutions and Alcohol-Based Hand Sanitizers on Common Perioperative Anesthesia Materials

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Introduction: Operating room fires pose a potentially lethal threat to patient safety and yield a great source of liability for anesthesia providers. The creation of fire requires an oxidizing agent, an ignition source, and a fuel supply. All 3 elements are in close proximity in the operating room during the delivery of anesthesia. As an anesthesia provider, it is imperative to recognize and prevent any conditions that increase the risk of ignition in surgery. This study was designed to assess the flammability of various preoperative skin preparation solutions and alcohol-based hand sanitizers on common perioperative anesthesia materials.

Methods: Nine anesthesia materials were selected to test their potential for ignition (IV tubing, oral airways, nasal airways, ETTs, LMAs, nasal cannulas, disposable arm straps, ECG leads, and esophageal temperature probes). The materials were assessed for flammability with no applied solution and with 7 wet preparations (Chloraprep, Duraprep, alcohol, Betadine, Hibiclens, Germ-X, sterile water). A lighter was used as the ignition source. The materials were tested immediately after application, after 3 minutes, after 5 minutes, and after 10 minutes. The time intervals were selected to help determine sufficient drying times for the solutions. All materials were tested in room air.

Results: When anesthesia materials were tested with no preparation, 8 out of the 9 materials demonstrated flame retardant properties. Disposable arm straps were highly flammable and exhibited burn through properties. No ignition was elicited at any time interval with the application of Hibiclens, Betadine, Chloraprep, or sterile water. Ignition and a sustained flame were seen on all 9 materials immediately after application of Duraprep, alcohol, and Germ-X, but no ignition was elicited after 3 minutes.

Conclusions: The aim of this study was to identify possible sources of ignition on common anesthesia materials in the perioperative setting. Disposable arm straps are highly flammable and pose a threat to patient safety. The addition of Duraprep, alcohol, and Germ-X did increase the flammability of all perioperative anesthesia materials. However, if the flammable solutions are allowed an adequate drying time of 3 minutes, they do not appear to present any risk of ignition or danger for the patient. Potential further research should test the perioperative materials at increased levels of oxygen in order to explore the influence of the oxidizing agent on the perioperative materials.

A22

An Effective Teaching Method for Endotracheal Tube Cuff Inflation

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Introduction: There are various ways to inflate an endotracheal tube (ETT) cuff, but currently no standardized way of teaching this skill. Student registered nurse anesthetists are not provided with formal instruction. Our research question asked if education and training would improve the accuracy of endotracheal tube cuff inflation to the appropriate value of 20 to 30 cm of H₂O pressure.

Methods: Twenty-five student registered nurse anesthetists were given a pretest prior to any education. After the pretest, students inflated an ETT cuff placed in a mannequin head. The pressures were measured and recorded. Then students were allowed to palpate the pilot balloon with a properly inflated ETT cuff. A presentation was given providing proper ETT cuff inflation and complications of improper ETT cuff pressures. Students were then given a posttest with the same questions and attempted to inflate the ETT cuff to the appropriate pressure again. The pressures were measured and recorded.

Results: The average ETT cuff pressure prior to education was 38.48 cm of H₂O, the average pressure after education was 19.88 cm of H₂O. There was a 16% success rate preinstruction and a 40% success rate postinstruction. McNemar test is used to compare these. The p-value is 0.0833, which is not significant at the 5% level, but is marginally significant. On the pretest, 40% of the students answered all 3 multiple-choice questions correctly. On the posttest, 96% of the students answered all 3 questions properly. On the posttest, 100% of the students answered that the education session was helpful and that they felt more confident in their ability to properly inflate an ETT cuff.

Conclusions: This study confirms that most anesthesia student providers routinely overinflate the ETT cuff pressure. Although all of the study subjects knew the appropriate theory as evidenced by them correctly answering the questions that were posed. This data shows that actual training involving sensory touch with immediate feedback is a necessary part of imbedding the theoretical base knowledge in order to effect proper ETT cuff pressure.

BodyExplorer: An Initial Report On Usability of a Novel Simulator Being Developed at the University of Pittsburgh

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Introduction: Simulation provides a safe environment for development of clinical skills using mannequins. BodyExplorer™ (BE) is an augmented reality mannequin simulator designed to provide memorable experiences with anatomy, pharmacology, physiology, and procedures including rapid sequence induction. Interactive image projection, preprogrammed curricula and automated tutoring tools will allow students to self-direct their learning. Instructors review individual performance reports and provide specific feedback without the need for continuous presence. The goal of the project is to provide realistic, engaging, and self-directed experiences designed to accelerate the learning process.

Methods: A convenience sample of 25 participants (instructors, students) were recruited from the University of Pittsburgh School of Nursing. A series of moderator-prompted tasks were performed with BodyExplorer. Three observers recorded structured participant feedback about the system. The sessions were each an hour long and were video recorded. Participants used the “think aloud” method during simulator interaction in order to capture their actions and impressions. Observers collected this information and integrated it with their own direct observations of the participant interaction with BodyExplorer.

Results: We present data from usability testing of an augmented reality simulation system. Participants provided feedback for understanding of current functionality as well as iterative improvements. For example, one of the main issues participants experienced was difficulty manipulating the interactive pen to complete assigned tasks that resulted in reengineering of the interactive pen interface. Despite minor difficulties, participants were excited regarding the potential of BodyExplorer to add a new dimension to healthcare education. Future directions include additional curricular and automated instructional capability, additional skill training modules, and the introduction of pathophysiologic conditions.

Conclusions: Body Explorer is a research prototype that aims to lower barriers (cost, infrastructure, personnel resources) for adopting simulation into education and enhancing the value of the student-simulator experience by increasing the “bandwidth” across which learning occurs. Our innovative approach to evaluation of the system will decrease the time in which innovations in simulation technologies can come to fruition. Additionally the approach should spur creation of modules custom tailored to the needs of diverse educational programs. Rapid sequence intubation (RSI), bag valve mask ventilation, and expanding categories of medication recognition utilizing case study modules are now being refined.

Source of Funding: Coulter Translational Research Partners II, Clinical & Translational Science Institute Department of Bioengineering, Department of Nurse Anesthesia, Undergraduate Research Mentorship Program.

Core Temperature Measurement Using a Noninvasive Zero-Heat-Flux Thermometer

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Introduction: Perioperative hypothermia, a core temperature below 36°C, is associated with several adverse outcomes in the surgical patient. A variety of invasive methods are currently used to obtain core temperature, but few are available preoperatively or continue into the postoperative period. Agreement of a noninvasive core temperature measurement device using zero-heat-flux technology was compared with the esophageal temperature probe in the intraoperative period. Additionally, this noninvasive device was compared with oral thermometry in the preoperative and postoperative periods.

Methods: Temperature measurements were obtained from 369 patients undergoing general anesthesia for a variety of surgical case types. Forehead probes, utilizing zero-heat-flux thermometry, were placed on arrival to the preoperative area and removed after discharge from the postanesthetic care unit. Core temperatures from the noninvasive device were compared with oral temperatures in the preoperative and postoperative settings and esophageal temperatures intraoperatively. When analyzing data using limits of agreement, we chose an absolute temperature difference of 0.5°C to be clinically relevant.

Results: The mean overall difference in temperatures between preoperative oral and the noninvasive device was -0.25°C with 68% of the differences falling within $\pm 0.5^\circ\text{C}$. Mean temperature differences between intraoperative esophageal and the noninvasive device ranged between +0.14 and +0.16°C, with the percentage of differences within $\pm 0.5^\circ\text{C}$ ranging between 83 and 88%. Upon admission to the PACU, a mean difference of -0.22°C was present between postoperative oral temperature and noninvasive device temperature, with 70% of differences within $\pm 0.5^\circ\text{C}$. At the time of discharge from the PACU, the mean overall difference between postoperative oral and noninvasive device temperatures was -0.09°C with 75% of the differences within $\pm 0.5^\circ\text{C}$.

Conclusions: The intraoperative esophageal temperature agreed with the noninvasive device to a greater degree than oral temperatures taken preoperatively and postoperatively. The agreement between the noninvasive device and esophageal temperature in our study was similar to a previous study comparing the same noninvasive device to pulmonary artery catheter temperatures. Results from our study suggest that a noninvasive device using zero-heat-flux thermometry is an effective, noninvasive alternative to accurately measure core temperature throughout the entire perioperative period.

Source of Funding: This research was supported by the Department of Anesthesiology, College of Medicine, Mayo Clinic, Rochester, Minnesota.

Determining Value in Non-ACT Model Clinical Rotations for SRNAs

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Introduction: Certified registered nurse anesthetists (CRNAs) have been the predominant anesthesia providers in rural areas. With a growing need for rural anesthesia providers in the United States, it may be beneficial for nurse anesthesia educational programs to provide students with independent CRNA clinical opportunities. However, the value of these clinical experiences has not been determined. The purpose of this study was to determine if there is value in providing clinical experience in nonanesthesia care team models (non-ACT).

Methods: Following MUSC IRB approval, an online survey was distributed to nurse anesthesia educational program directors in the United States to forward to their students. Students were asked for information about types of clinical experiences and characteristics of their academic program. Questions were designed to measure confidence in practice, knowledge of scope of practice, and likelihood to work in non-ACT settings. Descriptive and nonparametric statistics were utilized to determine the significance of the differences between the respondents who did and who did not have non-ACT clinical experience.

Results: Regarding areas of individual decision making, clinical preparation for independence, management of critical events, and ability to work in both non-ACT and ACT care team models, respondents in the non-ACT group reported significantly more confidence than those in the ACT group ($p = 0.001$). Respondents in the non-ACT group were significantly more likely than those in the ACT group to state that CRNA practice was not required by state law to be supervised by an anesthesiologist ($p < 0.001$). Respondents in the non-ACT group were significantly more likely than those in the ACT group to indicate that they would prefer to work in a non-ACT setting ($p < 0.001$).

Conclusions: The results of the study suggest that providing non-ACT clinical rotations is valuable to students and, potentially, to anesthesia workforce development. Non-ACT clinical experiences were related to improved confidence, independence, and management of critical events and to a greater interest in working in a non-ACT setting. Given the need for CRNAs in non-ACT rural settings, it is important to train students for these opportunities to pursue. Further research is needed to identify the specific skills that would prepare students for non-ACT practice settings.

Eisenmenger and Noncardiac Surgery

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Introduction: In 1999, an increased risk of cardiovascular complications for patients with Eisenmenger syndrome (ES) undergoing noncardiac surgery was identified. Morbidity and mortality associated with ES patients were also described. Since 1999, there have been significant developments and data to guide medical care for ES patients. This current research identified risk factors for ES patients' operative mortality and morbidity along with interventions and precautions. Updated guidelines for management of ES patients during the perioperative period may help minimize ES patients' mortality and morbidity.

Methods: A retrospective study was conducted with a total of 35 patients with ES, 17 to 67 years of age, undergoing noncardiac related surgery for the period of 1997 to 2014. Anesthetic type included monitored anesthetic care, general or regional anesthesia, and registered nurse sedation. Echocardiogram studies completed within 2 years prior to surgery were analyzed, and patients were excluded if they did not have any sedating medication for the procedure. Data obtained prior, during and after surgery was collected for 35 patients and 157 procedures and assessed for perioperative complications.

Results: This study addresses the changing needs of the ES patient in the setting of new medical advances and surgical techniques. There were 35 patients who underwent noncardiac surgery at age ≥ 17 years. In these patients, 157 procedures were conducted at the Mayo Clinic. Of these procedures 83 met inclusion criteria for data abstraction. Of these procedures, 64 were uncomplicated and 19 had at least 1 complication, including new-onset arrhythmia (4), congestive heart failure (6), stroke (1), respiratory failure (3), hepatic dysfunction (1), acute kidney injury (3), and hemodynamic instability necessitating inotropic/vasopressor support (5). Thirty-day morbidity was 22.9% and 30-day mortality was 5.7%.

Conclusions: The number of adults living with congenital heart disease is estimated to exceed a million. These patients are at significantly higher risk during noncardiac surgery due to multiple organ impairment. There is a deficit of updated data regarding anesthesia/surgical outcomes for these patients. Although this study had limitations due to the rare nature of Eisenmenger syndrome, the data presented with this article offers anesthesia providers current information about comorbidities to consider when anesthetizing patients with this syndrome.

Source of Funding: This research was supported by the Department of Anesthesiology, College of Medicine, Mayo Clinic, Rochester, Minnesota.

Factors That Predict Incident Reporting Behavior in CRNAs

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Introduction: Robust mechanisms for collecting and sharing information about adverse events in healthcare in order to help prevent future events are recognized as essential to patient safety efforts. A review of the literature revealed that studies of attitudes toward incident reporting and reporting behaviors have been done in anesthesiologists, yet no equivalent studies in nurse anesthetists have been published. Lack of knowledge about incident reporting behavior in nurse anesthetists is a critical barrier to progress in this area.

Methods: This study employed a nonexperimental, descriptive, correlational design to explore the relationship between cognitive factors and incident reporting behavior in practicing CRNAs. A novel survey questionnaire was designed, based on the theory of planned behavior, and distributed to a random sample of 3,000 CRNAs in the United States. Descriptive analysis provided a snapshot of CRNAs' recent use of incident reporting systems. Logistic regression was used to determine the most important predictors of incident reporting behavior in CRNAs.

Results: Fifty-two percent of CRNAs had experienced at least 1 incident in the past year, yet nearly half rarely or never reported the events. Females were 5 times more likely than males to have reported incidents. The majority of CRNAs surveyed reported having a positive attitude toward reporting, perceived social pressure to report, and perceived that he or she had control over reporting. There was a positive correlation between cognitive factors and the likelihood that a CRNA would report patient safety incidents. A combination of attitude toward reporting and social pressure to report best predicted the likelihood of using an incident reporting system. Social pressure to report had the greatest effect on the likelihood of reporting.

Conclusions: Patient safety incidents are not consistently reported by practicing CRNAs. Every unreported incident represents a missed opportunity for learning, and this study reinforces the assertion that strategies to maximize utilization of incident reporting systems by CRNAs are needed. Social pressure to report, or the degree to which a CRNA perceived that others approve of incident reporting and that others report incidents, was the strongest individual predictor of a CRNA's incident reporting behavior. Interventions that highlight cultural support of reporting should be emphasized in future strategies to improve the rate of reporting in this provider group.

Source of Funding: This study was supported by a Doctoral Fellowship Award from the AANA Foundation.

A28

First Time Success: The Power of Ultrasound

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Introduction: Clinical educators regard arterial line placement as a technically difficult and meticulous skill to acquire. The aims of this project are to observe if student registered nurse anesthetists can accurately palpate the radial artery and if the use of ultrasound (U/S) aids in successful cannulation. According to the American Institute of Ultrasound Medicine, the use of U/S improves first pass success rate, decreases time to access, and reduces iatrogenic injury. This process improvement project may have broad implications for the future of clinical education.

Methods: Informed consent was obtained from the student and the patient whose preoperative evaluation indicated the need for an arterial line. After induction of anesthesia, the student palpated the radial artery and with a surgical marking pen, marked its strongest point. The researcher used U/S to verify the accuracy of the palpation method. If variability was greater than 1 mm, a second mark was made to identify the correct location. The student attempted to place the arterial line based on the new mark identified by the U/S. Successful cannulation was defined as an arterial waveform tracing.

Results: Of the 30 study subjects, 19 participants did not palpate the radial artery correctly. Sixty-eight percent palpated the radial artery medially and 32% palpated it too laterally. The mean difference between palpation and U/S identification was 2.2 millimeters. Students with more than 10 prior experiences placing arterial lines were twice more likely to correctly palpate the artery compared with less experienced students. Patients with a BMI < 25 kg/m² and female gender enhanced the accuracy of the palpation method. Greater U/S experience of the anesthesia student was a statistically significant factor ($p < 0.05$) to successfully cannulating the radial artery.

Conclusions: Even with assistance from U/S, placing an arterial line remains technically difficult for the majority of first and second year students. Recommendations include training in U/S technology and imaging along with simulation practice. Novice providers may opt to select patients with a BMI < 25, younger age, and of female gender in order to acquire a greater level of confidence and proficiency. Although statistical significance was not seen regarding patient demographics with the use of U/S, we did see a significant trend toward decreased morbidity and increased success rate when U/S was present.

A29

General Anesthesia and Development of Mild Cognitive Impairment: A Population-Based Study of Aging

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Introduction: The purpose of this study was to assess whether exposure to general anesthesia after age 40 is associated with development of mild cognitive impairment (MCI) in an elderly population-based cohort. The study utilized data from the Mayo Clinic Study of Aging, which is a longitudinal cohort study of a randomly selected, population-based sample of Olmsted County, Minnesota, residents, who were 70 to 89 years old on October 1, 2004. At baseline and subsequent visits, participants were evaluated for demographic, clinical, and neuropsychological measures, and were classified as cognitively normal, MCI, or dementia.

Methods: Using the resources of the Rochester Epidemiology Project, which is a collaboration between healthcare providers, clinics, and hospitals in southeastern Minnesota to share medical records for research, we retrieved information regarding all anesthetic exposures for study participants from age 40. Proportional hazards regression, with age as the time scale, was used to assess whether exposure to procedures requiring general anesthesia after the age of 40 is a risk factor for developing MCI.

Results: Of 1,731 participants, 537 developed MCI during followup. When exposure to anesthesia was assessed, anesthesia was not associated with MCI ($P=0.594$). No association was found when anesthetics were quantified as the number of procedures ($P=0.869$), or when total cumulative duration of exposure was assessed ($P=0.958$). From secondary analyses, any exposure to procedural anesthesia after the age of 60 was found to be associated with an increased risk for MCI ($P=0.034$). Similar associations were detected for any exposures in the previous 20 and 10 years ($P=0.006$ for 20 years, $P=0.015$ for 10 years). However, when number of exposures and cumulative duration of exposure was analyzed, a dose-response was not observed.

Conclusions: We found no significant association between exposure to general anesthesia after age 40 and MCI.

Source of Funding: This project was supported by the Department of Anesthesiology, College of Medicine, Mayo Clinic, Rochester, Minnesota; the Rochester Epidemiology Project (NIH grant); and the Mayo Clinic Center for Translational Sciences Activities (National Center for Advancing Translational Sciences grant).

How Do We Choose? A Meta-Analysis of Tools to Evaluate Applicant Critical Thinking

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Introduction: Based on a 2005 review, academic dismissal accounts for 30% of attrition from CRNA programs. Inadequate critical decision making (CDM) skills may contribute significantly to deficiencies resulting in attrition. Cognitive scoring tools such as GPA or GRE are frequently used to predict success. Though these methods may predict the ability to complete coursework, the ability to engage in CDM is harder to evaluate. Reliable methods to select students optimized for success is crucial for mitigating relief. This meta-analysis compared tools to assess CDM skills in graduate applicants.

Methods: The search identified published and unpublished works published in English from 1970 to present. Reference lists from all articles retrieved were examined for additional articles. Selected works were assessed by 2 independent reviewers using a standardized critical appraisal form. Data was extracted independently by each reviewer, which included study type, r values, number of subjects, and reported p values. The meta-analysis was performed using the method for effect size analysis published by Hunter and Schmidt in 2004.

Results: The search primarily led to 377 potentially relevant studies. After detailed assessment of inclusion criteria and methodological quality review, 361 studies were excluded from the review. Sixteen studies were included in the review/meta-analysis. All were retrospective case series studies. Date range was 1970 to 2009. Total number of subjects from the combined works was 4,357. The strongest relationship was between undergraduate GPA and graduate GPA (small effect size, $r = 0.27$, credibility interval 0.18-0.37). The second strongest relationship was between GRE's verbal section and graduate GPA (small effect size, $r = 0.24$, credibility interval, 0.11-0.37).

