Implementation of a Simulation-Based Educational Module to Reduce Perioperative Complications in Obese Patients: Intraoperative Subanesthetic Ketamine Infusions

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Author Note

There is no known conflict of interest.

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Abstract

A central role of anesthesia providers is to effectively manage a patient's pain response throughout the perioperative process. Historically, providers have utilized unimodal approaches to pain management through opioids. In 2017, the opioid crisis in the U.S. was declared a public health emergency (U.S. Department of Health and Human Services, 2019). In order to minimize contributions to this crisis, anesthesia providers began to increase the use of multimodal opioid-sparing techniques for perioperative pain management. The use of subanesthetic ketamine infusions is considered an effective opioid-sparing technique that avoids the unfavorable profile of opioids while still producing analgesia. Throughout the perioperative process, obese patients are at risk for increased morbidity and mortality in relation to ventilatory/respiratory complications. Unimodal approaches to managing pain in this population with opioids can exacerbate the occurrence of these complications in this at-risk population. Research demonstrates the efficacy of ketamine administered as a bolus dose and low dose subanesthetic infusion. Patients experiencing major surgery such as open abdominal, thoracic, or orthopedic surgery and patients with chronic opioids benefit most from this technique. While effective, the use of subanesthetic ketamine infusions widely varies among anesthesia providers.

The purpose of this project was to utilize and educational intervention to translate evidence into practice through Lewin's three step theoretical model of unfreezing, moving, and refreezing. This educational intervention applied evidence-based practice (EBP) to support the use of subanesthetic ketamine infusions for intraoperative pain management. Overall, the goal was for anesthesia providers to increase knowledge regarding risk reduction strategies for perioperative obese patients. Following education, patient safety and outcomes would be increased through participants expanding clinical knowledge and considering a personal practice change.

Implementation occurred over a three-week period with 22 anesthesia providers completing the per-test, educational module, and post-test. Data results showed 86.4% strongly agreed and the remaining 13.6% of participants agreed personal knowledge following the education increased regarding ketamine use. Furthermore, 100% of participants agreed the information provided encouraged the consideration of a personal practice change.

Key words: ketamine, subanesthetic infusion, multi-modal, opioid sparing, opioid crisis, intraoperative, postoperative, pain, educational module, evidence-based practice, perioperative obese patients, Lewin's 3-Step Model, anesthesia providers

Implementation of a Simulation Based Educational Module to Reduce Perioperative Complications in Obese Patients: Intraoperative Subanesthetic Ketamine Infusions

Anesthesia providers are responsible for effectively managing a patient's pain response throughout the perioperative process. Opioids are a common class of medications that are used for patients undergoing a variety of surgeries. While their pain management effects are notable, sole use and increased dosing of opioids can have significant adverse effects. In the post-operative period, specifically, patients are at risk for ventilatory complications. During many invasive and stimulating procedures, patients have a breathing apparatus in place to protect the airway. Intraoperative medication administration has a direct impact on a patient's postoperative ventilatory status. Obese patients in this setting are particularly sensitive to the effects of opioid administration. These patients are at an increased risk for respiratory complications when the protective breathing apparatus is removed postoperatively. Subanesthetic ketamine infusions can be administered intraoperatively to effectively manage pain, reduce overall opioid requirements, and avoid postoperative pulmonary complications.

Chapter One: Introduction and Overview of the Problem of Interest

Background & Significance

The misuse of opioids in the United States (U.S.) is a growing health epidemic that has a significant fiscal impact on the American economy, costing $92 billion in 2016 (Levy et al., 2018). In 2018, it was estimated that prescription opioids have contributed to nearly 600,000 deaths in the U.S. and will directly contribute to an additional 180,000 deaths by 2020 (Leopold and Beadling, 2017). While beliefs attribute opioid misuse to illegal transactions, it is estimated that over two million citizens are addicted to legally prescribed opioids in the U.S. (Levy et al., 2018). According to Leopold and Beadling (2017), a more significant concern is that despite only contributing to 4.6% of the world's total population, the U.S. consumes over 80% of the world's opioids and 99% of the hydrocodone supply. The successful management of peri-operative pain contributes to reducing the incidence and prevalence of chronic pain in surgical patients, thus increasing patient satisfaction and outcomes while decreasing the need for chronic opioid use (Ladha et al., 2016).

In 2017, 68% of overdose deaths in the U.S. were related to illicit use of prescribed opioids (Centers for Disease Control, 2018). Deaths related to overdose continue to rise in the US. From 1999 to 2017, deaths increased six-fold making it a leading cause of injury-related deaths (Centers for Disease Control, 2018). Following these events, the Trump Administration declared the opioid crisis a public health emergency in the U.S., allocating $1.8 billion in funding to fight the crisis (U.S. Department of Health and Human Services, 2019). In response to the crisis, anesthesia providers have been challenged to adopt opioid sparing pain management techniques to reduce the contribution to the crisis.

According to the American Society of Anesthesiologists Task Force on Acute Pain Management, practice guidelines support the use of opioid sparing techniques for perioperative pain in all surgical patients (Ladha et al., 2016). The literature clearly demonstrates the efficacy of subanesthetic ketamine infusions; however, their use remains inconsistent among anesthesia providers (Ladha et al., 2016). Despite increasing doses of opioids, postoperative pain remains a significant challenge for both anesthesia providers and patients. Achieving effective pain management for perioperative patients is multifaceted. This challenge involves combining the unique aspects of a patient's history along with the pain that is linked to varying surgeries (Ladha et al., 2016).

The development of ketamine began in the late 1950s with the goal to produce an anesthetic agent that also produced analgesic effects (Mion, 2017). While use of ketamine has varied over the years, it has found resurgence through its use in multimodal anesthesia. Brown et al. (2018) explains multimodal anesthesia as a balanced approach to the delivery of anesthetics. Rather than exposing patients to high plasma concentration of a single medication, multimodal techniques allow for a lower dosing of multiple medications from varying classes. Using analgesics with varying mechanisms of action allows for pain to be managed at multiple receptor sites. Lower dosing of each medication also produces analgesic effects while minimizing side effects associated with higher dosing and plasma concentrations (Brown et al., 2018).

According to Chou et al., 2016, despite conventional unimodal methods for pain control, many patients still experience significant postoperative pain in the U.S. today. 80% of surgical patients experience post-operative pain with 75% of these patients reporting pain from levels of moderate to severe (Chou et al., 2016). Furthermore, the occurrence of severe post-operative pain comes with increased health care costs and significantly impacting a patient's recovery.

Uncontrolled pain leads to extended hospitalization and increased risks for nosocomial complications. Chou et al., (2016) explains that opioids can be minimized and potentially avoided in many patients. This can be achieved through the widespread availability of nonopioid analgesics that carry a more favorable side effect profile while producing significant postoperative analgesia. In correlation with this, it is suggested that anesthesia providers utilize nonopioid analgesics in multimodal approach for perioperative patients such as the use of subanesthetic ketamine infusions (Chou et al., 2016).

There are also associated risks for the development of chronic pain and opioid induced hyperalgesia (OIH) (Chou et al., 2016). While opioids manage pain, they are also associated with many adverse effects that lead to unfavorable outcomes and added health care costs (Brown et al., 2018). Adverse effects of opioids include post-operative nausea and vomiting (PONV) prolonged sedation, ventilatory depression, decreased gastric motility, and opioid induced hyperalgesia (OIH). OIH is related to repeated dosing of opioids that produces an increased sensitivity and pain response (Mao, 2016). Ketamine works to produce analgesia through mu receptors while antagonizing the stimulation of the NMDA receptor thus preventing OIH (Mion, 2017). Nonopioid analgesics commonly utilized in multimodal anesthesia consist of non-steroidal anti-inflammatory drugs (NSAIDs), magnesium, acetaminophen, gabapentin, lidocaine, and ketamine (Chou et al., 2016). As previously stated, multimodal anesthesia is a balanced approach to the delivery of anesthetics (Brown et al., 2018). Subanesthetic ketamine infusions are considered a component of this approach.

According to Stokes et al. (2019), obesity in the U.S. has dramatically increased in recent decades. In 1980, 15% of the adult population was considered obese. Current assessments revealed that in 2016, 40% of the adult population is considered obese. This population also

exhibits an increased incidence of obstructive sleep apnea (OSA) and are therefore predisposed to opioid induced airway obstruction post operatively. Increasing the use of opioids for perioperative pain management places this population at increased risk for perioperative morbidity and mortality (Sultana, 2017). In obese and non-obese patients, the use of opioids can further exacerbate symptoms of OSA due to blunting of chemoreceptor responses to hypoxemia and hypercarbia. Opioids also decrease pharyngeal muscle tone, increase upper airway collapsibility leading to obstruction, and worsen existing sleep apnea. (Weinbroum, 2018).

Increased opioid administration in obese patients can also lead to delays in postoperative mobility. Delays in rehabilitation can further potentiate respiratory complications, prolonging length of stay and increasing health care costs (Weinbroum, 2018). The use of ketamine is favorable in this patient population as it has an appealing safety profile in obese patients. While this population is prone to develop postoperative respiratory obstruction, hypoxia, and deep sedation with perioperative opioid use, ketamine infusions are useful as analgesic adjuvants while minimizing respiratory depression and narcotic consumption (Weinbroum, 2018).

PICO Question Guiding Inquiry

According to The American Pain Society Practice Guideline for the Management of Acute Postoperative Pain and the American Society of Anesthesiologists Task Force on Acute Pain Management practice guidelines, multimodal techniques are useful in all perioperative patients and should be regularly employed to support perioperative pain management (Chou et al., 2016). Unfortunately, although current scholarly evidence supports the use of multimodal anesthetic techniques, the utilization of these practices is significantly varied among providers according to Ladha et al. (2016).

Originally, this EBP project was developed to provide an online educational intervention regarding subanesthetic ketamine infusions as a multimodal opioid sparing technique for perioperative pain control. This educational intervention was to be implemented in a hospital setting for anesthesia providers in lecture format. Learners would complete a pre-educational survey, listen to the lecture and complete a post survey. Due to the challenges related to COVID-19 pandemic, this project was altered to an online educational intervention in a simulation-based format. The PICO question regarding this project is: Among anesthesia providers, does an online simulation-based educational intervention increase knowledge of risk reduction strategies using standardized assessments or multimodal pain management in obese patients?

System and Population Impact

Upon implementation, anesthesia providers will be asked to voluntarily complete an online based educational module regarding the use of subanesthetic ketamine infusions. Through the implementation of this evidence-based practice project, the population of learners will be provided with evidence-based strategies for caring to obese patients in the perioperative period. These strategies will help to manage common risk factors associated with this patient population. The anticipated system and population impact of this project is multifactorial. Overall, the efforts of this module will seek to increase anesthesia providers' knowledge of utilizing subanesthetic ketamine infusions as a perioperative risk reduction strategy for obese patients. Learners will also be provided with information surrounding the opioid crisis. In relation to this crisis, these providers will be encouraged to consider a personal practice change by utilizing the effective opioid sparing techniques discussed in the learning module. With the utilization of the presented education, the system and population will effectively manage perioperative pain will reducing the consumption of opioids in obese patients.