Conclusions: The meta-analysis of r values from the combined works demonstrated that an applicant's undergraduate GPA has the strongest predictive ability with graduate program success. The next best predictor of success was the GRE verbal score. Importantly, all of the recorded variables positively correlated with graduate success; however, the effect sizes were lower. One selected work analyzed a tool other than GPA or GRE: the California Critical Thinking Skills Test. The meta-analysis reinforces that traditional predictors of graduate school success and CDM skills are valid and effective.

Investigation of the Antidepressant Effects of Asiatic Acid, a Compound From Gotu Kola or *Centella asiatica*, in the Male Sprague-Dawley Rat

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Introduction: Major depression is a complex and crippling disease affecting 3% to 5% of the population. Antidepressant therapies are limited because of the significant time lapse between initiation of medication and improvement of symptoms. Alternatives to traditional treatment are herbal medications, such as asiatic acid (AA), a major compound in gotu kola or *Centella asiatica*. The purpose of this study was to investigate the antidepressant effects of AA and its potential modulation of the γ -aminobutyric acid (GABA_A) receptor. The aim was to determine the effects of AA on depression.

Methods: A prospective, experimental, between groups design was used. Fifty-five rats were divided into 5 groups: 1) vehicle, 0.5% dimethyl sulfoxide (DMSO); 2) AA, 30 mg/kg; 3) midazolam, 1.5 mg/kg; 4) flumazenil, 3 mg/kg + AA, 30 mg/kg; or 5) midazolam, 1.5 mg/kg + AA, 30 mg/kg. The forced swim test (FST) was used to assess depression in the rodent model. Data analysis was performed using a 2-tailed multivariate analysis of variance (MANOVA) and least significant difference (LSD) post-hoc tests.

Results: Two behaviors were observed in the FST: mobility time and fecal pellet output (FPO). Mobility time is the mean time elapsed before immobility, averaged between 2 blinded observers. The mobility times showed an increased time mobile in all groups over the vehicle, but no statistical significance was found. Significance in the FPO was found between the AA group and vehicle group ($p < .001$), the midazolam + AA group and vehicle group ($p < .000$), and the midazolam + AA group and the flumazenil + AA group ($p < .022$). The FPO averaged 4.6 for the vehicle group, 1.8 for the AA group, 3.3 for the flumazenil + AA group, and 1.5 for the midazolam + AA group. No significance was found in the midazolam group at 3.0 FPO.

Conclusions: The increased mobility time in the FST in the AA groups showed a trend toward alleviating depressive symptoms in the rat. The significance found between the flumazenil + AA suggests a benzodiazepine like component to the effects of AA because its efficacy is greatly reduced when combined with a benzodiazepine receptor antagonist. The decrease in FPO in the groups that received AA may suggest a decrease in stress and depression. Future studies should evaluate a multidose or prophylactic regimen to include other behavioral despair tests such as the tail suspension test to verify FST results.

Source of Funding: This study was funded by the AANA Foundation and conducted at the US Army Institute of Surgical Research.

Measuring Competency in the Provision of Ultrasound-Guided Regional Anesthesia

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Introduction: While relatively new, ultrasound-guided regional anesthesia (UGRA) blocks are rapidly gaining popularity with Certified Registered Nurse Anesthetists (CRNAs). As an increasing number of CRNAs utilize UGRA, a need exists to ensure competency in performing this skill. To date, there is no standardized tool to determine CRNAs competency in UGRA. Through a review of the literature, a task oriented checklist and global rating scale (GRS) was identified that has been utilized to determine UGRA competency. The purpose of this project was to determine the feasibility and reliability of implementing these instruments to evaluate competency of CRNAs in UGRA at a military ambulatory surgery center.

Methods: Following IRB exemption, staff CRNAs were instructed on instrument use. UGRA blocks were evaluated by CRNAs with the greatest experience, from March 16 to April 10, 2015. Inter-rater reliability was established by adding a second rater (weeks 3-4 of the study), each blinded to the others' scoring. The CRNA placing the block completed an anonymous survey regarding CRNA and regional anesthesia experience. Each evaluator completed a usability questionnaire focusing on the task specific checklist and GRS. Inter-rater reliability was assessed with intraclass correlation coefficient (ICC) based on a 2-way random effects model. A p-value of 0.05 was considered statistically significant.

Results: During the four weeks of data collection, the ambulatory surgery center performed 64 UGRA blocks, 58 of those were evaluated using the checklist and GRS; 8 regional blocks were not evaluated due to limitations in staffing. Of the 58 blocks evaluated, 25 were evaluated by a second rater. The ICC for the task specific checklist was 0.82 (95% CI 0.58-0.92), the GRS scale ICC was 0.40 (95% CI -0.39-0.73) and the total score ICC was 0.79 (95% CI 0.51-0.91). As a measure of overall usability the mean SUS percentile score from all evaluators (n=7) was 82.5 (SD ± 16.6). A score > 68 demonstrates above average usability. A score > 80.3 represents the 90th percentile.

Conclusions: This study aimed to determine the feasibility and inter-rater reliability of the checklist and GRS to assess UGRA practice. In support of the feasibility, we were able to evaluate 91% of the UGRA placed. The task specific checklist and total score demonstrated high inter-rater reliability, while the inter-rater reliability of the GRS was not statistically significant. Moreover, our results add to the overall construct validity of the tool. This project has laid the foundation for future study and use of the instrument for the purpose of assessing UGRA competence. The expected long-term impact is to increase and improve UGRA assessment practices, ultimately advancing in patient safety.

A33

Measuring Differences in Adenosine Triphosphate from Human Erythrocytes after Exposure to Sevoflurane

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Introduction: Adenosine Triphosphate (ATP) is involved in several intracellular processes. Human erythrocytes (RBCs) are known to release ATP when exposed to hypoxic/hypercarbic conditions and has been shown to cause vasodilation. A known side effect of sevoflurane administration is hypotension. Several mechanisms have been proposed for sevoflurane-induced hypotension, but the exact mechanism remains unclear. Proposed mechanisms include direct vasodilation, myocardial depression, and blunting of the baroreceptor reflex. One mechanism of sevoflurane-induced hypotension may include the release of ATP from RBCs.

Methods: RBCs were obtained from 5 human donors. The cells were washed and diluted to allow for manual cell counting and spectrophotometry. Test-group RBCs were exposed to different volume-percentage doses of sevoflurane. Both control and test groups were then assayed using the ATP bioluminescent assay kit to determine the amount of ATP released in each group. A standard curve using a ATP stock solution was created daily in order to quantify luminometer readings. Calculated ATP amounts were then divided by the number of RBCs in each group. Using increasing doses of sevoflurane, a dose-response curve was created.

Results: There was no significant difference in the ATP released per RBC between the 73 control and experimental trials ($p > 0.05$). In order to strengthen the study, 5 RBC donors were used. No significant difference existed between the different donors and amount of ATP released ($p > 0.05$). Statistical comparisons between pretest and posttest RBC counts showed no statistical difference ($p > 0.05$), thus ruling out RBC lysis as a source of increased extracellular ATP. The dose-response curve showed significance ($P < 0.05$); as sevoflurane doses were increased, the amount of ATP released also increased.

Conclusions: The dose of sevoflurane estimated to be equal to the minimum alveolar concentration used for general anesthesia appears to not be associated with an increase in ATP release from RBCs. The possibility of a sevoflurane-induced hypotension was not completely ruled out with the results of the dose-response curve showing an increase in the amount of ATP release with increasing the sevoflurane percentage exposed to the RBCs.

A34

Ondansetron Prior to Spinal Anesthesia in Total Knee Arthroplasty and the Incidence of Hypotension

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Introduction: Spinal anesthesia is the most common anesthetic used with total knee arthroplasty (TKA); side effects include hypotension and bradycardia, induced by the sympathectomy and the Bezold-Jarisch reflex (BJR). Peripheral serotonin five-hydroxytryptamine (5-HT₃) receptors may play a role in mediating the BJR. Studies in obstetrics have shown a reduction in hypotension with spinal anesthesia after premedication with ondansetron. The aim of this study was to evaluate the prophylactic administration of ondansetron, a 5-HT₃ receptor antagonist, on attenuating hypotension with spinal anesthesia in TKA.

Methods: A prospective, double-blind, randomized study with 70 patients were scheduled for a total knee arthroplasty under spinal anesthesia. Patients were randomly divided into 2 groups receiving either the placebo (normal saline) or 4 mg ondansetron. The control (n=32) received 2 mL normal saline 5 minutes prior to spinal anesthesia; the experimental group (n=38) received 4 mg ondansetron 5 minutes prior to spinal anesthesia. Percent drop in MAP at several time points after spinal anesthesia and total amount of phenylephrine administered were measured and analyzed between the 2 groups.

Results: Demographic data was not statistically different between the 2 groups. There was no statistical difference in the incidence of hypotension in patients receiving spinal anesthesia for total knee arthroplasty between the placebo and ondansetron groups at several time points assessed (immediately postspinal anesthesia, 5, 15, 30, 45, and 60 minutes postspinal anesthesia). Likewise there was no statistical difference regarding the use of phenylephrine between groups (p=0.27).

Conclusions: Prophylactic administration of 4 mg ondansetron 5 minutes prior to spinal anesthesia does not attenuate spinal induced hypotension or the amount of phenylephrine used in patients undergoing total knee arthroplasty.

Source of Funding: Webster University.

A35

Optimizing Postoperative Pain Management by Comparing a Single Dose of Intrathecal Morphine With Intravenous Patient Controlled Analgesia in Hysterectomy Patients: A Randomized Control Trial

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Introduction: Postoperative pain following total abdominal hysterectomy (TAH) is often managed with patient controlled analgesia (PCA) for the first 24 hours after surgery. An alternative to PCA use for postoperative pain in this patient population that may reduce postoperative pain scores, reduce opioid requirements, and requires less nursing time is the use of preoperative intrathecal morphine (ITM). The use of ITM has been shown to be effective in controlling postoperative pain. The advantage of using ITM is that it has prolonged analgesic affects with a single preoperative injection without the need for multiple intravenous or intramuscular injections during the postoperative period.

Methods: Twenty-two patients scheduled for an elective TAH were randomly assigned to 2 groups. The first group (PCA group, n=11) received general anesthesia followed by PCA for postoperative pain, and the second group (ITM group, n=11) received a single shot of 200 micrograms of intrathecal morphine prior to surgery followed by general anesthesia. Total opioid consumption, patient satisfaction, and pain scores using the verbal numeric rating scale (VNRS) were measured upon arrival to the recovery room, arrival in the gynecology ward, and at 4, 8, 12, 16, 20, and 24 hours after surgery.

Results: There were no differences in demographics or satisfaction scores in both groups. Pain scores were significantly reduced in the ITM group at 4, 8, 12, 16, and 20 hours after surgery ($p < 0.05$). Total morphine consumption was also significantly reduced from 60.30 mg in the PCA group compared with 8.98 mg in the ITM group ($p < .05$).

Conclusions: Intrathecal morphine does reduce postoperative pain scores and total morphine consumption without additional side effects when compared with the use of patient controlled analgesia.

Patient Satisfaction in Anesthesia

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Introduction: Goal-oriented patient care and patient satisfaction are becoming increasingly vital parts of modern healthcare. Outcome measurements of quality, once focused on morbidity and mortality, are now shifting to patient experience. Patient satisfaction is achieved when expectations meet experience.

Outcome measurement of the anesthesia experience from the patient perspective is limited due to the nature and environment of care. However, direct feedback may be obtained during the preoperative and postoperative periods. In this study, a patient satisfaction survey was distributed with the goal of identifying areas for future quality improvement initiatives aimed at patient satisfaction.

Methods: This quantitative, descriptive study was achieved using an online survey distributed in the preoperative area via Qualtrics Internet link to patients having surgeries requiring general anesthesia at a 678-bed tertiary care hospital over a 2-month period. Patient satisfaction with general anesthesia was measured using a 10-question Likert scale survey previously validated for content. Inclusion criteria were patients receiving general anesthesia between the ages of 25 and 70 years, who had access to a computer with Internet. Pregnant women, patients with chronic pain, and persons with psychiatric illness or mental disability were excluded.

Results: Data were obtained from 30 respondents. The overall mean satisfaction score was 4.43 out of 5 points (SD 0.5). Patients were most satisfied that their provider showed concern during their care (mean 4.46, SD 0.58). Additionally, patients were very satisfied with the communication skills of their provider (mean 4.43, SD 0.5), and felt that their questions were answered (mean 4.43, SD 0.5). The item trending toward less satisfaction (mean 4.21, SD 0.5) was the feeling of well-being during anesthesia care.

Conclusions: The aim of this study was to identify modifiable areas of satisfaction and dissatisfaction in patients who undergo general anesthesia. Overall, patients were satisfied with their anesthesia care. Additionally, patients valued communication skills of their provider as a marker of satisfaction. The area in which patients were least satisfied involved their overall sense of well-being during anesthesia. This survey tool may be used in the future to isolate variables regarding patient satisfaction with anesthesia care. There exists a potential for further research involving the implementation of interventions based on satisfaction scores.

A37

Perceptions of Acupuncture and Acupressure by Anesthesia Providers

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Introduction: Randomized controlled trials show acupuncture and acupressure support anesthesia management by decreasing anxiety, opioid requirements and treating postoperative nausea and vomiting. Acupuncture and acupressure have demonstrated clinical usefulness and received governmental support (US military, NIH, WHO, PPACA), but have not yet diffused into mainstream anesthesia practice. To date, this is the first study to assess US anesthesia providers' perceptions of these alternative medicine modalities.

Methods: After receiving Institutional Review Board approval, 96 anesthesiology departments stratified by geographic region (Northeast, South, West, and Midwest) and institution type (university medical centers, community hospitals, children's hospitals, and VA hospitals) were selected for participation in an anonymous, pretested, online survey. The target sample was 1,728 providers of which N = 292 (54% anesthesiologists, 44% CRNAs, 2% AAs) responded, yielding an overall 17% response rate.

Results: Spearman correlation coefficient revealed a statistically significant correlation between acupuncture and geographic region, with the West having the highest predisposition toward acupuncture use ($r_s = 0.159$, $p = 0.007$). Females are more likely to use acupuncture than men ($r_s = -.188$, $p = 0.002$). Some providers have used acupuncture (27%) and acupressure (18%) with positive outcomes; however, the majority have not used these modalities but would consider using them (54%, $SD = 1.44$ acupuncture; 60%, $SD = 1.32$ acupressure). Seventy-six percent of respondents would like acupuncture education and 74% would like acupressure education ($SD = 0.43$, $SD = 0.44$, respectively).

Conclusions: While most US anesthesia providers have not used these modalities, they still report a favorable perception of acupuncture/acupressure's role as part of an anesthetic, and the majority of providers express an interest in receiving education. This study adds to the body of acupuncture and acupressure research by providing insight into anesthesia providers' perceptions of these alternative medicine modalities.

Source of Funding: This study was supported by a 2013 AANA Foundation Doctoral Fellowship.

Predicting Blood Volume by Change of Hematocrit: A Secondary Data Analysis

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Introduction: The goal of perioperative intravenous fluid management is to optimize perfusion. Standard monitors unreliably predict blood volume and inadequately guide therapy. The Daxor BVA-100 is an FDA approved blood volume analyzer. The BVA-100 is impractical for routine perioperative use. We believe a mathematical model can reliably predict blood volume based on a known change in HcT following fluid change (FC). Four data points are required to utilize this model. They are: a baseline Hct (HcTb), a postinfusion HcT (HcT2), an FC, and patient ideal blood volume (BVi). This study evaluated the model using secondary data for cardiac surgery patients who had BVA-100 blood volume measures.

Methods: Pearson correlation coefficient was used to determine the relationship between predicted (BVp) and actual (BVa) blood volumes at 2 time points. Proportional error between BVp and BVa at T1 and T2 was further explored using methods described by Bland and Altman. The degree of error was assessed in terms of bias and variability. To estimate clinical utility, sensitivities and specificities of BVP for hypovolemia and hypervolemia were estimated at T1 and T2.

Results: Thirty-five subjects were 24 males and 11 females and ranged in age from 42 to 86 (mean 61.6 ± 11.9) years. Correlation between BVp and BVa was $r = 0.91$ ($N = 35$; $p < 0.01$) at T1 and $r = 0.26$ ($N = 35$; $p = 0.13$) at T2. The nonsignificant correlation at T2 was attributable to the influence of 2 subjects with significant abnormal measures; omitting those 2 subjects resulted in a BVa-BVp correlation of $r = 0.989$ ($N = 33$; $p < 0.01$) at T2. Sensitivity and specificity of BVp for hypovolemia at T1 are 1.0 and 0.968 and 0.867 and 0.95 at T2. The sensitivity and specificity of BVp for hypervolemia at T1 are 0.947 and 0.813 and 1.0 and 0.963 at T2.

Conclusions: Despite some outliers these results demonstrate a strong correlation between blood volume as predicted by the mathematical model and blood volume as measured by the Daxor BVA-100. This method presented may prove to be a valuable technique to assist with the clinical administration of intravenous fluid. Future research is needed to fully understand the strengths and limitation of this mathematical model.

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Prevalence of Obstructive Sleep Apnea and Its Association with Maternal and Infant Morbidity in US Military Treatment Facilities, 2008-2014

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Introduction: Obstructive sleep apnea (OSA) is associated with severe maternal morbidity and mortality. The prevalence rate of diagnosed OSA in parturients in nonfederal US hospitals has increased from 0.3 per 10,000 in 1998 to 7.3 per 10,000 in 2009. Unfortunately, little is known about the prevalence of diagnosed OSA and its association with maternal and infant morbidity and mortality in parturients delivering at US military hospitals. Therefore, the purpose of this study was to determine the prevalence and trend of diagnosed OSA and its association with perinatal complications in women delivering at US military hospitals.

Methods: This was a retrospective cross-sectional analysis of all deliveries at Department of Defense military hospitals from 2008 to 2014. We utilized ICD-9CM codes to identify parturients with a preexisting diagnosis of OSA (327.23, 780.53, 780.57), and examined its relationship with maternal pregnancy-related outcomes (cesarean delivery, gestational diabetes and hypertension, preeclampsia/eclampsia, hospital stay >5 days, and in-hospital mortality), maternal clinical conditions, and fetal outcomes (early-onset labor and poor fetal growth). Descriptive statistics were used to analyze results.

Results: There were 266 cases of OSA out of 304,735 deliveries (OSA rate = 8.7 per 10,000). From 2008 to 2012, the rate was 7.4 per 10,000, then increased to 14 per 10,000 in 2014. Parturients with OSA were older (30.68 ± 6.38 vs 26.72 ± 5.22 , $P < 0.0001$), had higher rates of chronic hypertension (11.28% vs 1.65%), and obesity (40.23% vs 7.87%). OSA diagnosis was associated with higher rates of cesarean delivery (50% vs 25.96%), gestational hypertension (10.53% vs 6.87%) and gestational diabetes (22.93% vs 9.39%), preeclampsia (14.66% vs 5.45%), preterm delivery (12.78% vs 6.01%), poor fetal growth (3.76% vs 2.39%), and hospital length of stay >5 days (6.77% vs 1.1%). No differences were found in the rate of in-hospital mortality (0 vs 0.002%).