Purpose

The purpose of this evidence-based project was to determine whether an online simulation-based educational intervention increases the knowledge of risk reduction strategies in perioperative obese patients. Implementation consisted of an electronically delivered educational module simulation for anesthesia providers regarding the appropriate application of subanesthetic ketamine infusions for perioperative pain control. At the completion of the module, the goal was for anesthesia providers to increase knowledge and have a better understand of subanesthetic ketamine infusions. With this knowledge, anesthesia providers were asked via survey to consider making a personal practice change that aligns with the material covered in the educational module.

It is not enough for research merely to support the use of subanesthetic ketamine infusions for pain control; the research must be effectively implemented into practice. Another goal of this project is to determine if an educational intervention is effective for increasing a learner's knowledge. According to Plemmons et al. (2019), educational interventions are effective in producing EBP implementation and practice change. Plemmons et al. (2019) assessed the infection control practice of anesthesia providers. The goal of this EBP project was to provide an educational intervention to improve infection control practices among anesthesia providers. A total of 95 observations took place pre and post educational intervention. Following implementation, Plemmons et al. (2019) saw a 71.9% increase in anesthesia provider compliance in accordance with the clean anesthesia workspace educational intervention guidelines.

Continuing, simulation-based education is an effective method for the implementation of practice changes in health care today. This type of education allows health care providers to experience the management of a variety of patient scenarios in a safe and reproducible

environment. Through simulation tools, providers are able to increase confidence in clinical decision making while expanding clinical knowledge (Green et al., 2016). More specifically, anesthesia providers are encouraged to regularly utilize simulation-based education to train in the management of crisis clinical scenarios (Green et al., 2016). Swerdlow et al. (2020) considers screen-based simulation (SBS), an important tool for current education of anesthesia providers. Beyond that, in a RCT comparing the use of high fidelity and low fidelity SBS for effectively teaching anaphylaxis treatment, there was no significant difference in outcomes. Therefore, if accurate, even cost effective and low fidelity SBS is effective in the education of anesthesia provider (Swerdlow et al., 2020).

Objectives

A central goal in the implementation of this project is to translate current evidence-based risk reduction strategies for perioperative obese patients into practice. This project was designed to increase awareness of opioid sparing multimodal techniques, specifically, subanesthetic ketamine infusions. The expected outcome is that anesthesia providers, as online learners, will increase knowledge and adopt a practice change supported by the presented evidence. Ultimately, utilization of this projects information will result in minimizing the unimodal use of opioids in perioperative pain control. The objectives of this project are:

1. By the end of the educational intervention, participants will increase knowledge regarding subanesthetic ketamine infusions with a 30% increase in post-test scored when compared to the pre-test scores.
2. After the completion of the module, at least 50 % of learners will indicate a willingness to utilize the information from the educational intervention and support a personal practice change.

Chapter Two: Review of the Evidence/ Literature

Search Methodology

A preliminary search of intraoperative ketamine infusions was conducted through Google and Google Scholar to estimate the research available prior to exhaustive exploration of the topic. Search terms used were subanesthetic and ketamine and infusion and pain yielding 2,190 articles. Results were further limited to systematic reviews, meta-analyses, and randomized controlled trials (RCT). Through all research, the evidence hierarchy was considered when determining the validity of research results. Studies that did not exhibit the key words included in the search articles were excluded. The search was also narrowed to the adult patient population. Next, the National Center for Biotechnology (NCBI) was used to derive information such as systematic reviews regarding the subject matter. An advanced search using the terms, intraoperative AND ketamine infusion, resulted in 2,072 articles. The search was again refined using full text articles from 2014 through 2020, further narrowing results to 1,120 articles. The most recent and highest level of evidence was selected such as systematic reviews and randomized control trials that pertained to the topic of study. Using exclusion criteria results were narrowed to 46 articles.

EBSCHost was utilized to conduct similar research by narrowing the databases to Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsychARTICLES, and PsychINFO. The key words used consisted of intraoperative AND ketamine AND infusion, yielding 66 results. Search results were restricted to systematic reviews, randomized control trials and meta-analysis to further narrow to 31 articles between 2014 and 2019. The search terms of intraoperative, postoperative, pain, multimodal, subanesthetic, and ketamine infusion were search in various formats. From these search parameters, 330 studies were found with 203

duplicate studies from previous research. The remaining 127 studies were further reduced to 15 articles according to exclusion criteria.

Findings

The use of ketamine for perioperative pain control is an effective component of multimodal anesthesia (Sultana et al., 2017). As a N-Methyl-D-aspartate (NMDA) noncompetitive antagonist, ketamine is a rapid acting nonbarbiturate general anesthetic that exhibits its effects directly on nociception through NMDA receptors (Bajwa & Haldar, 2015). The inhibition of nociceptive transmission produces profound diminishing effects on the perception of pain in the brain. The descending inhibitory controls of pain modulation in the central nervous system are also affected by preventing sensitization of the nociceptive pathway (Bajwa & Haldar, 2015). Nociception is neural encoding associated following the occurrence of tissue damage. This four-step process consists of transduction, transmission, perception, and modulation of pain from the peripheral to central nervous system. The initiation of transduction occurs when the energy from noxious stimuli is converted into an action potential through fast A-delta and slow C fibers peripheral nociceptors (Morgan et al., 2013).