Conclusions: Our results demonstrate an increasing rate of diagnosed OSA at the time of delivery starting around 2012 in US military hospitals. This increase may be related to an increasing awareness and screening for OSA in women of child bearing age at US military hospitals. Our results confirm that OSA is associated with perinatal complications. These results may help inform the management of parturients with OSA. Future research should seek to develop screening tools to identify parturients with undiagnosed OSA and examine interventions to reduce perinatal complications.

A40

Promoting Hemodynamic Stability During Endoscopy and Colonoscopy Procedures: A Combination of Propofol and Etomidate for Sedation

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Introduction: Patients with ASA III and IV risk assessment are vulnerable to side effects of propofol sedation. Propofol can cause hypotension averaging 30% of baseline. Hypotension, negative inotropy, and cardiac depression contribute to 50% morbidity and mortality. Etomidate has cardiopulmonary stabilizing properties, although extrapyramidal side effects are observed. The purpose of this study was to examine blood pressure, MAP, heart rate, and oxygen saturation of patients age 55 and older when a combination of propofol and etomidate is used as compared with using propofol vs etomidate alone.

Methods: A prospective quasiexperimental study design examined the effects of propofol alone and the combination of etomidate and propofol. Participants were 55 and older, ASA III and IV risk, having a GI procedure. Age, ASA, weight, medications, preinduction, postinduction, and postprocedure blood pressure, MAP, heart rate, and oxygen saturation were measured. Using SPSS version 18, a t-test compared differences in means of the 2 groups' blood pressure, MAP, heart rate, and oxygen saturation during preinduction, post-induction, and postoperative times. A 3-way ANCOVA compared interventions.

Results: A total of 142 patients were recruited. Group 1 had propofol alone (N=76) and group 2 had propofol and etomidate (N=66). Repeated measure ANCOVA compared baseline, postinduction and postoperative systolic, diastolic, mean arterial pressures, heart rate, and oxygen saturation between 2 groups. Systolic BP (baseline: 142.01 ± 24.91 vs 145.30 ± 26.38 ; postinduction: 119.75 ± 20.70 vs 138.92 ± 20.67 ; postoperative: 124.25 ± 17.04 vs 137.71 ± 22.32 ; $F = 7.62$, $p < 0.01$), diastolic BP, and MAP were significantly different between 2 groups among 3 time points; $F = 6.27$, $p < 0.01$; $F = 11.74$, $p < 0.001$. Oxygen saturation values were significantly different between 2 groups among 3 time points: $F = 3.99$, $p < 0.05$. Heart rate was not statistically different.

Conclusions: Propofol/etomidate sedation is a safer anesthetic in the older ASA III and IV population. Study findings support greater hemodynamic stability with fewer side effects. The combination balanced the effects of each medication and maintained physiological parameters close to the patients preexisting condition. The extrapyramidal side effects of etomidate were ablated with the propofol. The narrow therapeutic window and lack of reversal agent associated with propofol supports the use of etomidate and propofol combined to provide safe, quality sedation in the elderly (>55), high risk population.

A41

Respiratory Outcomes Following Administration of Intravenous Neuromuscular Blockade for Patients Undergoing Kidney Transplantation

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Introduction: General anesthesia for renal transplantation includes nondepolarizing muscle relaxants (NDMRs); all have different pharmacokinetic profiles. Routes of administration include intravenous bolus doses or controlled infusions, both requiring reversal with anticholinesterases. Other measures of clinical assessment are needed to gauge neuromuscular blockade. The purpose of this study was 3-fold: to determine if relationships exist between the type and route of NDMRs and respiratory outcomes of care and to determine if other components of the anesthetic influence respiratory outcomes.

Methods: After HIC approval, a retrospective chart review was planned for 100 patients who had kidney transplantation surgery between January 2011 and December 31 2013. Specific data including demographic profiles; surgery and anesthesia length of time; type, amount, and route of administration of nondepolarizing muscle relaxants; type and amount of anticholinesterase agents administered; extubation details; and respiratory outcomes in the postanesthesia or intensive care unit from 100 medical records were captured and documented. Data analysis was performed to answer the research questions.

Results: A total of 98 medical records were analyzed. The most commonly administered NDMR used for induction was rocuronium (n = 46), followed by cisatracurium (n = 45). Six received succinylcholine for induction; all induction drugs were given IV push (IVP). For anesthesia maintenance, 37% of the sample (36/98) received NDMR via controlled infusion with either rocuronium, cisatracurium or vecuronium. Of those admitted to the PACU (n = 89), 24.7% (n=22) experienced predefined “respiratory events.” Eight received rocuronium for maintenance (4 via infusion), 11 received cisatracurium for maintenance (10 via infusion), and 1/22 received vecuronium for maintenance by infusion. No other components of care appeared to influence respiratory outcomes.

Conclusions: The administration of NDMRs warrants comprehensive understanding of their pharmacokinetic profile, as well how they are impacted by the physiologic status of those receiving them. Restoration of kidney function does not result in immediate normalization of all physiologic processes. The results of this study demonstrated those who received NDMRs via IV infusion as compared with IVP administration during anesthesia maintenance experienced more respiratory events such as delayed extubation, need for adjusting FiO₂ upward, and/or placement of airway adjuncts to support ventilation and reintubation.

Retrospective Analysis of Low-Volume Ultrasound-Guided Interscalene Blocks and Hemidiaphragm Paralysis

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Introduction: Interscalene nerve blocks traditionally have a high incidence of hemidiaphragm paralysis, which may reduce pulmonary function by 25% to 30%. Previous research has shown that 5-mL injections using a nerve stimulation technique have reduced its incidence to 43.3%. A fluoroscopic sniff test is a highly specific test for diagnosis hemidiaphragm paralysis. Many studies assess hemidiaphragm paralysis with ultrasound or pulmonary function changes. This study investigates the use of ultrasound with a 5-mL injection to determine the incidence of hemidiaphragm paralysis assessed with fluoroscopy.

Methods: A retrospective chart review was performed on 33 patients over 18 years of age at Phelps County Regional Medical Center where continuous catheter interscalene blocks were placed under ultrasound guidance for shoulder and upper arm surgery. Patients were included that had a fluoroscopic sniff test performed within 4 hours of initial injection of 5 mL of local anesthetic. Results of the fluoroscopic sniff test were used to diagnose or rule out ipsilateral hemidiaphragm paralysis. Hemidiaphragm paralysis was diagnosed if ipsilateral paradoxical or absent motion of the diaphragm was observed.

Results: Of the 33 records reviewed, 11 patients experienced hemidiaphragm paralysis (33%). There was no significant difference ($p=0.24$) when these results were compared with a previous study, where a 43.3% incidence of hemidiaphragm paralysis was observed with nerve stimulation. In our study group, there was a significant difference in the mean BMI ($p=0.01$) between patients that experienced hemidiaphragm paralysis (34.4 ± 1.62) and those without (28.8 ± 1.25). There was a significant difference in the incidence of hemidiaphragm paralysis ($p=0.03$) when a sniff test was performed within 2 hours (50%) versus within 2 to 4 hours (13.3%). There were no documented reports of Horner syndrome or recurrent laryngeal nerve paralysis.

Conclusions: Although this study did not show a significant difference between ultrasound and nerve stimulation placement techniques, the low-volume ultrasound-guided technique does result in a low incidence of complications while maintaining analgesia. A larger scale prospective study may look further at the effects of obesity and the length of time that hemidiaphragm paralysis occurs following placement and during infusion of a continuous interscalene catheter.

A43

Sleep Quality and Pain after Total Knee Arthroplasty: A Case Series

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Introduction: Adequate sleep is an important factor in recovery after surgery; however, no studies have examined the self-reported sleep quality and pain after total knee arthroplasty (TKA). Therefore, the purpose of this case series was to characterize the sleep quality, pain scores, and opioid consumption during the first 3 nights in patients after TKA.

Methods: All patients underwent a standardized analgesic regimen (epidural postoperative day 0 (POD), then a continuous femoral nerve block for POD 1-3; acetaminophen OTC, oxycontin SR OTC + oxycontin IR PRN). Each subject completed a sleep diary preoperatively and postoperatively for POD 0-2. Each night, subjects completed an unattended polysomnography. Visual analogue scales (VAS; 0-100 mm; lower score denotes better sleep quality) were used to examine sleep quality (deep vs light, solid vs broken up, long vs short, restful vs restless). Average pain scores (0-10 scale) for each postoperative day were recorded. Descriptive and inferential statistics were used to analyze the results.

Results: A total of N = 19 were included in this case series. Sleep duration decreased from 6 ± 1.8 hours preoperatively to 4 ± 2.2 hours on the first night after surgery, followed by an increase to 5 ± 1.9 hours on night 2 ($P < 0.05$). Sleep quality was worst on POD 0 (first night after surgery), with 71% of subjects rating their sleep quality as worse as or much worse than usual when compared with only 26% preoperatively. All 4 VAS scales demonstrated a peak worsening of mean sleep quality on POD 0, with scores ranging from 71 to 85 as compared with 49 to 69 preoperatively, followed by improved sleep quality by POD 2 (VAS results ranged from 49-59). Average pain scores were worst on POD 1 after removal of the epidural (3.5 ± 1.8) as compared with POD 0 (2.7 ± 1.9) and POD 2 (1.8 ± 1.2 ; $P = 0.0003$).

Conclusions: Results demonstrate sleep quality is the worst on the first night after surgery in patients undergoing TKA. Pain scores on average were less than 4, indicating patients experienced very good postoperative pain control with our multimodal analgesic regimen.

Source of Funding: TriService Nursing Research Program N13-P17.

Stuck on You: Best Practice of Adhesive Tape to Secure Eyelids During the Perioperative Period

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Introduction: Eyelid taping is found to be the most popular protective measure for securing the eyes during the perioperative period. There are a variety of adhesive tapes on the market to secure eyelids. The purpose of this study was to test the adhesiveness of 3 commonly found tapes in the operating room.

Methods: This bench study utilized a Laerdal® Airway Management Trainer™ mannequin to simulate an adult patient. A total of 675 measurements were conducted. Each different type of tape was tested 225 times using 3-inch tapes; cloth tape (3M™ Micropore™), clear tape (3M™ Transpore™), and silk tape (3M™ Durapore™). Three taping methods of each type of tape were performed 75 times, each of which involved horizontal (0°), diagonal (45°), and vertical (90°). A digital force meter (HF-500) measured the amount of force required to remove each piece of tape by a single researcher.

Results: A total of 675 experimental assessments were conducted utilizing 3 common surgical tapes. Among the 3 tape varieties tested, Durapore™ silk tape required the strongest forces to remove (19.68 + 15.26 N), followed by Transpore™ clear tape (10.10 + 13.21 N), and Micropore™ cloth tape (7.10 + 14.28 N). Similarly, a trend was noted with the taping method angles tested, diagonal (45°) required the most force to remove (34.94N, 23.31N, 21.38N), followed by vertical (90°) (27.35N, 18.50N, 14.10N) and horizontal (0°) (19.68N, 10.10N, 7.10N), respectively.

Conclusions: The study clearly exhibited 3 identified trends with each type of tape and methodology used. It was identified that Micropore™ cloth tape in the horizontal angle (0°) requires the least force to remove from the eyelids. Durapore™ silk tape in the diagonal angle (45°) appears to be the most adhesive tape in securing eyelids during the perioperative period.

Syringe Choice for Passive Release Technique of Endotracheal Tube

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Introduction: The purpose of this study is to identify which commonly used syringe provides the most appropriate inflation pressure when utilizing the passive release technique for endotracheal tube cuff inflation. The amount of air necessary to inflate the cuff varies according to the size of the tube and the size of the patient's trachea; however, the ideal pressure is between 20 and 30 cm H₂O. Overinflation of the cuff can cause ischemia and damage to the trachea. Underinflation places the patient at risk for aspiration.

Methods: Syringes tested were 5 mL and 10 mL (BD Medical) and 6 mL and 12 mL (Monoject). A 7.5-mm endotracheal tube (ETT) was inserted into a PVC trachea model or pig trachea. The cuff was inflated with air, 5 mL at a time, leaving the syringe attached, until achieving a backward movement of the syringe stopper. The syringe was left attached to the ETT cuff and allowed to passively release air from the ETT cuff, back into the syringe. Once the plunger on the syringe stopped moving, the syringe was removed, and a manometer was attached to the cuff to measure the pressure remaining in the ETT cuff.

Results: The 6-mL syringes yielded pressures <40 cm H₂O 3.7% of the time and in the goal range 2.6% of the time. The 5-mL syringes were <40 cm H₂O 36% of the trials and in the goal range 8.5% of trials. The 12-mL syringes yielded pressures <40 cm H₂O 84% of the time and in the goal range 30.5% of trials. The 10-mL syringes yielded pressures <40 cm H₂O 87% of trials and in the goal range 36.5% of the time. The study identified a success as defined as a pressure of 20 to 30 cm H₂O. Overall percentages with all syringes and all tracheas demonstrated a success rate of 19.7% of trials. The pressure was above range 68.4% of trials and below range 11.8% of trials.

Conclusions: This study offers evidence the passive release technique is unreliable and may be dangerous for patients. With common syringes available for inflation of ETT cuffs, the pressures were often >40 cm H₂O. This pressure is thought to cause capillary occlusion and poses risk for tracheal ischemia. The passive release method is expedient but lacks the consistency for patient use. The results showed variability not only between different syringe types but also with different individual tracheas. This indicates the technique may lack the dependability necessary to consistently maintain patient safety.

A46

The Effect of Adding Sodium Bicarbonate to Lidocaine for a Modified Bier Block

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Introduction: Injection of local anesthetic (LA) during intravenous regional anesthesia (IVRA) can result in significant pain. Anecdotal reports from anesthesia providers suggest that the addition of sodium bicarbonate to the LA decreases pain on injection, although to date, there are no research studies that have explored this theory. Therefore, the purpose of this prospective, randomized, double-blind study was to determine if the addition of sodium bicarbonate to a lidocaine IVRA decreases pain during injection.

Methods: This was an IRB approved study conducted at Naval Medical Center San Diego. Subjects were randomized to 1 of 2 groups scheduled for hand or wrist surgery requiring an IVRA. The control group received 20 mL of 0.5% lidocaine with 2 mL preservative free normal saline and 15 mg Ketorolac, and the experimental group received 20 mL of 0.5% lidocaine with 2 mL sodium bicarbonate (8.4%) and 15 mg ketorolac. Subjects were asked to rate their pain using a 0-10 verbal numeric rating scale immediately following the completion of the LA injection and time to complete anesthesia at the operative site was evaluated every minute using a loss of sharp sensation technique.

Results: Twenty-three subjects were enrolled; however, 1 subject was excluded following a change in the anesthetic care plan. More than 50% of the study subjects were Filipino undergoing elective carpal tunnel release surgery. Study groups were similar in age, height, weight, and total surgical time. There was no significant difference in VNRS pain scores during injection of the LA admixture between the experimental group ($M = 1.73$, $SD = 3.36$) and control group ($M = 4.13$, $SD = 3.68$; $t(21) = 1.57$, $p = .131$).

Conclusions: This may be the first study to explore the effectiveness of sodium bicarbonate in reducing pain upon injection of an LA for a forearm IVRA. Our results suggest the addition of sodium bicarbonate to LA for use in IVRA may decrease pain during injection; however, we cannot draw any definitive conclusions about the efficacy of this intervention because the study was underpowered. Future studies may need a sample size of at least 70 subjects.

A47

The Effects of Arterial Blood Pressure on Hemorrhage Control when QuikClot Combat Gauze is Used in a Porcine Model of Lethal Femoral Injury

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Introduction: Bleeding is the leading cause of death in trauma for military and civilians. Tactical Combat Casualty Care Committee (TCCC) was initiated in 1996 and has become the standard of care in the US military. The TCCC has mandated QuikClot Combat Gauze (QCG) as the first-line hemostatic agent to control hemorrhage that cannot be controlled by tourniquet. The purpose of this study was to determine the effect of arterial blood pressure on hemorrhage control when QuikClot Combat Gauze (QCG) is used.

Methods: The effectiveness of QCG was compared with a pressure dressing control group in controlling hemorrhage from a complex groin injury not treatable by tourniquet. After initial hemorrhage control was obtained, blood pressure was increased via a phenylephrine drip until rebleeding occurred or a target of 200 mm Hg systolic blood pressure was reached. If there were no rebleeding, then up to 5 liters of crystalloid was administered. If no rebleeding occurred, movement of the affected extremity was commenced with up to 10 each of adduction, abduction, extension, and flexion or until rebleeding occurred. A multivariate analysis of variance was used to determine if there were significant differences.

Results: There were significant differences found between the groups in all 5 target variables investigated ($p < 0.05$). The mean for the 5-minute bleed for QCG was 4 mL with an $SD \pm 12.65$ and for the control group was 386.1 mL with an $SD \pm 352.58$. The mean for the highest systolic BP to rebleed for the QCG was 206.6 mm Hg with an $SD \pm 7.34$ and for the control group a mean of 94.6 mm Hg and an $SD \pm 12.55$. The mean for highest mean arterial pressure to rebleed was 171.7 mm Hg for QCG with an $SD \pm 31.13$ and for the control group a mean of 75 mm Hg with an $SD \pm 14.25$. The mean for the amount of fluid administered before rebleed was 5,000 mL for the QCG with an SD of 0 and for the control group was 600 mL with an $SD \pm 966.1$. The mean for number of movements for the QCG was 36.3 with an $SD \pm 11.7$ and for the control group the mean was 1.0 with an $SD \pm 2.8$.

Conclusions: The results of this study show a significant difference between the 2 groups in every variable investigated. This includes the 5-minute bleed ($p= 0.003$), systolic blood pressure ($p= 0.001$), mean arterial pressure ($p= 0.001$), amount of fluid resuscitation ($p= 0.001$), and number of movements ($p= 0.001$) before rebleeding occurred. This research can have a major impact on the care of hemorrhage on the battlefield and in civilian trauma. The results also confirm the choice of the TCCC to use QCG as first-line treatment for hemorrhage after tourniquet.

Source of Funding: This study was funded by the TriService Nursing Research Program and was conducted at the University of Texas Health Science Center.

A48

The Effects of Sevoflurane on the Cytoskeleton of *Saccharomyces cerevisiae*

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Introduction: Several studies have been performed on the neurotoxic effects and contribution to postoperative cognitive decline of isoflurane, desflurane, and sevoflurane (Hudson and Hemmings, 2011; Li et al, 2013). The etiology of this neurotoxicity, however, continues to remain unclear, specifically due to the challenges of studying the effects of volatile agents in vitro and in vivo. Model organisms such as rats and cultured cells are being used to study the effects of volatile agents at the cellular level. One organism that has been used for study in the field of human disease is *Saccharomyces cerevisiae*, commonly known as budding yeast (Botstein and Fink, 2011).

Methods: A genetically modified *Saccharomyces cerevisiae* strain tagged to fluoresce actin-binding protein was grown and divided into 3 groups. The first group served as the control. The second group was the positive control and was exposed to 1.5 mM of H₂O₂. Lastly, the third group was exposed to 0.3% sevoflurane. White field and fluorescence images of all groups were obtained at time 0 and hours 1, 2, and 3. The number of cells present in the fluorescent image with crisp, punctate cellular markings were then compared with total number of cells present in the white field image of the same slide.

Results: The experiment demonstrated a significant loss ($p = <0.05$) of crisp and punctate cellular markings across the 13 sample populations in the groups exposed to sevoflurane. The mean difference between the control group and sevoflurane exposed group decreased by 22.87 after the first hour, 32.69 after the second hour, and 26.93 after the third hour. The positive control group exposed to H₂O₂ demonstrated a mean difference of 46.58 after the first hour, 46.98 after the second hour, and 44.53 after the third hour.