A noxious stimulus can be a mechanical, thermal, of chemical trauma that occurs in peripheral tissue and leads to a series of biochemical events that stimulates the transduction of the pain signal to the dorsal horn of the spinal cord (Morgan et al., 2013). Next, transmission occurs when the actional potential from peripheral nociceptors enters the central nervous system (CNS). In the CNS, the action potential travels via the spinothalamic anterolateral pathway in an ascending tract that is responsible for pain, temperature, itch, and crude touch (Morgan et al., 2013). From this point perception is when the signal is recognized by the brain through structures such as the amygdala sensory cortex, hypothalamus, and anterior cingulate cortex. Finally,

modulation occurs through descending mechanisms in the spinal cord that can either suppress or enhance pain. Overall, the goal of descending efferent modulation is to suppress pain transmission from the brain to the brainstem and dorsal cord of the spinal cord (Morgan et al., 2013).

While high dosages of opioids produce marked analgesia through mu receptors, it is inevitably curtailed through an increased pain response know as OIH (Mion, 2017). Historically, the cause of heightened pain following surgery was believed to be related to a lack of narcotics throughout surgery. This led to increased opioid administration in the post-operative setting, which caused OIH. While hyperalgesia is produced through stimulation of the NMDA receptor, ketamine works to produce analgesia through the mu receptor while antagonizing the NMDA receptor and prevent OIH (Mion, 2017). In association with recent trends in health care to minimize narcotic usage, ketamine has been employed to produce perioperative analgesia with the added benefit of producing NMDA receptor antagonism and reducing opioid requirements (Mion, 2017).

The use of subanesthetic ketamine infusions for pain control is rooted in current literature through meta-analyses, systematic reviews, and RCT's. According to Schwenk et al. (2018), while ketamine infusions have been utilized for many years in acute pain clinics, there has been a rapid increase in the use of infusions throughout the perioperative environment to minimize narcotics. Considering the wide variability of use, the American Society of Regional Anesthesia and Pain Medicine (ASRAPM), the American Academy of Pain Medicine (AAPM), and the American Society of Anesthesiologists' (ASA) Committees on Pain Medicine and Standards and Practice Parameters combined to formulate a set of consensus guideline for the safe use of ketamine for acute pain (Schwenk et al., 2018). The Ketamine Guidelines Committee focused on

the areas of acute pain indications and contraindications compared to chronic pain, review of evidence, and the subanesthetic dosage range.

Schwenk et al. (2018) states the ketamine guidelines committee concluded that subanesthetic ketamine infusions are beneficial for patients undergoing surgeries associated with severe pain, such as open abdominal and thoracic surgery. Not limited to these surgeries, the committee also recommends subanesthetic ketamine infusions for patients undergoing orthopedic procedures such and limb and spine cases (Schwenk et al., 2018). Furthermore, patients with chronic opioid use and tolerance were found to benefit from acute on chronic exacerbation of pain in the surgical setting. Finally, Schwenk et al. (2018) recommends the use of subanesthetic ketamine infusions for patients with obstructive sleep apnea (OSA) that are at risk for respiratory depression following surgery.

Dosing guidelines for subanesthetic ketamine infusions vary throughout literature. The analgesic properties of ketamine are produced at low plasma concentrations between 100 to 200ng/ml (Schwenk et al., 2018). This is important because as ketamine is administered in higher doses patients exhibit undesired psychomimetic effects. Plasma concentration following the induction of general anesthesia with high dose ketamine increases plasma concentration from 9,000 to 25,000 ng/ml, far beyond analgesic concentration and in the range of psychomimetic effects (Schwenk et al., 2018). According to the consensus guidelines, subanesthetic dosage range among studies very. According to the literature review, the majority studies that successfully used ketamine for acute pain administered a bolus of less than 0.5 mg/kg followed by an infusion less than 0.5 mg/kg per hour (Schwenk et al., 2018).

Furthermore, subanesthetic ketamine is initially administered through intravenous bolus of 0.3-0.5 mg/kg prior to incision with the addition of an infusion at 0.1- 0.2 mg/kg/hr. Similarly,

according to Chou et al. (2016) systematic review, ketamine was administered preoperatively, intraoperatively, and post operatively. Intraoperative dosing was first given in a bolus form of 0.15-2mg/kg prior to the initial incision and skin closure (Chou et al., 2016). A subsequent infusion was administered after the initial skin incision at a rate of 0.12mg/kg/hour to 2mg/kg/hour. Ketamine was associate with psychomimetic hallucinations at higher dosage ranges (Chou et al., 2016).

According to Schwenk et al. (2018), through a meta-analysis of 14 randomized trials with 649 patients, the use subanesthetic ketamine was causally related to a decrease in pain scores. There was also a subsequent reduction in morphine consumption for the initial 24 hours following spine surgery. Ketamine was administered to patients from an initial bolus between 0.15 to 10 mg/ kg with an intraoperative infusion of ranging from 0.06 to 5.0 mg/kg per hour without reported incidence of psychomimetic side effects in patients (Schwenk et al, 2018). Ketamine dosing according to the consensus guidelines limits the precision ketamine bolus to a maximum dose of 0.35mg/kg and infusions less that 1mg/kg (Schwenk et al., 2018). According to Kaur et al. (2015) in a randomized trial, large IV doses of ketamine exceeding 2mg/kg along with rapid administration of ketamine exceeding 40mg/min was associated with the manifestation of psychomimetic side effects. Additionally, the study suggest that the occurrence of side effects was minimal when ketamine infusions were less than 2.5 mg/kg/min (Kaur et al., 2015).