Conclusions: As evidenced by the literature a strong correlation between anesthetic exposure and POCD exists. The exact mechanism for this relationship remains unknown. In addition, the total cost to the healthcare system because of this phenomenon is unknown at this time but could become great as the population ages.

The Role of Central Inflammation in the Chronic Pain Paradigm

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Introduction: There is increasing evidence linking chronic pain to altered levels of central inflammation and increased levels of perceived pain, anxiety, depression, and sleep disturbance. However the inflammatory molecules responsible for physiologic and psychological components of chronic pain still warrant identification and exploration. Using central inflammation as a paramount factor in the creation and maintenance of chronic pain, this study aims to investigate and describe the physical and psychological aspects of chronic pain associated with central inflammation.

Methods: Using a cross-sectional descriptive design, cerebral spinal fluid (CSF) inflammatory patterns present in 8 chronic pain participants were compared with inflammatory patterns present in 30 control CSF samples using MANOVA, with ANOVA analysis for followup. Levels of depression, anxiety, sleep disturbance, and pain were measured in approximately 8 chronic pain patients and correlated to CSF levels of inflammatory cytokines using Pearson r correlations. Demographic information was also explored for relationships to central inflammation and descriptive statistics were examined for responses.

Results: To our knowledge, this is the first study to describe increased CSF levels of IL-8 in a population of majority failed back surgery syndrome chronic pain patients ($F(1, 36) = 14.89, p < 0.001, \text{partial } \eta^2 = 0.293$). gender ($F(1,6) = 7.782, p = 0.032, \eta^2 = 0.565$), socioeconomic status ($r = -0.823, p = 0.012$) and educational level ($r = 0.727, p = 0.041$) were also correlated with central levels of inflammation, indicating that central physiologic changes may be related to host sex and psychosocial factors. All participants reported poor sleep quality and took at least 1 opioid medication, indicating that sleep and opioids may scaffold a portion of the chronic pain paradigm.

Conclusions: This study richly describes the dynamic experience of chronic pain. Bringing physiologic and psychological aspects of the disease together, this study describes an association between chronic pain, central inflammation, gender, socioeconomic status, opioid medications, and poor sleep quality. Thus, the future of pain treatment must consider these aspects when treating patients and look to future studies for possible new treatment options that target these factors.

Source of Funding: Funding for this project was obtained from the AANA Foundation and the National Institutes of Health/National Center for Advancing Translational Sciences, University of California, Los Angeles Clinical and Translational Science Institute Grant Number UL1TR000124.

The Use of Dexmedetomidine in Pediatric Patients Requiring Extracorporeal Membrane Oxygenator Support: A Single Center's Experience

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Introduction: The safety and efficacy of dexmedetomidine (Dex) use for pediatric patients receiving Dex during extracorporeal membrane oxygenator (ECMO) support are unknown. To address this knowledge gap we evaluated Dex use for augmenting sedation and analgesia during ECMO support in the pediatric patient. We hypothesized that Dex use during ECMO support reduces narcotic and benzodiazepine requirements.

Methods: We conducted a retrospective chart review of all children ≤ 18 years of age from January 2003 to July 2014 who required ECMO support. Sedatives and narcotics administration were documented for the first 14 days of ECMO initiation. The patients were divided into 2 groups based on whether or not dexamethasone was a part of their sedative regimen (Dex group versus non-Dex group). This study was approved by the Institutional Review Board. Patients without prior research authorization were excluded from the study. JMP software (SAS Corporation) was used for all statistical analyses.

Results: The study included 127 patients who required ECMO: median age = 54 days, 55% (n=66) were male and 28 (22%) patients received Dex (median duration of 114 hours). Sedative and narcotic use was significantly different between the groups. Propofol and midazolam use was higher in the Dex vs non-Dex group (50% vs 3%; $p < 0.01$). Morphine use was lower in the Dex group (14% vs 44%; $p < 0.01$). There were no differences between groups in the total standardized amount of propofol, midazolam, morphine, and ketamine drug doses. Frequency of fentanyl utilization and cumulative dose was higher in the Dex group, but cumulative drug dose did not reach statistical significance. The Dex group trended toward a lower 30-day mortality rate (11% vs 27%; $p = 0.08$).

Conclusions: We found that Dex utilization in our pediatric ECMO population was more frequent in older children who required longer durations of ECMO support. Dex use was associated with less morphine use, higher rates of propofol, midazolam, and fentanyl administration and a lower unadjusted 30-day mortality rate. These findings suggest that Dex administration during pediatric ECMO support was a safe and efficacious method for achieving sedation in our population. Further investigation in a larger multicenter cohort of patients is needed to confirm these findings.

Source of Funding: This research was supported by the Department of Anesthesiology, College of Medicine, Mayo Clinic, Rochester, Minnesota.

A51

The Use of Regional Analgesia during Radical Cystectomy and Impact Oncologic Outcomes for Bladder Cancer

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Introduction: Radical cystectomy is the mainstay treatment for muscle-invasive bladder cancer, but cancer recurrence occurs frequently secondary to perioperative micrometastasis of peripheral tumor cells. These tumor cells can be neutralized by immune system NK cells, but these are impaired by perioperative physiologic stress and systemic opioids. Neuroaxial analgesic techniques (NA) could mitigate these effects, preserve the immune response, and improve cancer surgery outcomes. The aim of this study is to assess if NA improves oncologic outcomes following radical cystectomy.

Methods: Patients who underwent radical cystectomy under general anesthesia with NA from 1989 to 2013 were matched 1:1 with controls who underwent surgery without NA based on pathologic TNM stage, age, and surgical year. Medical records were reviewed for relevant comorbidities, perioperative and first 48-hour opioids, overall cancer specific survival, and time to tumor recurrence. Cox proportional hazard regression models assessed the impact of NA.

Results: A total of 201 subjects were matched with 201 controls. Preoperative and cancer-specific characteristics did not differ with the exception that fewer lymph nodes were removed in cases, median 7 [min 0, max 55] vs 10 [0, 43], $P = 0.017$. Cases received lower doses of systemic opioids compared with controls, perioperatively (25 [IQR 15, 33] vs 45 [39, 54] intravenous morphine equivalents mg, $P < 0.001$) and within the first 48 hours (39 [25, 60] vs 93 [63, 129], $P < 0.001$). There was no difference between groups with respect to overall and cancer specific survival and time-to-tumor recurrence [HR (95% CI) 1.16 (0.83, 1.62), $p=0.377$; 1.16 (0.77, 1.76), $p=0.483$; 1.29 (0.86, 1.94), $p=0.214$, respectively].

Conclusions: Oncologic outcomes were not associated with NA techniques. No beneficial effects of regional anesthetic techniques were found in relation to oncologic outcomes following bladder cystectomy. Bladder cancer is more aggressive than prostate cancer, which may negate the influence of NA anesthesia.

A52

Train of Four: A Survey of Certified Registered Nurse Anesthetists' Use of Train of Four with Neuromuscular Blockade

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Introduction: Train of four is a mode on peripheral nerve stimulators that assess the degree of neuromuscular blockade in patients after receiving neuromuscular blocking agents during surgery. Train of four monitoring helps guide practitioners in creating appropriate pharmacologic reversal regimen. AANA Standard V(e) states “when neuromuscular blocking agents are administered, monitor neuromuscular response to assess depth of blockade and degree of recovery.” The inspiration for this study was the clinical observation that there is much variation on how train of four (TOF) monitors are used among CRNAs.

Methods: Train of four monitoring use among CRNAs was evaluated using a modified survey. Appropriate review and approval of the University of North Florida's IRB was attained. Data was collected at the winter Florida Association of Nurse Anesthetists meeting, held February 19-22, 2015. The survey included 9 questions and was distributed utilizing Qualtrics software. Fifty-six surveys were collected from CRNAs at the meeting.

Results: Results from the 56 participants included a majority (89%) check TOF before the end of surgery when a nondepolarizer was given, 88% recheck TOF after administering reversal agents, and 93% believe TOF monitoring should be routinely used in the OR and prior to PACU transfer. When a nondepolarizer was given, only 39% always administered an anticholinesterase. Reasons why an anticholinesterase was not always given were: total dose of nondepolarizer (66%), timing of last dose of nondepolarizer (89%), absence of TOF fade (60%), and no evidence of clinical weakness (89%). Many (64%) of participants knew the correct TOF ratio required for extubation, and 68% believe postoperative recurarization is a significant public health risk.

Conclusions: This study confirms that the majority of survey participants adhere to the standard of care regarding neuromuscular blockade. There is room for improvement in the education of the correct TOF ratio, although this might not be crucial considering that many nerve stimulators utilized in the OR are qualitative not quantitative. Future research should focus on the comparison of qualitative vs quantitative nerve stimulators to see if there is impact on patient care by switching to the quantitative nerve stimulator.

Ultrasound-Guided Radial Arterial Catheter Placement as a Means to Decrease Cost

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Introduction: Radial arterial line catheters are used in the perioperative setting; supplies for their placement can be costly. Anesthesia students are often placing the catheters and multiple kits are utilized in attempts to place the arterial line. The more kits used, the higher the cost. There is evidence of the success and cost-effectiveness ultrasound has on central venous catheter insertions. This study evaluated if cost-effectiveness could be shown with the use of ultrasound for radial arterial catheterization. Cost was evaluated by the number of kits used for radial arterial catheterization.

Methods: Prior to starting data collection, education was provided in the form of videos to all student nurse anesthetists. Informed consent was obtained. All consented patients were assigned a nurse anesthesia student. The nurse anesthesia student randomly selected a notecard that had palpation or ultrasound on the card to instruct them of which method was to be used. The researcher recorded demographic data including BMI, age, ASA score, and gender. As the student attempted to cannulate the artery, the data collector evaluated the procedure for number of attempts, sites, success, and kits opened.

Results: The study had an n=50. Random selection placed a total of 19 patients in the ultrasound group and 31 patients in the palpation group. There were no statistical demographic differences in the study groups. There was no statistical difference found between the number of kits used in each group. Ancillary findings included analysis of number of sites, number of attempts, and success rate. There was not a difference in groups in number of sites, but there was a statistical difference between each group in relation to attempts. Success rates between groups were found to be statistically different.

Conclusions: The aim of this study was to identify if the use of ultrasound significantly decreased the number of Arrow kits opened for radial arterial line placement, therefore, reducing cost. Based on results from our statistical analysis, it is concluded that the use of ultrasound guidance technique for radial arterial line placement by nurse anesthesia students does not decrease the number of Arrow kits opened. Therefore, our alternate hypothesis is rejected and the null hypothesis is accepted. Attempts and success rates were significant and implications need to be determined.

Using Big Data to Transform Anesthesia Outcomes

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Introduction: The introduction of the Affordable Care Act (ACA) has placed an increasing burden on providers and organizations to show improved outcomes. The Anesthesia Quality Institute (AQI) recently became a Qualified Clinical Data Registry (QCDR) specifically tailored for anesthesia. This year's reporting measure expansion leans heavily on extraction of data from electronic anesthesia records as they become more prominent. It is vital for CRNAs to have involvement in the reporting of their information. We describe a successful methodology and implementation of a project to facilitate an anesthesia department's participation in MPOG and submission of quality and outcomes data to AQI.

Methods: The IRB approval was obtained from all involved institutions. There were 4 main steps involved in migrating the AIMS data from University of Florida Health into an outcomes research registry through the University of Michigan's MPOG: extraction of all data, validation of data labels and values, PHI de-identification, and submission to the master MPOG database. Data was categorized into universal MPOG clinical concepts. These concepts were then reviewed and validated thoroughly before submitting the dataset to Michigan. A specialized connection transmits quality and outcomes data measurements to AQI where the department level outcomes performances are measured.

Results: Prior to the initiation of this project, there was no mechanism to facilitate the measurement and evaluation of anesthesia specific quality and outcomes measurements. In addition, there was no feasible mechanism in place to contribute required CMS data to a QCDR. The participation in MPOG/AQI allowed the first look into retrospective and continuing quality and outcomes data at a large academic medical center. Response by department leadership and hospital administration was overwhelming.

Conclusions: In the new era of value based costing payment models, quality and outcomes data submission to QCDRs necessitates the use of technology. Technological methods will allow aggregation of large datasets to be organized in a manner that facilitates submission and enables direct feedback. This methodology is used in many other industries and has found its way to anesthesia. Participation in outcomes registries provides the unique opportunity to perform innovative big data research techniques and develop clinical decision support algorithms. If we are to remain at the forefront of quality anesthesia care, we must forge and develop skill sets and expertise in the arena of quality and outcomes.

Visualizing Intraoperative Vital Sign Data to Identify Hidden Patterns in Hemodynamic Data Management

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Introduction: Clinical decision-making during anesthesia and quality patient care are guided by the concept of hemodynamic stability. Hemodynamic stability is defined as heart rate (HR) and systolic blood pressure (SBP) measurements within 20% of baseline. However, calculations for the parameters of hemodynamic stability are not provided to Certified Registered Nurse Anesthetists (CRNAs) during patient care. Methods are needed to understand how CRNAs manage intraoperative hemodynamic status and patterns in hemodynamic data. The purpose of this study was to describe hemodynamic data patterns during intraoperative anesthesia care.

Methods: HR and SBP measurements were collected from a convenience sample of 50 adult patients having elective surgery between May and December 2014. The data were transformed into a percentage of the first respective intraoperative measurement (baseline). The concurrent HR or SBP that was the furthest from baseline was plotted as the range. The range data were averaged over 3 consecutive time points to generate a smoothed line. Over 153 iterations of horizon time charts were visualized to enable detection of hidden patterns in the data. Salient (obvious) patterns were determined by consensus of the 3 authors that data were in close proximity.

Results: The demographic data is as follows: 64% female (n= 35), mean age 50.2 years (SD 15.9), 70% ASA class 2 (n=35), 30% had general surgery (n=15), and 82% had general anesthesia (n=41). There were 2 salient hemodynamic data patterns. First, the range of vital sign data was in close proximity to 80% of baseline. The second pattern was that vital sign data management changed during induction, maintenance, and emergence from anesthesia. Both range and smoothed data demonstrated that lower acuity patients were managed differently than higher acuity patients. Data visualization is a big data research method that required many iterations. Microsoft Excel® was superior to Tableau® for data visualization when there were greater than 30 time points because the data appeared on a single chart.

Conclusions: Patterns in the hemodynamic data reflect real-time CRNA thought processes and patient management. Anesthesia providers such as CRNAs may benefit from informatics solutions that would calculate and display hemodynamic data patterns to guide intraoperative patient care. Visualization of intraoperative hemodynamic data enabled detection of 2 novel salient patterns related to CRNA management of hemodynamic stability during elective surgery. Further research is needed to determine if these 2 patterns are generalizable to other CRNAs and intraoperative hemodynamic data sets.

Source of Funding: Funding support from the Helen Wells Fund, School of Nursing Foundation, University of Minnesota.

Weight Change and CRNA School

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Introduction: From our own experience and the testimonies of other students and Certified Registered Nurse Anesthetists (CRNAs), it is difficult to maintain a healthy lifestyle, diet and exercise included, while in CRNA school. It is estimated that 200 million US adults are overweight or obese. The risk for cardiovascular disease, certain cancers, diabetes, and overall mortality is linearly related to weight gain. These statistics affect anesthesia providers, both credentialed and students, too. This survey for current CRNAs is aimed to obtain hard data about this topic.

Methods: We created an anonymous survey in Qualtrics asking questions about weight change in CRNA school and coping mechanisms utilized during this period. We obtained exempt status from IRB. Our survey was sent out in the April 2015 Florida Association of Nurse Anesthetists (FANA) bulletin specifically to current CRNAs only. Over 350 CRNAs participated in the survey. The data was analyzed via Qualtrics using descriptive statistics.

Results: We received 352 responses from nurse anesthetists who voluntarily completed our survey. Most of the respondents were CRNAs who had been out of school 2 years or less. Greater than half of the survey participants reported that they exercised more than once per week prior to entering into the nurse anesthetist program, but only 30% were able to maintain working out more than once per week during the program. Sixty percent of the CRNAs who responded gained weight during their nurse anesthetist program. The results also show that not only was the nurse anesthetist program the most stressful thing they've ever endured (77%), but 47% also agreed that it had a negative effect on their health.

Conclusions: As a community of nurses, both educating and being taught in the CRNA program, we should be more cognizant of the damaging side effects of disregarding healthy habits. Studies have documented increases in BMI and body fat in student populations indicating that health is not a priority during formal education. The survey we implemented returned similar results from individuals who have gone through CRNA school. We recommend that program directors encourage and assist students in maintaining a healthy lifestyle while obtaining their education in a rigorous academic program.

Workforce Imitative for Current Predictors of CRNA Employment in the State of Florida

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Introduction: Challenges across the country and especially in Florida have made predicting supply and demand of anesthesia providers difficult. Anesthesia does not follow true competitive markets, leading to periods of surpluses and shortages. (Rand). With 3 types of anesthesia providers in Florida, detailed workforce studies are needed to predict current and future trends to provide optimal anesthesia service to Florida's growing population. The purpose of the study was to identify the current supply and demand of the nurse anesthetist profession in the state of Florida.

Methods: Following institutional review board approval, 87 hospitals and ambulatory surgical centers in the state of Florida were enrolled in this descriptive cross-sectional research study. The numbered surveys focused on the current status of their anesthesia workforce, and projected needs in 1, 2, and 5 years in each of the facilities. The surveys were addressed to "The Director of Nursing (DON)" at each facility. The DONs were instructed to distribute the survey and return the stamped envelope to the chief nurse anesthetist or chief anesthesiologist. The return of the survey implied consent.

Results: Among the 87 responding facilities, 17% return, 74% of CRNA positions are full-time, 12% of positions are part-time, and 14% of positions are per diem. In aggregate, respondents project 73 new full-time openings through 2018, representing full-time positions growth of 18.4%. An 18.4% growth rate implies there will be approximately 633 new full-time positions for CRNAs opening through 2018. Projected increase of 633 full-time positions and 747 new graduates entering the Florida labor pool indicate a surplus of 114 CRNAs. Our estimates conclude 85% of the new graduates will find full-time positions. Regional, practice setting, and facility size differences were also detected.

Conclusions: Full-time positions are expected to grow 18%. The expected number of full-time positions will provide 85% of the Florida graduate anesthetists with employment. The number of full-time positions would have to grow 22% in order to absorb the projected number of new graduates in Florida's labor pool in order to meet this predicted surplus of nurse anesthetists.

Source of Funding: Funding provided by the Florida Association of Nurse Anesthetists.

An Evaluation of the Literature Examining Two Separate Techniques for Endoscopic Retrograde Cholangiopancreatography

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Introduction: Gastroenterologists in the United States annually perform about 500,000 endoscopic retrograde cholangiopancreatography (ERCP) procedures to diagnose and treat biliary and pancreatic disorders. ERCP is one of the most complex endoscopic procedures performed, and there are no current clinical guidelines for the safest, most efficacious anesthetic plan for these cases. This systematic review of the literature examined the relationship between anesthetic method (sedation/monitored anesthesia care [MAC]) vs general anesthesia (GA) and morbidity and mortality in patients >18 years undergoing ERCP.

Literature Review Analysis: Peer-reviewed literature was searched for articles published between 2002 and 2014, in English, that described the anesthetic technique used for ERCP and associated rates of morbidity and mortality. Of the 25 articles retrieved, 15 met criteria. Articles meeting criteria were appraised for quality and compared to determine morbidity and mortality associated with each type of anesthesia. Findings suggest that both MAC and GA are successfully used to manage ERCP cases. However, patients with an ASA grade of III or greater, BMI > 35 kg/m², chronic obstructive pulmonary disease (COPD), an interventional procedure, or in a low-volume practice are at greater risk of respiratory and cardiovascular complications when ERCP is performed under MAC.

Implement Evidence: When selecting an anesthesia technique for ERCP, factors such as ASA grade, BMI, the presence of COPD, the planned performance of an interventional procedure, and the volume of ERCPs performed in the practice must all be taken into account. A systematized process for screening and identifying ERCP patients at greater risk of respiratory and/or cardiovascular complications would improve planning and scheduling of potentially challenging procedures.

Conclusions: Undersedating patients for ERCP can lead to increased discomfort and movement that compromises the procedure while oversedation can lead to respiratory and cardiovascular complications that compromise patient safety. This literature review revealed specific factors related to the patient, procedure, and provider, singly or in combination, that should be elicited during preoperative preparation to guide the anesthetic plan. For patients with one or more of these factors, anesthesia providers may plan to perform GA instead of sedation to guard against adverse outcomes.

A59

An Evidence-Based Review Examining the Prolongation of a Subarachnoid Block With the Concomitant Use of Intravenous Dexmedetomidine

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Introduction: The overall failure rate for subarachnoid blocks (SABs) is about 0.6% with a quarter of all SAB failures attributed to prolonged surgical times. SAB failures resulting in a general anesthetic conversion negates the positive effects of regional anesthesia. Authors from a 2013 systematic review described the use of intravenous (IV) dexmedetomidine (DEX) as an extrathecal adjunct capable of extending the duration of an SAB and possibly reducing the need for intrathecal additives to lengthen SAB duration. We evaluated this systematic review and sought subsequently published evidence.

Literature Review Analysis: The search for evidence published subsequent to the 2013 systematic review (2012-2015) was conducted using PubMed, Cochrane Database of Systemic Reviews, and Google Scholar. Eight randomized controlled trials met the inclusion criteria. The findings from these studies were similar to the findings of the 2013 systematic review. The administration of IV DEX concurrently with an SAB prolonged the duration of sensory blockade, provided extended postoperative analgesic benefits, and produced minimal side effects. Contrary to published results in the systematic review; motor blockade recovery times are not prolonged by the addition of DEX to an SAB.

Implement Evidence: The findings from this evidence-based review have been presented at the Texas Wesleyan University Clinical Coordinator meeting for broad dissemination across 11 states in April 2015. These findings have also been presented to John Peter Smith (JPS) Hospital in Fort Worth, Texas, at a monthly clinical conference meeting for consideration of implementation into practice. Meetings are also scheduled at JPS Hospital with the pharmacy department and the surgical conference committee to facilitate successful implementation of this intervention into anesthetic practice.

Conclusions: A major disadvantage of the SAB is the inability to extend the duration of the anesthetic intraoperatively to address the needs of prolonged surgical procedures. Modalities are available to the anesthesia provider to address these concerns, including the use of intrathecal adjuncts, combined spinal-epidural techniques, and higher SAB local anesthetic doses. The evidence indicates that IV DEX is an alternative to these methods for extending the sensory and postoperative analgesic duration of an SAB.

A60

Anesthesia Safety: Filter Needle Use With Glass Ampules

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Introduction: Glass particle contamination (GPC) of medication occurs when opening ampules, which may cause patient harm (Jack et al, 2010). The use of filter needles (FN) reduces this risk (Kalinski et al, 2012). Many anesthesia providers use ampules daily but do not use FN when aspirating medications from ampules. In addition, FN may not be readily available at the anesthesia medication preparation site (Farmer et al, 2012). Many CRNAs do not follow existing standards regarding FN use with ampules. Not using FN or having them available for use can increase the risk of patient harm by GPC.

Literature Review Analysis: Glass particle contamination (GPC) of medication occurs when opening ampules which may cause patient harm (Jack et al, 2010). The use of filter needles (FN) reduces this risk (Kalinski et al, 2012). Many anesthesia providers use ampules daily, but do not use FN when aspirating medications from ampules. In addition, FN may not be readily available at the anesthesia medication preparation site (Farmer et al, 2012). Many CRNAs do not follow existing standards regarding FN use with ampules. Not using FN or having them available for use can increase the risk of patient harm by GPC.

Implement Evidence: The purpose of the study was to educate participants about the evidence regarding FN use with ampules to reduce GPC after an educational intervention. A pre/post intervention survey was given, FNs were stocked on carts, FN use was tracked 3 months before/after the intervention, and standards for FN use were presented. The goal of the study was to improve patient safety by reducing GPC by compliance to evidence-based practice standards when preparing medications from ampules by using an FN. Participants changed their practice: 32% (n=43) used FN pre/survey; 83% (n=34) used FN post/survey.

Conclusions: Anesthesia providers have an ethical responsibility to follow established guidelines when preparing medications from glass ampules. Safe injection practices will reduce the amount of GPC and, therefore, the risk of patient harm. Providing an education intervention to anesthesia providers can increase an awareness of the evidence supporting compliance to existing standards regarding FN use with ampules. This was made evident in this study by a 5-fold increase in FN use posteducation intervention (115 pre/575 post).

A61

Anesthetic Considerations of Thoracic Surgery: Double-Lung High Frequency Jet Ventilation Versus Traditional One-Lung Ventilation

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Introduction: A synthesized literature review was used to answer the following PICO question: In adult patients undergoing thoracic surgery, will the use of double-lung high frequency jet ventilation (HFJV), as opposed to the use of one-lung ventilation (OLV), result in improved intraoperative hemodynamics, PaO₂, and PaCO₂?

Literature Review Analysis: A review of literature was conducted and multiple databases were searched between the years 2013 and 2015 including Cochrane, MEDLINE/EBSCOhost, EMBASE, and PubMed. Keywords searched included one lung ventilation, high frequency jet ventilation, and thoracic surgery. A total of 7 articles determined to be topic specific were included in this literature review. The literature shows that HFJV via a single-lumen endotracheal tube has been shown to result in superior oxygenation and equivalent operative conditions for thoracic surgery patients. In addition to providing optimal intraoperative oxygenation, research has shown that HFJV also improves many postoperative conditions, such as sore throat, total chest tube blood loss, chest infections, and length of hospital stay.

Implement Evidence: It is clear from this narrative review that further research on the topic of HFJV versus OLV in thoracic surgery is warranted. One obvious downside to the HFJV method is that it requires a formal automated jet ventilator and a thorough understanding of its use. As the research supporting the method becomes more abundant, the competency and availability of the practice will surely increase as well.

Conclusions: In the case of HFJV versus OLV in adult thoracic surgery, it is evident that the research supports the use of either practice.

Applications of Complementary Alternative Medicine in Nurse Anesthesia

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Introduction: The purpose of this project is to raise awareness and explore the potential use of complementary and alternative medicine (CAM) in nurse anesthesia. Nearly 40% of the population in the United States use CAM therapies, and their reasons include a need for a “person centered” approach and a desire for greater control over one’s own health. CAM therapies such as acupuncture to treat nausea and vomiting, chronic pain, and anxiety, along with massage and music therapy, are therapies that could be part of our CRNA toolbox to broaden our practice and increase patient satisfaction.

Literature Review Analysis: Recent literature research using PubMed, CINAHL, and MedlinePlus using “clinical trials in complementary alternative medicine” yielded more than 1,500 articles. This project looked at 41 articles using acupuncture/acupressure, music therapy, and massage therapy to prevent and/or treat entities such as chronic pain, postoperative nausea and vomiting, and preoperative anxiety. Research to better understand how complementary health practices can produce beneficial effects are important and may ultimately advance the science and practice of pain management. Studies are indicating that in patients scheduled for surgery, 76% are interested in using some type of CAM in their anesthetic care.

Implement Evidence: The use of complementary alternative medicine spans almost the entire history of man and has a long history in American medicine. The incorporation of CAM into anesthesia practice has been slow and met with caution. Three challenging clinical problems pertinent to anesthesia are postoperative nausea and vomiting, postoperative pain and chronic pain, and preoperative anxiety. Recognition of the shortcomings of conventional pharmacotherapy along with extensive research in these areas align with increased patient acceptance and use of CAM in nurse anesthesia practice.

Conclusions: The Patient Protection and Affordable Care Act, passed by the US Senate in 2010, promotes a shift from the sick-care model to a preventative care model that encourages an active involvement in people’s decisions regarding healthcare and treatment. The Institute of Medicine recognizes that forces within society continuously shape healthcare and that CAM is now part of this evolutionary process. Nurse anesthetists have the capability to become trained CAM practitioners and offer provision of comprehensive care with contributions from all resources.

Best Practice for Venting Glass Containers: A Review of the Literature

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Introduction: Hospital-acquired infections (HAIs) negatively impact patient lives, safety, and costs of healthcare. The incidence of HAIs can be directly related to the healthcare practitioner's lack of using established evidence-based practice standards. Intravenous (IV) lines have been cited as the source of many HAIs. It is not uncommon for anesthesia providers to vent glass bottles with hollow needles in order to allow air to enter the bottle and infuse the contents. There are no filters on these needles allowing bacteria from the provider's hands or airborne ultrafine particles from surgical smoke to enter the container through the needle.

Literature Review Analysis: The standard search procedures were used to access published studies, systematic reviews, and meta-analyses. The electronic databases searched were ERIC, CINAHL, EBSCO, NCBI, MEDLINE, Google Scholar, and the Cochrane Library. The key terms used were: hospital/healthcare associated infections, intravenous/central-line associated bloodstream infections, intravenous administration sets, open IV infusion systems, and surgical smoke. The inclusive dates for studies or articles used were 2003 to 2013, unless they were seminal works, which the more recent studies referred to. The search was limited to English language articles only.

Implement Evidence: Bloodstream infections account for the second largest percent of HAIs (14%). Pathogens can be introduced at the time of insertion of intravenous lines or an extrinsic pathway, such as setting up the administration set or during use of the administration set and needleless ports. The practice of using a hollow needle with a rigid or semirigid container can allow pathogens to enter the bottle or the infusate to leak out through the needle. Transmission of pathogens from surgical smoke/plume anesthesia providers' hands can occur through the hollow needles. Eliminating this practice can reduce the risk of HAIs.

Conclusions: The evidence presented in the studies looked at open versus closed infusion containers and the consensus was that the risk of infection was much higher with an open infusion container than with a closed infusion container. The administration sets used in all but 2 of the studies were vented administration sets with filters. It is not hard to extrapolate that using a hollow needle without a barrier to the environment would be much worse.

Breastfeeding After General Anesthesia

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Introduction: Worldwide initiatives are underway to increase the number of infants exclusively breastfed at 6 months. There is conflicting information regarding the safety of breastfeeding after anesthesia. The Academy of Breastfeeding Medicine and the American Association of Nurse Anesthetists both support breastfeeding as soon as the mother is awake and aware in most situations. However, some textbooks still recommend to have the mother “pump and dump” her breast milk for 12 to 24 hours following an anesthetic. This review examines the available evidence on breastfeeding after anesthesia.

Literature Review Analysis: An online database search found 433 potential sources. One systematic review (SR), 2 clinical practice guidelines based on SR, 2 randomized controlled trials, and 1 observation study met inclusion criteria. Fentanyl concentration in breastmilk peaks in 45 minutes, is almost undetectable by 2 hours, and is less than 0.033% of maternal dose in 24 hours. Infant behavior scores are better using morphine rather than meperidine for postoperative analgesia. Propofol administration results in low breastmilk concentrations and no neonatal depression. Midazolam in breastmilk is less than 0.005% of the maternal intravenous dose in 24 hours. There is no evidence on neuromuscular blocking agents or current inhalation agents used in the United States.

Implement Evidence: The findings of this review will be used to develop recommendations for breastfeeding patients undergoing anesthesia in a community hospital in rural Oklahoma. Currently, there are varying opinions among the anesthesia providers regarding resumption of breastfeeding and whether the patient should “pump and dump” after general anesthesia. An anonymous survey will be distributed before and after dissemination of the evidence to determine the effect on provider attitudes toward breastfeeding after general anesthesia.

Conclusions: The evidence suggests that most routinely used anesthetics and adjuncts are excreted in breastmilk with limited effect on infants except for meperidine. Recommendations were based on data regarding the ability of a drug to pass into breastmilk, time course quantification of a drug in breastmilk, knowledge of pharmacokinetic properties of the drugs, and infant neurobehavioral assessments. A major barrier to a group consensus is the weakness of the evidence including small sample sizes, small number of studies examining a limited number of drugs, and lack of studies evaluating infant behavior.

A65

Building a Culture of Safety From the Ground Up: A QSEN-Based Patient Safety Science Course Initiative

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Introduction: Presently, medical error is the cause of death for 210,000 to 400,000 patients in hospitals each year. There will not likely be substantial improvement in healthcare safety without major reform of health professional education to reflect modern patient safety practices. The goal of this project was to develop and implement an evidence-based safety science curriculum guided by the 2012 Quality and Safety Education in Nursing Graduate Competencies. The project goal was to improve nurse anesthesia student patient safety knowledge, skills and attitudes, making patient safety an intuitive, ingrained part of the nurse anesthetist's practice from the outset of their professional training.

Literature Review Analysis: A literature search was conducted between December 2013 and May 2014 to determine patient safety movement history, salient patient safety topics, and patient safety in graduate nursing education. Little progress has been made in patient safety in the last 15 years, partly due to the deeply rooted culture of healthcare underpinned by hierarchical structure and autonomous individual performance. Health professional education is regarded as the bridge to creating systemic cultural change in healthcare through the integration of patient safety science into the curricula. The Institute of Medicine has advocated for the inclusion of evidence-based patient safety science in health professional education, but few institutions have done so.

Implement Evidence: The information yielded from the literature review was organized topically and conceptually cross-mapped with the 2012 QSEN competencies. The curriculum was delivered to 10 nurse anesthesia students, in the fall of 2014, before their first clinical rotation. Example topics were high reliability theory/organizations, patient safety history, culture, human error, systems theory, just culture, crew resource management in the operating room, quality improvement methods, and patient safety. Content was delivered traditional lecture, small group problem-based learning and simulation. The Patient Safety Attitudes, Knowledge and Skills (PS-ASK) survey was administered before and after the delivery of the curricular content.

Conclusions: This project was an evidence-based strategy to educate graduate nurse anesthesia students in patient safety science before entering clinical practice. The project impacted a small group of graduate nurse anesthesia students at the outset of their training. Overall PS-ASK mean scores increased on the posttest. Mean skills scores did not show a positive change, but the cohort scored higher on the posttest knowledge and attitudes subscales. Developing strategies for formative professional education is an important approach to ingraining patient safety science from the outset of professional training and is key to changing the culture of healthcare.

Current Evidence for Intraoperative Neuromonitoring for 1- and 2-Level Lumbar Fusions

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Introduction: One and 2-level lumbar spinal fusions (LSF) are a mainstay of treatment for a variety of lumbar conditions. The use of intraoperative neuromonitoring (IONM), to include electromyography (EMG), somatosensory evoked potential (SSEP) and motor evoked potential (MEP) monitoring, increases the complexity of these procedures on many fronts, including anesthetic management. Therefore, the purpose of this review is to synthesize the current evidence regarding IONM use during 1- and 2-level lumbar fusions.

Literature Review Analysis: A review of English language literature was performed for articles published from January 2005 to present. PubMed, Embase, and Cochrane Collaborative Library were searched using the key terms: neuromonitoring, neurophysiologic, neurophysiological, electrophysiological, electromyographic, and spine. Articles describing IONM in children, complex (eg, > 2-level) procedures, and procedures other than LSF were excluded. Of the 3 modalities of IONM, only EMG was demonstrated to be highly sensitive and specific for intraoperative neurological injury. The use of IONM significantly increased the cost and complexity of anesthetic management but was not associated with outcome improvement in patients undergoing 1- or 2-level LSF.

Implement Evidence: Implementation involves development of an audiovisual education training package for anesthesia staff at Eglin Hospital to increase awareness of the evidence surrounding 1- and 2-level lumbar fusions and intraoperative neuromonitoring during lumbar spinal surgery.

Conclusions: Depending on the modality used, IONM can be a useful adjunct to detect intraoperative neurologic injury during spinal procedures. Therefore, IONM is recommended for complex spinal procedures, particularly procedures involving the thoracic and cervical spine. At present, evidence is lacking that IONM improves outcomes in patients undergoing 1- and 2-level LSF. Given that utilizing IONM significantly increases the cost and complexity of anesthetic management, further research is needed to appraise the utility and efficacy of IONM for 1- and 2-level LSF.

A67

Dexmedetomidine and Emergence

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Introduction: Emergence from anesthesia and tracheal extubation can lead to unfavorable elevated hemodynamic responses such as hypertension and tachycardia. Dexmedetomidine is an alpha 2 agonist that has anxiolysis, sedation, analgesia and sympatholytic properties. Dexmedetomidine helps blunt hyperdynamic responses without compromising respiratory status. The purpose of this work is to describe the hemodynamic response of a single dose of dexmedetomidine on emergence.

Literature Review Analysis: The following PICO question was postulated: In surgical patients receiving general endotracheal anesthesia (P), does administering a dexmedetomidine bolus immediately prior to the emergence phase (I) compared to not receiving dexmedetomidine (C), attenuate hemodynamic responses during and after tracheal extubation (O). Five double-blind randomized control trials were examined. The results found that dexmedetomidine, when given prior to extubation, attenuates the hemodynamic response typically seen with emergence and extubation more than a placebo or fentanyl.

Implement Evidence: The clinical implication of using dexmedetomidine prior to emergence is efficacious in blunting the adrenergic response and catecholamine surge during the emergence phase. This decrease in hemodynamic variation can provide stability in heart rate and blood pressure during the transition phase of emergence.

Conclusions: Based on the evidence, the use of dexmedetomidine prior to emergence can be useful in patients who would benefit by having a reduction in myocardial demand, prevention in increased vascular wall stress, and a maintenance of normal intracranial pressures during this period.

A68

Effectiveness of Dexmedetomidine Use in General Anesthesia to Prevent Postoperative Shivering: A Systematic Review

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Introduction: Postanesthetic shivering (PAS) remains a significant source of distress following general anesthesia. Despite numerous studies investigating pharmacologic prophylaxis for postanesthetic shivering, no gold standard medication has been identified. Prophylactic dexmedetomidine administration has been examined as a possible preventative treatment modality for postanesthetic shivering; however, its effectiveness has not been established.

Literature Review Analysis: The search strategy aimed to find both published and unpublished studies. A 3-step search strategy was utilized in this review. An initial limited search of PubMed, Web of Science, and CINAHL was conducted, followed by analysis of the text contained in the title and abstract and of the index terms used to describe articles. A second search using all identified keywords and index terms was performed across all included databases. Thirdly, the reference list of all identified reports and articles were searched for additional studies. Only studies published in English or available in English translation were included in this review. Studies published between 1999 and 2015 were included in this review.

Implement Evidence: This systematic review and meta-analysis showed statistically higher incidence and severity of PAS in the control group. As evident in the literature, it is appropriate to recommend a prophylactic intravenous dose of dexmedetomidine for patients who are at high risk of PAS or whose physiologic reserve is unable to meet the metabolic demands of PAS.

Conclusions: The prophylactic administration of intravenous dexmedetomidine reduces the incidence of PAS in patients undergoing general anesthesia.