Kaur et al. (2015) analyzed a total of 80 patients undergoing open abdominal cholecystectomy surgery and found that the use of subanesthetic ketamine produced desired analgesic effects up to 6 hours following the surgery. In this case, patients were given a pre-incision IV bolus of ketamine at 0.2-mg/kg followed by an infusion at a rate of 0.1-mg/kg/h. Pain

scores and opioid consumption were significantly reduced in the first 6 hours postoperatively. Patients in this study significantly reduced pain scores and subsequent opioid use compared to patients who did not receive ketamine. Also, adverse side effects were not reported in patients who received intraoperative ketamine (Kaur et al., 2015).

Jouguelet-Lacoste et al., (2015) researched the use of subanesthetic ketamine for perioperative analgesia through a systematic review of 39 clinical trials and five metanalyses in patients who received ketamine between 1966 and 2013. Surgeries consisted of orthopedic spine, cardiac surgery, hip arthroplasty and ear, nose, and throat (ENT) surgery. In four meta-analyses, reported pain scores within 24 hour postoperatively were found to be significantly reduced in 87.5% of patients who received subanesthetic ketamine (Jouguelet-Lacoste et al., 2015). Three metanalyses exhibited a reduction in opioid consumption between 30% to 50 %. Considering the clinical trials, post-operative pain scores and opioid administration was compared to those that did not receive ketamine. Subanesthetic ketamine was administered at a rate of 1.2mg/kg/hour or less without a pre-incision bolus. The use of subanesthetic ketamine infusions in this case were found to reduce opioid use by 40% with no report on significant adverse effects within 48 hours (Jouguelet-Lacoste et al., 2015).

Schwenk et al. (2018) state that the use of subanesthetic ketamine infusions should be avoided in patients with uncontrolled hypertension and associated cardiac disease. Furthermore, subanesthetic ketamine should be also avoided in liver failure, parturients, patients with active psychosis, seizures, and patients exhibiting elevated increased intracranial pressure. Patients with a history of active psychosis are at an increased risk of developing adverse psychomimetic effects (Schwenk et al., 2018). According to practice guidelines, the psychomimetic effects of

ketamine can be reduced and/ or prevented through pretreating the patient with 1 to 2 mg of midazolam prior to infusion (Schwenk et al., 2018).

Pendi et al. (2018) completed a meta-analysis of randomized controlled trials (RCTs) to evaluate the effectiveness of perioperative supplemental ketamine on reducing narcotic usage in spine surgery. There was a total of 14 RCTs with 649 patients were utilized for the meta-analysis. Patients who were administered adjunctive ketamine reported lower pain scores exhibited less morphine equivalent consumption at 4-, 8-, 12-, and 24-hours following spine surgery. The occurrence of adverse effects from ketamine was not statistically significant. The study concluded that supplemental perioperative subanesthetic ketamine reduces postoperative narcotic consumption (Pendi et al., 2018).

Limitations

Although sufficient evidence exists for the efficacy of subanesthetic ketamine infusions, limitations are present in the applied studies. Each study utilized a varying dosage range of subanesthetic ketamine infusions in surgery. Although each study remained in a similar administration range, they failed to detail the duration of each infusion. The consensus guideline on the intravenous use of ketamine shows that there is a need for larger studies that determine dose ranges for specific acute pain conditions. In addition, studies varied on the application of utilizing a bolus of ketamine prior to starting the infusions versus solely using the subanesthetic infusions.

The assessment of pain score methods varied among the studies, resulting in a lack of consistent pain reporting, and reducing the accurate determination of the effect of subanesthetic ketamine infusion analgesic effects. Pendi et al. (2018) reported there may have been an underreporting of the adverse effects associated with the use of the infusions as this study only

focused on pain management and opioid consumption. Also, Jouguelet-Lacoste et al. (2015) noted that there was insufficient information to determine efficacy of ketamine analgesics effects based on the type of surgery. This study suggests while subanesthetic ketamine infusion display efficacy for pain control, precise dosage ranges remain unknown.

Green et al. (2016) states while simulation is clearly an effective method educating anesthesia providers, the most effective methods are still being determined. At this point, expense in simulation equipment is a significant limiting factor for the use of implementation. Furthermore, there is a need for high fidelity simulation tools that are consistent with real like experiences. Swerdlow et al. (2020) exhibits that there is a lack of published data supporting the use of SBS in distance learning for anesthesia providers. According to Moore (2017), where comparing the implementation of an EBP in online and in person format, there was no statistically significant differences among the two groups. The implementation of an EBP in an online simulation-based formation consists of a variety of limitations. As opposed to in person education, the online format does not allow for learners to seek clarification of content through real time questions (Moore, 2017). Considering subanesthetic ketamine infusions, the overall consensus therapeutic dose range variers among sources in patient populations outside of open abdominal, orthopedic, and neuro-skeletal surgeries.

Conclusions

Pain management is a central role for anesthesia provider throughout the perioperative process. The opioid crisis has placed a precent on anesthesia providers to reduce opioid usage in practice. Subanesthetic ketamine infusions are useful tool in combating the opioid while effectively managing perioperative pain. Ketamine is a N-Methyl-D-aspartate (NMDA) noncompetitive antagonist and is an adjunct used with narcotics and other multimodal

techniques. Subanesthetic ketamine infusions are an effective an inexpensive tool for anesthesia providers to minimize narcotic usage in the perioperative period.