A69

Effectiveness of Ketamine Gargle in Reducing the Incidence of Postoperative Sore Throat in Patients Undergoing Airway Instrumentation: A Systematic Review

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Introduction: Postoperative sore throat (POST) is a common, minor adverse event occurring in individuals undergoing general anesthesia. Postoperative sore throat can diminish patient satisfaction, and increase the need for adjunct pain therapy. Many techniques are utilized to reduce postoperative sore throat; however, no one intervention has proven to be completely effective. The use of ketamine gargle is a novel intervention, and the effectiveness of administering it preoperatively is uncertain. Further evaluation of current evidence is needed to determine the effectiveness of ketamine gargle compared with placebo in reducing postoperative sore throat.

Literature Review Analysis: A comprehensive search of the literature was completed to find studies that compared the effectiveness of ketamine gargle with placebo gargle (saline or drinking water) or no intervention. Five randomized controlled trials were assessed for methodological quality by 2 reviewers. Populations for the included studies ranged from 40 to 90 ASA I-II participants receiving general anesthesia for various surgical procedures. All the studies utilized a 0-4 point scoring system to determine the presence and severity of sore throat. A meta-analysis was performed by calculating the DerSimonian and Laird relative risk for the 2 groups. Ketamine gargle caused a statistically significant ($p < 0.015$, RR < 0.53) reduction in the incidence of postoperative sore throat compared with placebo across all 5 time intervals studied (0, 2, 4, 8, and 24 hours).

Implement Evidence: POST is an adverse event that causes significant morbidity, and anesthesia providers should place priority on the prevention of POST as it is reported as a frequent cause of postoperative discomfort and dissatisfaction. Based on the results of this systematic review, it is recommended that anesthesia providers consider the use of ketamine gargle as part of the preoperative medication regimen to reduce the incidence of postoperative sore throat in patients undergoing airway instrumentation for placement of ETT. The collective reduction in POST by utilization of ketamine gargle can lead to a large elimination of POST and, therefore, improve patient satisfaction.

Conclusions: The available evidence suggests that the use of preoperative ketamine gargle (40-50 mg) in saline or drinking water significantly reduces the incidence of POST at 0, 2, 4, 8, and 24 hours in patients undergoing general anesthesia with airway instrumentation for placement of ETT compared with a placebo gargle of saline or drinking water. Additional research is needed to determine the systemic effects of ketamine gargle and whether other N-methyl-D-aspartate antagonists are effective in reducing postoperative sore throat. Future research should include previously excluded populations and expanded to include other methods of airway manipulation.

Gastrointestinal Endoscopy and Possible Complications

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Introduction: There are 50 to 60 million affected annually by gastrointestinal (GI) disease in the United States each year (Peery). Endoscopic anesthetic demands are increasing in both diagnostic and interventional treatment in and out of the endoscopy suite. Endoscopic procedures are further complicated with the demands of a rapid turnover and introduction of new endoscopic procedures. Therefore, providing an evidence-based summary of anesthetic risks, comorbidities, and procedure-related complications of endoscopic procedures is the focus of this investigation.

Literature Review Analysis: A search for relevant literature across disciplines was conducted to explore endoscopy procedures and comorbidities. Using FirstSearch, Liline Online, and ProQuest Direct search engines, the following computerized databases were used for this search: ABI Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Periodical Abstracts (PERAbs): gastric intestinal (GI) endoscopy procedures, anesthesia for GI procedures, incidence of GI procedures, and complications.

Implement Evidence: Approximately 50% of morbidity and mortality occurring in endoscopy is cardiopulmonary related (Amornyotin). Analysis of 17,542 endoscopic procedures over an 8-year period determined that 4.5% of adult patients experienced cardiopulmonary complications (Agostoni). Other complications include arterial hypotension (1.78%), desaturation (1.24%), bradycardia (1.16%), hypertension (0.39%), arrhythmia (0.21%), and aspiration (0.10%). Risk factors include age, obesity, obstructive sleep apnea, ASA III or higher, inpatient status, and involvement of a trainee in the procedure (Amornyotin).

Conclusions: As more and more advanced endoscopic procedures are being performed, it is imperative that data, information, and resources become readily available to ensure safety to the patient when delivering anesthesia. The practice of yesterday is no longer feasible as more patients are entering the healthcare system with multiple comorbidities, cardiac risks, and increased healthcare demands. As anesthesia providers, we need to be cognizant of the advancement of endoscopic procedures and the associated patient risks to provide a continuance of optimum safe anesthetic care.

A71

Intranasal Dexmedetomidine for Preoperative Anxiety and Postoperative Delirium

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Introduction: Dexmedetomidine is a highly potent alpha 2 adrenoreceptor agonist that has sedative and analgesic properties without respiratory depression and an ability to be administered via multiple routes without irritation to the patient. Sixty percent of pediatric patients encounter preoperative anxiety leading to uncooperative behavior during parental separation or mask application for anesthetic induction, postoperative pain, and postoperative delirium. Dexmedetomidine is a replacement for midazolam as premedication in pediatrics due to hemodynamic stability, analgesia, anxiolysis, and reduced delirium.

Literature Review Analysis: Thirteen articles were selected for inclusion in the literature review that supported dexmedetomidine as superior to midazolam in preoperative sedation, parental separation, mask acceptance, and incidence of postoperative delirium. Research supports there is no clinical significance in HR, SBP, or SpO₂ when 1 mcg/kg or 2 mcg/kg of intranasal dexmedetomidine is administered as premedication, compared with midazolam. Midazolam was not found to have protective qualities against postoperative delirium when given as a premedication to children who were anesthetized with sevoflurane or desflurane. Intranasal dexmedetomidine had superior satisfactory sedation at parental separation and time of mask induction compared with buccal administration.

Implement Evidence: Benefits of an alpha 2 adrenoreceptor agonist when compared with midazolam include the ability to produce anxiolysis, analgesia, sedation, attenuation of catecholamine release, and cardiovascular response secondary to surgical stimulation and endotracheal intubation. The collection of level I and level II evidence points to the safety and efficacy of dexmedetomidine. This literature review serves as the best empirical evidence to support practice utilizing dexmedetomidine as a premedication for pediatric patients undergoing general anesthesia for outpatient surgery.

Conclusions: Dexmedetomidine is superior to midazolam in preoperative sedation, sedation at parental separation, mask acceptance, and incidence of postoperative delirium. Dexmedetomidine produced reduction in analgesic requirements and showed little to no change in hemodynamic stability. Intranasal dexmedetomidine is invaluable due to ease of administration to a reluctant and hesitant child, inability to spit out, administration without discomfort or burning, and the rapid absorption when compared with oral administration. Two mcg/kg of intranasal dexmedetomidine is the optimal dose for premedication.

Ketamine: An Adjunct to Multimodal Analgesia

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Introduction: Perioperative pain lengthens stays, reduces patient satisfaction, and potentiates catastrophic outcomes. However, treating pain is at odds with the side effects of narcotics. Multimodal therapy is considered the gold standard to optimize patient safety and pain control. Guidelines stress regional techniques and nonsteroidal anti-inflammatory drugs (NSAIDS), but procedural and patient limitations restrict usage. Unfortunately, ketamine may be underutilized as a multimodal agent. The purpose of this project is to evaluate the efficacy of ketamine as an adjunct for treating perioperative pain.

Literature Review Analysis: Twenty-four studies were identified in PubMed, MEDLINE, and through sourcing reference sections. Exclusion criteria included obstetrical and pediatric anesthesia as well as articles published greater than 10 years ago. Inclusion criteria comprised randomized controlled trials (RCTs) or systemic reviews of RCTs involving adult surgical patients treated with perioperative ketamine in at least one arm of the study. Articles were evaluated on the basis of surgical procedure, anesthetic type, timing and dosage of ketamine, side effect profile, limitations, and overall quality of trials using the Johns Hopkins Evidence-Based Practice tool. In addition, visual analog pain scale differences and opioid consumption between the ketamine arms and control arms were evaluated.

Implement Evidence: In total, 22 RCTs and 2 meta-analyses were evaluated. Of the 22 RCTs, 14 indicated significantly reduced pain scores and 16 indicated a reduction in opioid consumption. Both meta-analyses concluded the same results. Reports of hallucinations or nightmares were sparse throughout the literature. Overall, ketamine doses of 0.3 mg/kg or greater prior to incision yielded consistently positive results compared with lower dosing. Of those studies 5 incorporated infusions after boluses. Infusion rates between 2 and 9 mcg/kg/min indicated positive results without incidences of nightmares or hallucinations.

Conclusions: Effectively managing perioperative pain improves patient outcomes. The AANA and ASA clearly support the use of multimodal therapy to optimize patient safety and to decrease opioid consumption. However, traditional adjuncts such as regional and NSAIDS have limitations. Current literature indicates that ketamine is a safe, efficacious alternative for use in perioperative pain control and does not have an adverse side effect profile when dosed for adjunct purposes. Subsequently, this project suggests that ketamine should be considered a standard option for multimodal pain control.

Laundering Methods for Reusable Surgical Scrubs: A Literature Review

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Introduction: Surgical site infection (SSI) is one of the most frequently occurring and costly postoperative complications. SSIs may be precipitated by bacteria introduced into the operating room setting. The potential for uniforms to carry bacteria has been demonstrated. Recommendations for laundering techniques for scrubs worn by surgical staff remains to be debated. There is a variance in perception among providers regarding where and how to launder surgical scrubs. The purpose of this literature review was to determine if facility laundering is superior to home laundering, to evaluate provider home laundering methods, and to provide recommendations for the laundering of reusable surgical scrubs.

Literature Review Analysis: An electronic search was conducted using CINAHL, PubMed, MEDLINE, and Scopus databases. The only search limit was the English language. The keywords searched were: surgical scrubs, home laundering, bacteria prevention, hospital laundry, and surgical site infection prevention. Additional sources included recommendations from the CDC, OSHA, and the AORN. Inclusion criteria for research articles was based on the article's ability to answer the questions: Can scrubs act as a vehicle for transferring bacteria?; Is there a relationship between microbes found on scrub uniforms and SSI?; What are the differences between facility laundering or home laundering in microbial decontamination?; What are the current or suggested recommendations for the decontamination of surgical scrubs? Research was classified using the Melnyk & Fineout-Overholt tool.

Implement Evidence: Thirty sources met inclusion criteria. Evidence suggests the presence of microbes and potential for transmission via scrub uniforms. The clinical significance is elevated if microbes are pathogenic in nature and found where cleanliness is imperative, such as the operating room. Reports indicate that bacteria transferred by providers' uniforms may lead to SSI. Correlations between SSIs and contaminated staff home-laundered scrubs have been identified. Research notes that facility-laundered scrubs have also been linked to SSIs. Minimal evidence exists that bacteria on scrubs plays a major role in SSI, but case reports imply the possibility for infection potential.

Conclusions: Evidence shows that hospital uniforms become contaminated during typical patient care activities. Yet, literature on the laundering of hospital uniforms is limited and most research has only examined laundering routines for linens that have been artificially inoculated with microbes. Some studies submit the possibility that domestic washers do not provide effective decontamination of hospital uniforms, while others propose that home laundering is a safe and cost-effective method for decontamination. Indeed there is insufficient evidence to conclude that home laundering is inferior to facility laundering in the level of decontamination.

Multiple Sclerosis and the Pregnant Laboring Patient: A Literature Review

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Introduction: Multiple sclerosis (MS) is among the most common neurologic diseases to affect young, otherwise healthy individuals. The autoimmune disease causes a demyelination and chronic inflammation of central nervous system neurons. The anesthetic management of a patient with multiple sclerosis in labor requires special considerations due to the demyelination. The purpose of this literature review was to examine the multiple sclerosis disease process, the impact of pregnancy on the disease process, and to identify the best methods of anesthesia management for the laboring patient with multiple sclerosis, focusing on the safety of neuraxial techniques in this patient population.

Literature Review Analysis: A literature search was conducted using PubMed, CINAHL, and Cochrane databases. The keywords searched were: multiple sclerosis, obstetric, pregnancy, anesthesia, labor analgesia, and neuraxial anesthesia. Results were narrowed to include research and evidenced-based publications from peer-reviewed publications. The search was limited to articles published in the last 15 years.

Implement Evidence: Seven articles meeting the above criteria were identified. There was no evidence to show that the disease negatively affects pregnancy, labor and delivery, or fetal well being. The incidence of an MS exacerbation is decreased during pregnancy, particularly in the third trimester; however, the risk of a relapse 3 to 6 months postpartum is increased. The evidence revealed that there is no increased risk of relapse or increased disability in the postpartum period associated with the use of neuraxial techniques in a patient with MS. Of concern was the potential for neurotoxicity that may result from exposure of demyelinated nerves to local anesthetics. The use of lower concentrations of local anesthetics and the addition of opioids to limit the amount of local anesthetic dose were discussed as a means to mitigate this risk.

Conclusions: Based on the literature reviewed, both spinal and epidural anesthetics are considered safe for patients with multiple sclerosis for the management of labor as well as cesarean delivery. Thorough neurologic assessment and careful planning are of utmost importance. Depending on the severity of the patient's symptoms and their severity of illness, it may be prudent to adjust local anesthetic concentrations and dosage, along with the addition of opioids to achieve the necessary results and to limit any potential risk of neurotoxicity.

Music Therapy and the Pediatric Perioperative Experience

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Introduction: Approximately 3 million pediatric patients undergo anesthesia and surgical procedures yearly. Fifty percent to 75% of children experience extreme anxiety during the perioperative period, which manifest signs and symptoms of disruptive behavior, noncompliance, and traumatic events. Historical perspectives recommend pharmacological measurements and behavioral interventions to manage pediatric behavior and anxiety. Noninterventional therapies excluding pharmacological techniques are being addressed. Music therapy has proven to be effective in reducing perioperative anxiety, pain, and hemodynamic instability.

Literature Review Analysis: Three randomized control trials examined hemodynamic parameters, pain, and psychological responses. Hemodynamic parameters were significantly altered with music therapy, with a reduction in heart rate ($p=0.04$) and respiration rate ($p=0.02$) postoperatively. Rises in serum glucose ($p<0.001$) with the music group's levels plateaued as compared with the nonmusic group, whose levels consistently rose postoperatively. The sympathetic nervous system responses were lessened by a decrease in both systolic and diastolic blood pressure in the music group during anesthesia emergence than the nonmusic group ($p=0.09$, $p=0.003$). Music also enhanced the pediatric patients' feeling of well-being and control during a music session ($p=0.005$).

Implement Evidence: The research validates music therapy decreases sympathetic responses to pain, stimulation, alleviates fear and anxiety, and provides an alternative to pharmacological interventions. Music therapy programs implemented nationally could ensure quality of patient care by consistently decreasing pediatric anxiety and setting a standardized national expectation to the public. Music therapy programs also increase safety standards by increasing pediatric compliance, ages 5 to 10, creates a cost-effective environment by decreasing pharmacological administration, pain, and behavioral interventions.

Conclusions: The conclusion of the research studies supports positive correlations between the use of music therapy and pediatric perioperative pain and anxiety. Pediatric patients upon induction were significantly less anxious ($p=0.03$) than the control group upon entering the OR and anesthesia mask induction ($p=0.003$). Pediatric compliance was higher than the control group, and results supported a positive correlation with music therapy and a reduction in pain intensity postoperatively. Future research supports musical genres on the impact of specific age groups in the pediatric population.

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Submental Intubation to Avoid Tracheostomy for Short-Term Artificial Ventilation

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Introduction: The purpose of this evidence-based practice research is to evaluate alternate methods of airway management when a tracheostomy is indicated. Submental intubation is an alternate method that has shown great success for oral maxillofacial surgery. Utilizing submental intubation for short-term mechanical ventilation allows the patient to avoid a tracheostomy. There are few complications associated with submental intubation compared with the significant complications of a tracheostomy.

Literature Review Analysis: A literature review was conducted to establish the best empirical evidence to support the practice change for submental intubation. Submental intubation has been described as a safe procedure with near perfect success. Submental intubation procedures were never aborted for a tracheostomy. The time taken for submental intubation averaged less than 10 minutes and the average time for a tracheostomy was 14 minutes. Complications of submental intubation include infection, submental fistula, and an incisional scar. The perception of the incisional scar was well received by patients. A submental intubation is easily reversed, there is minimal postprocedure care, and many complications are avoided with proper oral care.

Implement Evidence: Submental intubation is an acceptable alternative to a tracheostomy if short-term mechanical ventilation is indicated for less than 7 days. The literature supports that submental intubation is a safe and effective procedure. The current indications for submental intubation mainly exist for oral maxillofacial surgery. A general consensus supports that submental intubation is underutilized and the potential for more applications exists. Further research is warranted to gather larger samples to support and validate the research for practice change.

Conclusions: Submental intubation was first described in 1986 and has undergone modifications over the years. The initial reason for the submental intubation has remained the same, which is to avoid a tracheostomy. The literature supports that submental intubation can be utilized for patients who potentially require short-term mechanical ventilation. While the sample size is small, there were no complications with leaving submental intubation in place for up to 7 days. Utilizing submental intubation has the potential to decrease the morbidity and mortality associated with a tracheostomy.

The Benefits of Utilizing Sugammadex for Reversal of Neuromuscular Blocking Agents

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Introduction: Sugammadex is the first agent in a new class of drugs called selective relaxant binding agents. Unlike cholinesterase inhibitors, which indirectly and competitively antagonize NMBAs, sugammadex directly encapsulates and inactivates NMBAs. Sugammadex safely and rapidly terminates neuromuscular blockade, including profound blocks, with minimal side effects and beneficial pharmacokinetic properties including biological inertness when compared with cholinesterase inhibitors. The efficacy, safety profile, and utilization in diverse patient populations brand sugammadex a superior reversal agent.

Literature Review Analysis: Twenty-one randomized controlled trials (RCTs) and expert opinions were analyzed and support sugammadex as safe and efficacious. Recovery of a train-of-four (TOF) ratio of 0.9 was 2.9 minutes with sugammadex versus 50.4 minutes with neostigmine and Robinul ($p < 0.0001$). Hemodynamic instability is eliminated with sugammadex when compared with neostigmine in all animal studies to date. Metabolism is eradicated as sugammadex is excreted unchanged in urine within 16 hours. Sugammadex also reduces biliary metabolism of rocuronium, increases urinary excretion of rocuronium by 2- to 3-fold and shortens the half-life by 30%. Sugammadex is unaffected by acid-base status, does not bind to plasma proteins or erythrocytes, does not affect blood sugar levels, or cross the blood-brain barrier.

Implement Evidence: Research supports recovery of TOF was achieved in a shorter time length with administration of sugammadex immediately following rocuronium when compared with spontaneous recovery after administration of succinylcholine. Reversal with sugammadex offers rocuronium as a new drug of choice for rapid sequence induction. Implementation of sugammadex is suggested for NMBA reversal in cardiac patients, elderly patients, pediatric patients, patients with myasthenia gravis, muscular dystrophy, and other neuromuscular diseases.

Conclusions: Utilization of sugammadex in the United States will improve patient outcomes significantly. Minimal adverse effects support the exceptional pharmacokinetic properties of sugammadex compared with anticholinesterase inhibitors. Sugammadex is an efficacious and safe NMBA reversal agent without deleterious side effects, quicker onset, longer duration, and ability to reverse deeper paralysis as supported by review of the literature. Sugammadex is an innovative drug, which will increase the functionality of the operating room, improve patient safety and outcomes, and change anesthesia practice.

The Cannabinoid System: A Safer Chronic Pain Management Approach

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Introduction: Treatment of patients for chronic pain has become a widening area of concern with increasing use and dependency on prescription opioids. Between 1999 and 2010, the rate of prescriptions opioid overdose nearly doubled. Now viewed as a public health epidemic, prescription opioid overdoses can safely be decreased by easing restrictions on medical cannabis and rescheduling its control status. However, marijuana has been prescribed by the government for 3 decades with smoking as the only approved route of administration.

Literature Review Analysis: A primary search through PubMed, MEDLINE, Science Direct, and Google Scholar advocated for therapeutic management of pain through the endocannabinoid system. Trials determined efficacy of cannabis as an adjunct for treatment of chronic neuropathic pain (CNP). Two trials evaluated dosing utilizing vaporized, metered dose inhaled (MDI) cannabis, and one implemented sublingual (SL) spray cannabis. Trials utilizing low dose vaporized cannabis demonstrated 57% reduction in pain, similar trial with a portable metered dose inhaler tetrahydrocannabinol (MDI THC) mitigated CNP with 45% reduction of pain. Administration with THC SL spray for CNP displayed 50% reduction of pain. In 2 randomized control trials, results supported inhibition of pain utilizing cannabinoids in laboratory rat testing.

Implement Evidence: The safety profile of cannabinoids is high with no risk of overdose death and no end-organ damage requiring routine laboratory monitoring. Data indicates patients can receive therapeutic dosing of 5 grams per day with minimum adverse effects while decreasing pain effectively. Used in conjunction with opiates, cannabinoids can lead to a greater cumulative relief of pain resulting in reduction of opiate consumption and adverse effects. Utilizing science and current evidence rather than societal and political stigma, alternative treatments of chronic pain can be made available.

Conclusions: Cannabinoids are significantly safer than opioids with applicability in palliative care. Despite a large body of political objection against medical cannabis, the need for alternative multi-targeted approaches addressing neuropathic pain is essential. The harm of cannabis is based on its illegal status, leaving patients experiencing adverse effects of opioids that diminish pain marginally. The known lethal effects of opioids provide a legitimate argument for alternative effective analgesic treatments with medical cannabis to decrease morbidity, mortality, and effectively treat chronic pain.

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The Effect of LTA and Endotracheal Cuff Lidocaine on Coughing at Extubation

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Introduction: Stimulation of airway reflexes during emergence can lead to coughing, resulting in a multitude of undesirable effects in the intubated surgical patient. Hemodynamic instability, arrhythmias, bronchospasm, and laryngospasm, have all been noted as a consequence of cough with emergence. Lidocaine is often utilized in an attempt to attenuate coughing upon extubation. With methods of lidocaine application varying greatly among anesthesia providers, an evidence-based approach to lidocaine administration is necessary for best practice.

Literature Review Analysis: The purpose of this work is to describe the evidence and effectiveness of laryngeal tracheal anesthesia (LTA) with lidocaine applied directly onto the vocal cords, in comparison to endotracheal cuff lidocaine, in preventing coughing during extubation. The following PICOT question was postulated: Do intubated surgical patients (P) receiving laryngeal tracheal lidocaine (LTA) by direct application prior to intubation (I) compared to similar patients receiving endotracheal cuff lidocaine at intubation (C) reduce the incidence of cough (O) up to 1 hour postextubation (T). Nine double-blind randomized control trials were examined, and when the length of surgery was considered, each technique had its own superiority.

Implement Evidence: The studies showed statistically significant results that the LTA technique was superior to endotracheal cuff lidocaine in surgeries that lasted less than 1 hour, while endotracheal cuff lidocaine cuff technique was superior to LTA in surgeries lasting greater than 2 hours. Based on the evidence, our recommendation is that the use of LTA be reserved for surgical procedures lasting less than 1 hour, and the use of endotracheal cuff lidocaine be used in patients with surgical procedures lasting greater than 2 hours.

Conclusions: Using lidocaine technique based on surgical procedure time has been proven effective with cough attenuation in the intubated surgical patient.

The Effectiveness of Tranexamic Acid at Reducing Postoperative Blood Loss Following Cesarean section: Aa Systematic Review Protocol of Quantitative Evidence

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Introduction: Postpartum hemorrhage is the most common cause of maternal morbidity in low income countries. Currently, tranexamic acid is used to reduce blood loss for orthopedic, trauma, and heart surgeries. Tranexamic acid may be beneficial in reducing blood loss in cesarean deliveries and preventing the morbidity and mortality associated with postpartum hemorrhage.

Literature Review Analysis: Twelve databases were searched using the keywords: antifibrinolytics or tranexamic acid, hemorrhage, and cesarean section. Ultimately, 7 randomized controlled trials were selected for meta-analysis that met the inclusion criteria and methodological quality assessment. All studies showed a reduction in blood loss with tranexamic acid administration compared with placebo. The results showed statistical significance when the results were separated into intraoperative and postoperative time periods, $p=0.0016$ and $p<0.0001$, respectively. However, from the start of cesarean section until 2 hours postpartum, the blood loss with tranexamic acid was not statistically significant, $p=0.07$.

Implement Evidence: Due to significant heterogeneity between both the interventions and outcome measures, it is not recommended that anesthesia providers routinely administer tranexamic acid in all patients undergoing cesarean section. Anesthesia providers should continue to administer prophylactic uterotonics, like oxytocin to prevent blood loss.

Conclusions: The studies analyzed in this review compared tranexamic acid with placebo or no intervention in women undergoing cesarean delivery with a primary outcome measure of blood loss. The dose of tranexamic acid administered varied between studies. While venous thromboembolism did not occur in any of the studies, the authors acknowledged that the sample sizes were underpowered to detect thromboembolism. Overall, tranexamic acid reduces blood loss, with an average reduction of 289 mL of blood.

The Jehovah Witness Population: Considerations for Perioperative Optimization of Hemoglobin

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Introduction: Jehovah's Witnesses (JWs) are a vulnerable patient population that presents unique ethical and legal dilemmas for anesthesia professionals. The religious beliefs of JWs deter them from receiving blood transfusions, which can lead to adverse reactions from the refusal of treatment. Irrespective of their reasons for declining blood products, patients and healthcare providers need to be knowledgeable about substitutions for blood product administration, as well as the risks and benefits of such treatments.

Literature Review Analysis: Current literature has indicated that blood transfusions can be avoided by exploring alternative bloodless treatment modalities. "Bloodless surgery" is an innovative phenomenon that medical centers are adopting for patients that refuse blood transfusions. In addition, bloodless surgery protocols are essential to minimize risks and offer patients who decline blood transfusions the same quality of care accessible to patients who do accept blood transfusions. Moreover, evidence suggests that mortality rates may be lowered in patients receiving bloodless surgery alternatives.

Implement Evidence: For the JW patient, there are many options available as an alternative to blood transfusions and the use of a multidisciplinary approach, one that is culturally competent and meets specific patient needs, which can be essential in order to optimize preoperative hemoglobin levels prior to elective surgery. Indeed, the preoperative period is the best time to optimize the JW patient and prepare for any known challenges related to blood loss during the procedure, and such optimization should begin at least 4 weeks prior to the day of surgery.

Conclusions: Preventing patient morbidity and mortality begins with a good plan of care and adequate preparedness for any challenge that may arise. Indeed, by using a multidisciplinary approach for the preoperative care of the JW patient, the paradigm shifts the administration of blood products to a more patient-centered approach. Rather than care that is driven by the administration of products, the goal becomes the provision of culturally competent care that adheres to patient beliefs, improving patient outcomes through risk minimization, and reduces costs.

The Role of Tranexamic Acid in Trauma Surgical Patients

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Introduction: Trauma is the sixth leading cause of death in all age groups and the first leading cause of death in individuals under age 35 worldwide. Hemorrhage accounts for 80% of all deaths in trauma patients. Tranexamic acid, an antifibrinolytic drug, prevents blood clots from breaking down and reduces blood loss by inhibiting plasminogen activation and plasmin activity. The purpose of this evidence-based practice research is to evaluate the best empirical evidence on the effects of tranexamic acid with regard to mortality, blood transfusion requirements, safety, and cost.

Literature Review Analysis: A randomized, double-blind trial involving 20,211 patients from 274 hospitals in 40 countries concluded that the administration of tranexamic acid to bleeding trauma patients significantly reduces overall mortality when compared with placebo. A systematic review of 5 trials concluded that tranexamic acid reduces the probability of receiving a blood transfusion by 30% when compared with no treatment. Four studies, which examined the effects of tranexamic acid on MI, stroke, PE, and DVT, concluded that tranexamic acid does not increase the risk of thromboembolic complications in trauma patients. A prospective study concluded that early administration of tranexamic acid to hemorrhaging trauma patients is highly cost-effective.

Implement Evidence: Administration of a loading dose of 1 g of IV tranexamic acid over 10 minutes, followed by an infusion of 1 g over 8 hours significantly decreases overall mortality in trauma patients. Tranexamic acid should be administered as early as possible, preferably within 3 hours of injury. The use of tranexamic acid reduces blood transfusion requirements in trauma patients, thus decreasing adverse effects associated with blood transfusions and cost to the healthcare system. Tranexamic acid is a safe intervention in trauma patients as it does not increase the risk of thromboembolic complications.

Conclusions: The widespread use of tranexamic acid is predicted to save 70,000 to 100,000 lives per year around the world. Tranexamic acid significantly reduces mortality and blood transfusion requirements in trauma patients without increasing the risk of thromboembolic events. Tranexamic acid is also cost-effective if routinely administered within 3 hours of injury in high, middle, and low income countries. Due to the benefits of tranexamic acid in reducing mortality in trauma patients, the drug has been included in World Health Organization's list of essential medicines.

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The Safety and Effectiveness of Carbohydrate Drinks Prior to General Anesthesia

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Introduction: Surgical patients are required to have nothing by mouth (NPO) for at least 6 hours and often more for those surgeries starting in the afternoon to reduce the risk of aspirating gastric contents during general anesthesia. Surgical patients who are NPO for greater than 6 hours may experience adverse effects such as hypovolemia and hypoglycemia perioperatively.

Literature Review Analysis: Keywords from the following PICOT question were used to search PubMed, CINAHL, Google Scholar, and Ovid. Do elective surgical patients receiving general anesthesia (P) who fast before surgery with a carbohydrate drink 2 hours before surgery (I), compared to similar patients who only fast overnight (C) have more favorable outcomes (O) perioperatively (T)? Randomized control studies and a systematic review were critically appraised.

Implement Evidence: The results of these studies found that a carbohydrate drink 2 hours preoperatively is not only safe but also has many benefits. Oral hydration with a carbohydrate drink decreased immunosuppression, decreased insulin resistance causing better glucose control, better pulmonary function, increased gastric pH, decreased gastric volume, increased patient comfort and satisfaction, and decreased nausea and vomiting.

Conclusions: From this evidence it is recommended that patients for elective surgery with no history of delayed gastric emptying be given a carbohydrate beverage 2 hours prior to surgery and general anesthesia.

The Safety and Efficacy of Intracuff Lidocaine in Reducing Emergence Cough

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Introduction: Emergence cough can result in harmful effects such as hypertension, tachycardia, increased intracranial pressure, and surgical site bleeding. Methods of mitigating this include opioids, intravenous and topical lidocaine, and deep extubation; all of these can have adverse effects. An alternative method to decrease emergence cough is to instill lidocaine into the endotracheal tube cuff. Lidocaine diffuses through the cuff and causes anesthetic action on the tracheal mucosa. The purpose of this inquiry is to evaluate the safety and efficacy of intracuff lidocaine in reducing emergence cough.

Literature Review Analysis: Four randomized controlled trials (RCTs) showed a statistically significant decrease in the incidence of emergence cough when intracuff lidocaine was utilized. One RCT also showed decreased requirements for sedation in patients requiring prolonged ventilatory support. Although one study showed no difference in the incidence of cough in procedures lasting less than 90 minutes, it was not statistically significant. None of the RCTs showed intracuff lidocaine result in the harmful side effects of respiratory depression, prolonged emergence, local toxicity, or aspiration. Additionally, none of the studies showed intracuff lidocaine result in other adverse events such as ruptured or expanded ETT cuff, laryngospasm, or depression of swallowing.

Implement Evidence: Intracuff lidocaine can safely and effectively be used in clinical practice to reduce emergence cough. Multiple concentrations of lidocaine, with and without the addition of bicarbonate, have all been shown to safely mitigate emergence cough.

Conclusions: Intracuff lidocaine should be used to decrease the incidence of emergence cough. Intracuff lidocaine diffuses out of the cuff and anesthetizes the tracheal mucosa. Anesthetizing the tracheal mucosa decreases coughing and has the potential to decrease incidence of hypertension, tachycardia, increased intracranial pressure, and surgical site bleeding. Studies indicate that intracuff lidocaine is a safe method of reducing emergence cough, because no harmful side effects were seen. Further research is warranted to determine the role of procedure length on effectiveness of intracuff lidocaine.

The Use of Acceleromyography to Reduce Residual Neuromuscular Blockade and Improve Patient Safety

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Introduction: Neuromuscular blocking agents, believed to be safe, have been associated with postoperative respiratory complications due to residual paralysis. These complications have led to prolonged PACU stays and increased total costs. Currently, most providers utilize qualitative monitoring, such as train-of-four ratio (TOFR), and/or clinical signs to assess the degree of neuromuscular block. However quantitative monitoring, such as acceleromyography (AMG), more accurately measures the TOFR, is a more predictable form of monitoring, can be cost-effective, and improve patient safety.

Literature Review Analysis: Thirty-eight articles were analyzed that covered 6 different areas of inquiry, which included negative effects of residual neuromuscular blockade, quantitative vs qualitative monitoring, high-risk populations, and cost comparisons. Current evidence indicated that anesthetists were unable to accurately differentiate fade between 0.4 to 1.0 and the use of qualitative monitoring correlated with 47% chance that the TOFR was <0.7 . The use of AMG decreased the patient's response to hypoxemia, oxygen desaturations, upper airway obstruction, aspiration, pharyngeal dysfunction, aspiration risk, and muscle weakness.

Implement Evidence: The literature review emphasized the importance of improving measures to prevent RNMB and its related complications. The results of these studies provide support for the presence of human error in relation to neuromuscular monitoring. A shift in monitoring techniques from qualitative to quantitative will lower rates of residual neuromuscular blockade, preventing related complications from occurring. Quantitative monitoring will not only improve patient safety but also will lower associated costs and increase patient satisfaction.

Conclusions: Residual neuromuscular blockade is a current problem that is often unrecognized but easily prevented with appropriate monitoring. If it goes unnoticed, certain adverse respiratory complications, such as weakness, hypoxia, and respiratory failure may result. Intraoperative use of AMG has been shown to decrease the incidence of residual paralysis. The ease of using AMG allows anesthesia providers to objectively quantify the TOFR in daily clinical practice. When used on high-risk patients, AMG is cost-effective and allows anesthesia professionals to provide safe care.

The Use of Cannabinoid Receptor Agonist Therapy in Rheumatoid Disease

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Introduction: There is a multitude of empirical evidence supporting cannabis for the treatment of chronic, intractable pain caused by inflammatory pathways, autoimmune processes, and neurodegeneration. Cannabinoid receptors affect and regulate the immune and nervous systems by affecting neuronal transmission and attenuating immune cell activity during inflammation and neurodegeneration. Glial cell stimulation in the spinal cord is affected by cannabis with a subsequent decrease of cytokines. Cannabis therapy ameliorates the symptoms of chronic disease patients.

Literature Review Analysis: Cannabis decreased average pain scores significantly in patients suffering from chronic pain. Smoked cannabis with THC reported an average decrease in pain scores of 2.74 ($p < 0.001$) compared with placebo; observational pain decreased on average of 5.28 ($p = 0.008$). There is a positive correlation between cannabis and pain relief associated with opioid resistant refractory pain. Continuous use of oral cannabis therapy for intractable neuropathic pain compared with placebo was reported as efficacious in a 2-year, ongoing study. No deleterious effects were observed in the research on vital signs during smoked inhalation administration of cannabis. Blood chemistry values and renal function did not change significantly when compared with placebo.

Implement Evidence: Future studies with human participants are required to advance cannabis research. In order to assess dose titration and patient response to cannabis therapy, extended trials beyond weeks or months is recommended. Extended trials should include expanding the number of participants, for a larger sample size. The most efficacious, safe, and efficient mode of administering cannabis could be further studied. Calculating the lowest efficacious dose with the fewest adverse outcomes is a priority.

Conclusions: The outcome for cannabis research is to support safe and efficacious care for patients with chronic pain and disabling diseases. The prevention of developing neuropathic pain or neurodegeneration is the best outcome for chronic disease patients. Randomized controlled trials reported significant reduction of pain and neuropathies with no adverse events of hypotension, hypertension, bradycardia, or tachycardia. Rheumatoid diseases, neuropathic pain, and autoimmune processes can be treated, and pain can be relieved as medical providers pledge beneficence and nonmaleficence.

The Use of Erythropoietin for the Reduction of Perioperative Allogeneic Blood Transfusion in Cardiac Surgery

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Introduction: The use of blood conservation techniques has become increasingly important in cardiac surgery because of the risk of high blood loss. Due to the hemostatic challenges presented by cardiopulmonary bypass, many patients still require 2 to 3 units of allogeneic blood prior to hospital discharge, which can cost \$250 to \$550 per unit. These types of transfusions present the risk of infectious disease transmission, acute kidney injury, transfusion related acute lung injury, graft-vs-host disease, and increased mortality. The objective of this study is to explore the use of erythropoietin (EPO) for the reduction of perioperative allogeneic blood transfusion in cardiac surgery.

Literature Review Analysis: This study utilized a search using the PubMed, Medline and ScienceDirect databases. Five articles met the criteria. The level of evidence ranged from Ia to IIIb. One study found that the administration of EPO with and without autologous blood transfusion was associated with significant risk reduction in the exposure to allogeneic blood transfusion (RR=0.28, P <0.001, RR=0.53, P <0.01, respectively). Another study found the EPO group required 0.33 units of blood per patient, whereas the control group required 0.76 units per patient (P = 0.008). A third study identified a decrease from 93% to 67% transfusion rate (P= 0.01). A fourth study discovered that EPO increased postoperative hemoglobin levels but did not change transfusion requirements. One study did not observe a significant decrease in allogeneic blood transfusion administration.

Implement Evidence: The principal conclusion from the studies is that the use of EPO in cardiac surgery was effective in decreasing the amount of perioperative allogeneic blood transfusions. Patients with severe preoperative anemia, Jehovah's Witnesses, and patients with coagulopathies can benefit from this blood conservation technique. EPO carries the risks of hypertension and thromboembolic events. In addition, preoperative hospitalization for drug administration and drug costs limit its use.

Conclusions: Four articles indicated a decrease in allogeneic blood transfusions and/or an increase in postoperative hemoglobin. The implication of EPO use is cost reduction through decreased hospital stays, decreased morbidity, and decreased allogeneic blood transfusions. The limitations of the studies are small sample sizes and the necessity for more randomized controlled trials. Future clinical research can explore optimal dose and the duration of treatment that is most cost-effective.

The Use of Stellate Ganglion Block to Treat Posttraumatic Stress Disorder (PTSD)

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Introduction: PTSD is a severe, chronic anxiety disorder an individual can develop after a traumatic event. Approximately 5.2 million adults in the United States suffer from PTSD and it is universally difficult to treat. The traditional treatments are psychotropic medication and/or cognitive behavioral therapy, which have an overall success rate of less than 30%. The stellate ganglion block has been shown to be a safe, minimally invasive procedure that supports immediate results, is cost-effective, decreases pharmacological therapy, and provides significant relief of symptoms for at least 3 months in patients with PTSD.