Dosing of subanesthetic infusions is based on ideal body weight (IBW) (Sultana et al., 2017). According to the consensus guidelines, subanesthetic ketamine is initially administered through intravenous bolus of 0.3-0.5 mg/kg prior to incision with the addition of an infusion at 0.1- 0.2 mg/kg/hr. (Schwenk et al., 2018). According to Weinbroum (2018), obese patients exhibit an increased incidence of obstructive sleep apnea (OSA) and are therefore predisposed to opioid induced airway obstruction post operatively. While this population is prone to develop postoperative respiratory obstruction, hypoxia, and deep sedation with perioperative opioid use, ketamine infusions are useful as an analgesic adjunct while minimizing respiratory depression and narcotic consumption (Weinbroum, 2018).

Chapter Three: Organizational Framework of Theory

Conceptual Definitions of Theory

The concept of evidence-based practice has been increasing for the past two decades in an effort to promote quality care and improve patient outcomes (Manchester et al., 2014). Despite these efforts, poor knowledge translation of research findings has significantly hindered the successful implementation of many evidence-based practices within the clinical setting (Manchester et al., 2014). Theoretical frameworks have been shown to facilitate successful implementation, and the guiding theoretical framework used throughout this project was Kurt Lewin's change model (Abd el-shafy et al., 2019; Manchester et al., 2014).

Kurt Lewin was a social scientist whose aim was to resolve social conflicts of minority and disadvantaged people (Burnes, 2004). He believed that the resolution of conflict could improve the human condition and stressed group behavior, versus individual behavior, should be the main focus of change; however, Lewin noted that group change was transient, and permanency was a more a desirable objective (Burnes, 2004). Lewin incorporated his Field Theory, Group Dynamics, and Action Research into a 3-Step model to facilitate change at group, organizational, and societal levels (Burnes, 2004).

Lewin's theory of change is comprised of three stages: unfreezing, moving, and refreezing (Shirey, 2013). He believed that human behavior was balanced by driving and restraining forces, and for change to occur, the equilibrium needed to be unfrozen before new behaviors can be implemented (Burnes, 2004). Lewin's model was also adopted in nursing theory. An example of unfreezing may involve a nurse leader who identifies a problem and acknowledges a need for change (Shirey, 2013). Nurse leaders must challenge the status quo and create a sense of urgency among stakeholders (Hussain et al., 2018; Shirey, 2013). Additionally,

the forces advocating for change must be greater than resistant forces in order for change to occur (Hussain et al., 2018).

The second stage is moving. Lewin aimed to account for all forces against change, and through a cycle of research, action, and more research, this enabled groups and individuals to move to a more desirable set of behaviors (Burnes, 2004). In regard to nursing theory, this stage involves employees making the change and striving for a new status quo. It is the inner movement that occurs within individuals in response to change, which necessitates unfreezing to move in a new direction (Shirey, 2013). This stage encourages people to perform the proposed change, with attitudes becoming more favorable towards the change while resistance decreases (Manchester et al., 2014).

The third stage is refreezing. Lewin viewed successful change as a group process because if the group failed to change the norm or routine, then changes to individual behavior would not be sustained (Burnes, 2004). This stage ensures that change becomes rooted into the existing system to produce a new status quo (Shirey, 2013). Reinforcing the change is critical to its sustainability over time (Shirey, 2013). If the change is not adopted as part of the new normal, the organization will return to the status quo (Manchester et al., 2014). It was imperative to design this project using Lewin's change theory in order to maximize its success.

Relationship of Theory to Scholarly Project

Lewin's 3-Step model was used as a guide throughout this project. To promote unfreezing, a simulation-based educational module was presented to anesthesia providers to highlight the significance of preoperative OSA screening and use of multimodal analgesic techniques, specifically ketamine, in the obese population. The dangers of undiagnosed and untreated OSA in obese surgical patients were discussed in addition to the deleterious effects of

opioids in this population. A scenario of a preoperative assessment, which explained OSA screening using the STOP-Bang Questionnaire, was presented to participants as part of the educational module. A second scenario highlighting the benefits of sub-anesthetic doses of ketamine to high-risk patients was also presented to participants. Additionally, a pre- and post-test was created to measure provider knowledge of these topics.

After presenting and identifying the problem to anesthesia providers, the educational module was designed to promote movement or change as described by Lewin. Due to the COVID-19 pandemic, measuring results could not be done within the clinical setting. In compliance with social distancing protocols to help limit the spread of COVID-19, participants were able to view the online module regarding OSA screening and ketamine usage. Participants were then inquired about implementing a practice change to incorporate OSA screening and sub-anesthetic ketamine infusions into everyday practice.

Reinforcement to facilitate sustainability was the main goal to promote Lewin's stage of refreezing. The educational module will remain accessible and free of charge to all anesthesia providers who wish to view it. This project has been presented to providers at various clinical sites, with the goal to educate, increase awareness, and facilitate a practice change among anesthesia personnel. Notably, while the COVID-19 pandemic has created uncertainty for continuing education among health care professionals, the utilization of online learning plus Lewin's 3-Step model has helped meet the educational needs of anesthesia providers during this health care crisis.

Chapter Four: Project Design

Institutional Review Board (IRB) Approval

The initial goal of this DNP project was to provide an educational intervention of subanesthetic ketamine guidelines to anesthesia providers at Tower Health: Reading Hospital. Current scholarly evidence supports the use of subanesthetic ketamine infusions as an opioid sparing technique, but the utilization of these practices varies significantly among anesthesia providers (Ladha et al., 2016). A gap analysis was completed at Tower Health: Reading Hospital regarding the need for an evidence-based practice. An initial interview was held with the Chief of Anesthesiology, Dr. David Matson, to determine practice improvement needs among anesthesia providers at the institution. During this meeting, Dr. Matson explained the need for increased utilization of multimodal techniques for perioperative pain management, specifically, through the use of subanesthetic ketamine infusions. Dr. Matson described the goal of such use would be to increase perioperative pain control with decreased opioids consumption.

With the rise of the global pandemic, the implementation of this evidence-based practice project shifted from an in-person educational intervention at Reading Hospital to an online-based education and simulation learning module for anesthesia providers. This project was further modified to collaborate with fellow student Andrew Hornick's topic of implementing the STOP-BANG assessment to identify OSA in perioperative patients. The adjusted project design of incorporating these topics together was utilized to focus on risk reduction strategies for perioperative obese patients. Together, these topics focused on the identification of obstructive OSA in perioperative patients and the utilization of subanesthetic ketamine infusions to minimize opioid usage subsequently reducing ventilatory complications in obese patients. As a group, IRB approval at Cedar Crest College (CCC) was requested in August of 2020. With revisions of the

initial application, CCC IRB approval (Appendix A) was granted on August 28th, 2020. At this same time, the research description supplement (Appendix B) and informed consent (Appendix C) were approved by CCC IRB prior to use.

Implementation Plan

The implementation of the evidence-based practice project began online from February 13th, 2021 through March 6th, 2021. A detailed summary of the proposed educational module with indication of voluntary and anonymous completion was provided. Implementation of this evidence-based practice project took place in an online based educational module covering the STOP-BANG assessment and subanesthetic ketamine infusions. The module consisted of a filmed clinical scenario covering each topic. Next, education was provided by each group member via a video voice over PowerPoint of each topic. The educational module was completed by anesthesia providers such as certified registered nurse anesthetists (CRNA) and student registered nurse anesthetists (SRNA) on a voluntary basis.

Anesthesia providers from previous clinical rotations were invited via personal email to voluntarily complete the educational module. Tower Health: Reading Hospital anesthesia providers were first to be provided the opportunity to complete the education as this was the initial site of implementation. The educational module was subsequently provided to anesthesia providers various neighboring clinical sites and accredited nurse anesthesia program in Pennsylvania. In a combined group effort, the goal was for at least 20 anesthesia providers among sites to complete the educational module. Through the implementation of this evidence-based practice project, the population of learners were provided with strategies supported by research for utilizing subanesthetic ketamine infusions.

Data Collection Tools

Participants were asked to complete pre-test survey (Appendix D) prior to the education and post-test survey (Appendix E) following education. Pres-test surveys were utilized to determine the learner's years of anesthesia experience, baseline knowledge of the subject materials and current use of subanesthetic ketamine infusions. Post-test surveys were used to determine the learner's knowledge following education. Furthermore, post-test surveys also inquired about the learner's perception of the educational modules efficacy and the likelihood of integrating the information provided into future practice.

The completion of all surveys was both voluntary and anonymous. All surveys utilized in this project had been previously approved by Cedar Crest College IRB. The surveys were accessed within the Wix website of the educational module through a web-based link to Survey Monkey ™. Both surveys took less than 10 minutes for the participants to complete. Survey results were stored in a password-protected computer through the survey monkey website. Results were further password protected through the website site and only available to the members of this project.

Resources Needed and Budget Justification

The simulation lab in the graduate nursing department at Cedar Crest College was utilized for the filming of the project. All props and materials were comprised of materials owned by the Cedar Crest College graduate nursing department. The preoperative waiting room and operating room was the site of filming in the department. The bariatric patient simulation suit was utilized for the patient in the project's main scenario. Video recording materials consisted of a 32gb SD card, Rhode ™ Microphone, camera tripod stand and a Panasonic ™ video camcorder. These materials were previously owned by the members of the project. VSDC

™ Free Video Editor and DaVinci Resolve 16 ™ were employed for video editing. A one-year subscription of WIX ™ was purchased to create a website for the evidence-based practice project. Screen-Cast-Omatic ™ was also used to record the video voice over component of each of the topics (Appendix F).

Chapter Five: Implementation Procedures and Processes

Implementation of the DNP project was accomplished by two Cedar Crest College doctoral students via an online educational module on perioperative risk reduction strategies of obese patients. Topics included OSA, the STOP-Bang Questionnaire, anesthetic considerations in patients with diagnosed and suspected OSA, and sub-anesthetic ketamine infusions. Education was provided via voiceover PowerPoint and a simulation-based video. Creation of the educational module was accomplished using a laptop with internet access, Microsoft Office 365™, Screencast-O-Matic ™, Wix.com, Inc. website creator, a Panasonic ™ video camera and tripod, SD card, and DaVinci Resolve 16™ editing software. Additionally, Cedar Crest College's simulation rooms were utilized to film the simulation-based scenarios. This required access to the simulation rooms, hospital bed, pillow, linen, obesity simulation suit, and clipboard. The Nursing Simulation Center manager also assisted with scheduling and development of the simulation-based scenario.

Participants consisted of CRNAs and SRNAs from various clinical sites and accredited nurse anesthesia programs in Pennsylvania. Participants were recruited via convenience sampling via text messages and personal email addresses and were invited to complete the education voluntarily and anonymously. The recruitment email (Appendix G) contained a description of the research, a hyperlink to the educational module, and contact information of the principal investigators. Participants were informed that their involvement in the project was voluntary and anonymous with the right to withdraw from participation at any time. A student-designed website was created through Wix.com, Inc. to house the module. Participants were directed to the website and educational module, which contained informed consent and research description. Completion of the module was self-paced according to the individual participant.