Literature Review Analysis: Seven peer-reviewed descriptive case studies were selected for this evidence-based practice research project. Each study participant received 1 to 2 stellate ganglion blocks for treatment of PTSD symptoms. PTSD symptom severity was evaluated and measured before treatment and posttreatment at varying times within each study. The number of participants within the studies ranged from 1 to 166. All of the studies showed significant clinical improvement in PTSD symptoms. Statistical analysis, when utilized, yielded a p value less than 0.05 denoting statistical significance. Along with significant rapid relief of PTSD symptoms, stellate ganglion block treatment allowed for reduction or discontinuation of psychotropic medication.

Implement Evidence: Overall, 75% of study participants experienced a significant decline in PTSD symptom severity after treatment with stellate ganglion block. No adverse effects were reported. The current research demonstrates that stellate ganglion block has the potential to be an effective treatment for PTSD, particularly in those who are noncompliant or resistant with other treatment avenues or as an adjunct therapy with traditional treatment. Future large-scale randomized research studies are recommended.

Conclusions: With the current worldwide climate in the rise of terrorism, military operations, and natural disasters, the incidence of PTSD is not expected to decline. Regardless of the traumatic event, individuals with PTSD suffer mental, physical, and social anguish. The ultimate goal of PTSD treatment is for individuals to be fully functioning with reduction of life disrupting symptoms. Research demonstrates measurable immediate, significant, safe, and lasting relief of PTSD symptoms after stellate ganglion block administration.

Use of Manometry in Endotracheal Tube Cuff Inflation

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Introduction: The use of endotracheal tubes (ETTs) occur 13 to 20 million times each year in the United States (Sultan et al, 2011). Commonly, ETTs are constructed with a cuff at their distal end in order to facilitate positive pressure ventilation (PPV) and to prevent aspiration of gastric contents (Sultan et al, 2011). Although ETT cuffs have a great deal of utility, there is no clear consensus on the ideal range of ETT cuff pressures or on the proper way to inflate and test the ETT cuffs. The purpose of this study is to determine if the literature supports that the use of a manometer to inflate ETT cuffs will reduce the incidence of postoperative complications.

Literature Review Analysis: This study is a systematic review of existing literature to determine what ETT cuff inflation technique results in improved patient outcomes in patients undergoing general anesthesia. This study utilized PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the Cochrane Database of Systematic Reviews for studies published from 2000 to 2014. Inclusion criteria were: human adult studies, in full-text form, published in peer-reviewed journals, and published in the English language. Exclusion criteria included aeromedical and pediatric studies.

Implement Evidence: The literature search yielded 265 articles. Twenty-nine were selected for full text review, and 18 were extracted for data analysis. Nine of 12 articles recommending an ideal cuff pressure cited 20 to 30 cm H₂O. Ten of 11 studies comparing subjective techniques with manometry found that manometry is more likely to result in pressures within the ideal range. Nine of 10 studies measuring patient outcomes found that tight control of cuff pressures is associated with fewer adverse sequelae. Sore throat is the most common sequela and is associated with visible tracheal lesions.

Conclusions: The majority of available literature indicates an ideal range of 20 to 30 cm H₂O, and our analysis suggests that the use of manometry is significantly more accurate in obtaining an intracuff pressure when compared with subjective techniques. Additionally, the use of subjective techniques is associated with more adverse patient outcomes, with the most statistically significant sequelae being sore throat and evidence of tracheal lesions. Recommendations for further studies would include a focus on quality research with short-term and long-term outcomes data, in addition to a cost-benefit analysis of utilizing a manometer for all patients undergoing general anesthesia.

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Implementation of a Standardized Preoperative Diabetes Medication Management Guideline: A Process Improvement Project

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Introduction: Approximately 25 million people in the United States have diabetes mellitus (DM) and one quarter is estimated to need surgical intervention at some point during their lifetime. Uncontrolled blood glucose levels in patients with DM presenting the morning of surgery may lead to case cancellations, prolonged hospital stays, and other perioperative morbidity and mortality, resulting in decreased patient satisfaction and increased healthcare costs. Lack of standardization and variability of preoperative patient instructions on diabetes medication management may contribute to these undesirable outcomes.

Literature Review Analysis: Review of literature included articles published or translated in English from October 2004 to October 2014 and included only human subjects. Databases searched included: PubMed, CINAHL, EMBASE, JAMA Evidence, and Google Scholar. Our search also included the Society for Ambulatory Anesthesia, American Diabetes Association, and Agency for Healthcare Research and Quality websites. Search terms included: preoperative, perioperative, pre-procedure, pre-anesthesia, diabetes, DM, diabetic, glycemic control, glycemic, blood glucose, insulin, guidelines, protocol, management, and program. Evidence was individually appraised by 3 coinvestigators according to the process developed by Melnyk and Fineout-Overholt (2011).

Implement Evidence: Using the Iowa Model as an implementation framework, a standardized protocol, education program, and a provider reminder and patient education tool were developed for preoperative diabetes medication management based on Society of Ambulatory Anesthesia guidelines. Primary measurable outcomes included a pre/post implementation analysis of: 1) provider knowledge and confidence levels using voluntary anonymous surveys; 2) patient day of procedure blood glucose levels; and 3) process compliance rates. Two months of basic patient demographics were collected retrospectively via data-mining methods and examined in summary reports with descriptive statistics.

Conclusions: Mean score on the knowledge test was 5.1 (SD 2.0) prior to training and 9.6 (SD 1.0) after training. Average confidence in responses was 58.3 (SD 15.4) before training and 89.6 (SD 9.1) after training. Mean blood glucose was 138.0 (SD 34.0) before implementation and 131.5 (SD 44.6) after. Despite 100% process compliance rates, odds of being within recommended blood glucose ranges were similar for patients who presented for surgery pre-implementation vs post-implementation. Therefore, the project significantly improved provider knowledge and confidence about evidence-based perioperative management of diabetes, but it did not significantly increase the proportion of patients within recommended limits.

Anesthetic Considerations for an Obstetrical Patient with Pseudotumor Cerebri Presenting With Preeclampsia

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Introduction: Pseudotumor cerebri is a syndrome in which the patient experiences increased intracranial pressure without hydrocephalus or mass lesion. Symptoms can become exacerbated during pregnancy due to hormonal changes and weight gain and may occur during any trimester. The purpose of this case report was to identify anesthesia considerations for a patient with pseudotumor cerebri undergoing an emergent cesarean delivery.

Literature Review: A literature review was conducted using PubMed, CINAHL, and EBSCOhost databases. The keywords searched were: pseudotumor cerebri, obstetric, pregnancy, anesthesia, labor analgesia, neuraxial anesthesia, and cesarean section. Results were narrowed to include research and evidenced-based publications from peer-reviewed sources. The search was limited to articles published in the last 10 years.

Description of Case: A 32-year-old parturient presented to the Labor and Delivery floor with complaint of headache and hypertension. Preoperative examination revealed a significant medical and surgical history, as well as a presumed difficult airway. A diagnosis of preeclampsia with severe features was determined and the patient was to undergo an emergent cesarean delivery. Intraoperatively, an epidural was placed without incident and a second peripheral IV was started. Hemodynamic stability was maintained using IV fluids, phenylephrine, and ephedrine. The patient was transferred to the PACU and had an uneventful recovery with discharge home 2 days postoperatively.

Conclusions: The decision to use epidural anesthesia for this patient stemmed from multiple concerns. Both general and spinal anesthesia were considered, but chosen to be suboptimal due to increased risks associated with each technique. Optimally, a neurologist consultation will be completed prior to finalization of anesthetic plan in this patient population. Without an assessment for papilledema or measurement of intracranial pressure we considered an epidural technique to be safest and most effective.

Anesthetic Management for Exploratory Laparotomy in a Neonate With Necrotizing Enterocolitis

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Introduction: Necrotizing enterocolitis (NEC) is the most common gastrointestinal disease in infants and plagues 1% to 8% of neonates. Despite medical advances, there is a lack of understanding the pathophysiology or effective treatments for NEC. Prematurity, formula feeding, low birth weight, and intestinal ischemia are associated with NEC. The mechanism is theorized as an activation of toll-like receptors in the intestines due to excess platelet activating factor, with subsequent activation of an inflammatory cascade. If untreated, NEC leads to intestinal ischemia, necrosis, septic shock, and death.

Literature Review: Clinical Key, Embase, and Cochrane Library databases were searched for articles using keywords singly and in various combinations: necrotizing enterocolitis, neonate, anesthesia, sepsis, septic shock, microcirculation, high frequency ventilation, operating room, anesthesia, neonate, and inhaled nitric oxide. Articles were retrieved and the titles and abstracts were reviewed for relevance. Thirteen pertinent articles were included in the case report for discussion of necrotizing enterocolitis and high frequency ventilation.

Description of Case: The patient (AA) was a 35-week preterm neonate born vaginally to a mother with no prenatal care, who had pregnancy-induced hypertension, obesity, and insulin-dependent diabetes. Within 24 hours of birth, AA developed septic shock and was placed on a high frequency oscillation ventilator with nitric oxide and intravenous vasoactive medications. On the eighth day of life AA presented for an exploratory laparotomy for free air presence on abdominal x-rays. The surgical procedure identified 59 cm of discontinuous necrotic small bowel, success entericus, turbid ascites, and perforation. Concerns throughout the procedure included line management, hemodynamic stability, fluid management, temperature regulation, and amnesia/analgesia.

Conclusions: Decreased placental perfusion in utero primes the inflammatory cascade for a hyperresponse, leading to decreased microcirculation, necrosis, and septic shock. Tissue CO₂ monitors, arginine supplementation, and direct application of hyperosmolar solutions are successful in improving microcirculation. Anesthesia providers can implement additional therapies to improve oxygen carrying capacity and microcirculation through judicious fluid administration, temperature regulation, and hemodynamic management.

Electrocardiogram Changes Associated With Intracranial Insults

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Introduction: Electrocardiographic changes may occur as a result of intracranial insults such as subarachnoid hemorrhage or intraventricular hemorrhage. Increased intracranial pressure is specifically associated with a characteristic inverted T wave with a prolonged Qt interval that is identified as a neurogenic T wave cardiac rhythm. The CRNA must be aware of this brain-heart association. Another consideration is the choice of medications during a case that may further increase the Qt interval and may result in torsades de points.

Literature Review: A search of the literature was conducted through the TCU library utilizing Embase, PubMed, EBSCO MEDLINE, and Ovid databases. Keywords for search included different combinations of the following: ECG changes, ECG abnormalities, intracranial injury, head injury, ST segment changes, subdural hematoma, subarachnoid hemorrhage, intracranial hemorrhage, and intracerebral hemorrhage. All retrieved articles were cross-referenced for potentially missed articles. All articles were reviewed and the article selection was narrowed based on relevance to the topic. Fourteen journal articles were chosen and used as references for the case report.

Description of Case: A 66-year-old, 175-cm tall, and 70-kg male underwent a posterior fossa craniotomy. The tumor biopsy results later determined metastatic renal cell carcinoma. The patient's past medical history was significant for hypertension, renal cell carcinoma status post left nephrectomy 4 years prior, alcohol abuse with malnutrition, gastroesophageal reflux disease, depression, and coronary artery disease. A 12-lead ECG was significant for a normal sinus rhythm with a nonspecific T wave abnormality. Similar abnormalities were noted on the ECG rhythm throughout the surgical procedure.

Conclusions: Cardiac irregularities are associated with intracranial insults. Therefore, it is prudent to have continuous ECG monitoring, especially in leads II and V4 or V5, during the intraoperative and immediate postoperative periods for all patients that have sustained intracranial injuries. Common ECG abnormalities associated with these injuries include changes to the ST segment, prolonged QTc interval and T wave irregularities. Medications that may provide a potential benefit for treatment include beta-blockers and Ace inhibitors/Angiotensin Receptor Blockers for cardiac protection. Subdural hematoma or epidural hematoma without concurrent subarachnoid hematoma, intracranial hemorrhage or other type of brain injury, are unlikely causes of ECG changes.

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Let's Talk About MERRF

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Introduction: Patients with myoclonus epilepsy with ragged fibers (MERRF) have altered mitochondrial function that requires the anesthetist to have extensive perioperative awareness. Maintenance of homeostasis throughout this period will generally lead to successful outcome. Understanding the mechanism of MERRF as presented in this poster will assist the anesthetist to achieve this goal.

Literature Review: A PubMed search was used to obtain pertinent research on MERRF in February 2015. Ten articles were utilized to formulate the basis of the poster including history of MERRF, anesthetic implications, mitochondrial DNA sequencing, and possible cures.

Description of Case: This 66-year-old male with MERRF and lipomatosis gigantea presented for removal of 3 large lipomas from his anterior chest. He had multiple comorbidities including history of a difficult airway. The case was completed using a general anesthetic, and the patient had minimal complications. Six kilograms of lipomas were removed from his chest.

Conclusions: Our particular patient had no significant complications throughout his perioperative period. Understanding the mechanism of MERRF and of mitochondrial DNA in general will help the anesthetist provide superior care to this small subset of patients in the future.

Liposomal Bupivacaine for Postoperative Pain Control

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Introduction: Shoulder surgery often requires aggressive postoperative pain control. The patient underwent a repair of a torn rotator cuff and had preexisting diaphragmatic paralysis on the contralateral side. Many options for pain control negatively affect respiratory function by either respiratory depression or temporary paresis of the phrenic nerve. Any form of decreasing respiratory efficiency is not desired in most patients, especially related to a patient with preexisting compromised pulmonary function. Liposomal bupivacaine was utilized successfully for postoperative pain control. The patient experienced no adverse pulmonary sequel and had excellent postoperative pain control.

Literature Review: Adequate postoperative pain control following any surgical procedure is fundamental to the role of anesthesia practitioners. In most recent practice, slow-releasing local anesthetics have become an option and alternative to peripheral nerve blocks. Massaro illustrated indications, chemistry and pharmacology, pharmacokinetics, and adverse reactions related to liposomal bupivacaine. The majority of bupivacaine in liposomal suspension is encapsulated in multivesicular liposomes; however, about 3% is free bupivacaine. Relatively quick onset mixed with long lasting release results in an initial effect, followed by extended blockade as the remaining drug is released over 72 hours.

Description of Case: The patient discussed was a 68-year-old male who presented for a repair of a torn right shoulder rotator cuff. A preoperative chest x-ray had revealed a left sided hemidiaphragm paralysis. The anesthetic plan was specifically tailored for the patient regarding the needs for adequate postoperative pain control with the aim of limiting pulmonary compromise. Due to existing phrenic nerve damage and related pulmonary compromise, interscalene nerve block was avoided. Historically, in cases where interscalene blocks are not used, larger doses of opioids are normally utilized. Liposomal bupivacaine was employed for the case instead of high opioid or nerve block technique. For the specific case discussed, liposomal bupivacaine provided excellent postoperative pain control without compromising pulmonary function any further.

Conclusions: Pain control continues to be a primary concern and focus for anesthetists. Pain in the postoperative setting has been linked to an increased level of morbidity and mortality, and pain control should be considered a priority for any surgical procedure. Peripheral nerve blocks (PNB) can often be considered a safe option for postoperative pain control. However, when PNB is contraindicated or not desired by patient or surgeon, other options for pain control should be considered. Liposomal bupivacaine is a beneficial option in patients requiring postoperative pain control with limited respiratory side effects and with a safe side effect profile.

Right Atrial Tumor: Implications for Anesthetic Management

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Introduction: Cardiac tumors present unique challenges to anesthesiologists. The infrequent occurrence of cardiac tumors leads to a dearth of information available to guide anesthesia practice. Further complicating matters are the differing anesthetic implications based on intracardiac tumor location. The following case report describes the delivery of anesthesia during the surgical resection of a right atrial mass initially diagnosed as a myxoma that upon pathology examination was found to be a metastatic renal cell carcinoma.

Literature Review: Published evidence related to anesthesia techniques for cardiac tumor surgery originated from lower level evidence found in case reports and expert opinions. Nine articles were found and all supported the overall anesthetic plan with the exception that 2 articles did not support the use of a pulmonary artery catheter.

Description of Case: A 76-year-old white female with a history of hypertension, hyperlipidemia, paroxysmal atrial fibrillation, stroke, and postoperative nausea and vomiting presented for resection of a right atrial mass. Preoperative management included obtaining chest x-ray, ECG, laboratory workup, and application of transdermal scopolamine patch. Intraoperative management included standard monitor application insertion of 16-gauge IV catheter and A-line, induction maintaining hemodynamic stability, PAC inserted only into SVC for CVP monitoring, and TEE utilized for cardiac imaging intraoperative. Anesthesia converted to TIVA upon incision. PA catheter advanced to pulmonary artery after resection. The patient was admitted to ICU and discharged in 3 days.

Conclusions: In addition to complications common to all open heart cases, specific complications from a right atrial tumor include pulmonary embolism, blood flow obstruction, conduction defects, and right to left shunt. Specific anesthetic concerns include using medications causing venodilatation with caution, avoidance of air bubbles intravascularly, and careful insertion of central venous catheter to prevent tumor fragmentation. Insertion of a pulmonary artery catheter is controversial but was successfully used in this case. Transesophageal echocardiographic examination can assist in the recognition of tumor embolization, identifying residual regurgitant lesions, line placement, and adequate de-airing of the heart.

The Antinociceptive Effects of Esmolol: A Case Report

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Introduction: Esmolol is an ultrashort acting, cardioselective, β_1 -adrenergic antagonist that is metabolized via red blood cell esterases. Although the pharmacodynamic effects of esmolol make it an ideal agent for rapid control of heart rate, multiple studies have investigated off-label uses of the drug. The primary focus of these studies has been to investigate the antinociceptive effects of utilizing an esmolol infusion during the perioperative period. The purpose of this case report is to describe the use of esmolol in the anesthetic management of a patient with a history of opioid abuse and on naltrexone XR (extended release).

Literature Review: Collard et al. conducted a randomized, prospective trial in which patients undergoing laparoscopic cholecystectomy received either 50mcg fentanyl boluses every 30 minutes, 0.1-0.5mcg/kg/min remifentanyl infusion, or 5-15mcg/kg/min esmolol infusion. The results showed that the esmolol group required statistically significant less fentanyl in PACU (post anesthetic care unit). Celebi et al. conducted a randomized, double-blind, controlled trial which compared patients receiving remifentanyl in combination with either a 0.5mg/kg esmolol bolus followed by a 50mcg/kg/min esmolol infusion vs patients that received the same volume of normal saline. The study found that the esmolol group had significantly lower intraoperative and postoperative opioid consumption, reduced VAS (visual analogue scale) scores, and prolonged time to first analgesic dose.

Description of Case: A 33-year-old male presented for an excision of a left cheek mass and extraction of teeth. The patient received monthly injections of naltrexone XR (extended release). The decision was made to avoid opioids. After receiving 2 mg midazolam, anesthesia was induced with 200 mg propofol, 80 mg succinylcholine, 40-mg bolus of esmolol, and initiation of a 5-mcg/kg/min esmolol infusion. A 7-mm nasal RAE tube was placed. Throughout the case the patient received 1,000 mg acetaminophen IV (intravenous), 30 mg ketorolac, 20 mg ketamine, and the site was localized. The intraoperative period was unremarkable. The patient was extubated and taken to PACU (post anesthetic care unit) where he denied pain or nausea. The esmolol infusion was stopped immediately following extubation.

Conclusions: While much research is still needed on the topic, it appears that esmolol may have analgesic properties and has been successfully used as an adjunct to surgical analgesia. The mechanism of analgesia associated with esmolol is not fully understood but proposed mechanisms include suppression of catecholamines and cytokines, NMDA (N-methyl-D-aspartate) receptor inhibition, and possible facilitation of inhibitory neurotransmitter release in the substantia gelatinosa.