The videos could be viewed multiple times, but the pre- and post-tests could only be completed once each throughout the implementation period from February 13, 2021 to March 6, 2021.

To measure baseline knowledge, participants were instructed to complete a pre-test prior to viewing the educational modules. Participants then viewed the 40-minute educational module consisting of a 10-minute simulation scenario of the perioperative process and two 15-minute videos covering the risk reduction strategies. Following this education, learners were instructed to complete the post-tests embedded in the student-created website. The post-tests were utilized to demonstrate an increase in knowledge of the topics and likelihood of anesthesia providers to implement a personal change in clinical practice supportive of the education found in the module.

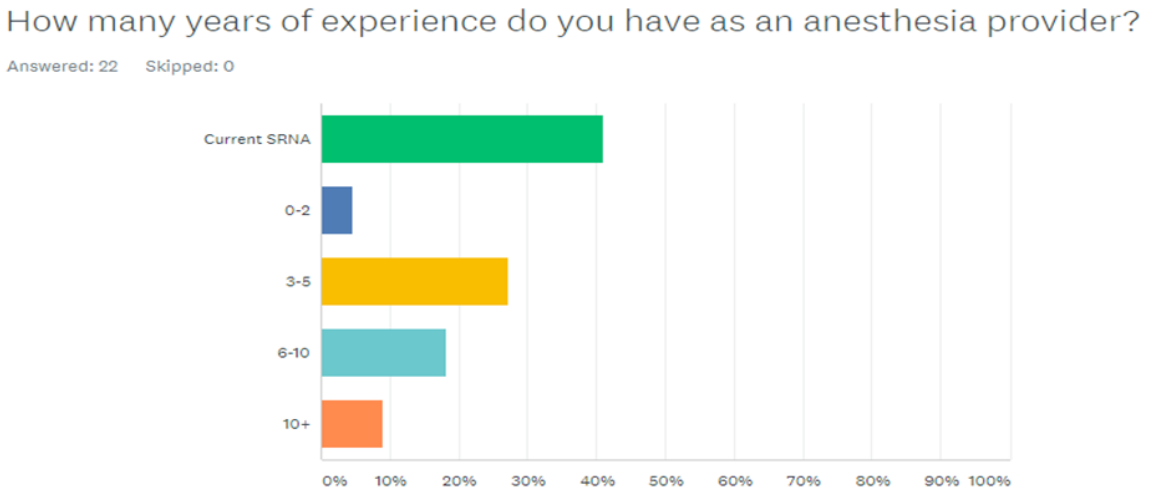
Data was collected and analyzed using Survey Monkey ™ and Microsoft Excel ™. Each paired knowledge-based question was analyzed using the McNemar test due to the nominal nature of each question and non-normal distribution pattern. A paired t-test was then used to analyze all knowledge-based questions collectively. These statistical tests were chosen to identify if knowledge increased after participants viewed the module. Upon completion of the post-test, participants were able to maintain access to the website as a reference. The website also provided links to the research utilized to formulate this evidence-based practice project.

Chapter Six: Evaluation and Outcomes

Over a three-week implementation period, 45 anesthesia providers were sent a recruitment email to voluntarily complete the learning module. Convenience sampling was used for recruitment. In total, 22 anesthesia providers completed the pretest, educational module, and post-test. The pretest consisted of nine questions. The initial question assessed years of anesthesia experience and criteria ranged from current SRNA to over 10 years of CRNA experience. Learners from this sample size consisted of 13 CRNAs and nine SRNAs. Considering the CRNA group, one participant had zero to two years of experience, six participants three to five years, four had six to 10 years, and one had over 10 years of experience (Figure 1).

Figure 1

Anesthesia Provider Demographics



ANSWER CHOICES	RESPONSES	
Current SRNA	40.91%	9
0-2	4.55%	1
3-5	27.27%	6
6-10	18.18%	4
10+	9.09%	2
TOTAL		22

Evaluation

In the pretest, four questions were asked regarding subanesthetic ketamine infusions. The McNemar test was utilized to evaluate ketamine knowledge-based question and determine the relationships between pre-test and post-test results (Adedokun & Burgess, 2012). To determine statistical significance of the surveys the alpha level was set to 0.05. One question surveyed the providers current use of ketamine infusions and three ketamine knowledge-based questions. The average score of the pretest consisting of OSA and subanesthetic ketamine infusions questions was a 56% among learners. When asked the site of action for ketamine, 68% (n= 15) of learners correctly identified the receptor site with nearly 32% (n=7) incorrectly identifying this location. 36% (n=8) of learners correctly identified the cause of opioid induced hyper algesia (OIH) and 82% (n=18) of participants agreed that the use of ketamine infusions reduce perioperative pain scores and opioid requirements.

The post-test consisted of 10 total questions among both topics with an increased post educational average score to 94%. To determine statistical significance, a paired t-test was used between pre-test and post-test scores after the close of the implementation period. The p-value was less than the set alpha level of 0.05 at a value calculated to be 0.0000001, indicating that the results of the educational module hold statistical significance. In the post-test, three of the five questions regarding subanesthetic ketamine infusions questions were knowledge based.

Ketamine Knowledge Question 1

Ketamine is a noncompetitive? For this question, there was a 32% increase in correct responses when compared to the pre-test responses. According to the McNemar test,

corresponding p-value is 0.023342 (Table 1). Since this value is less than the set alpha of 0.05, there is statistical significance.

Table 1

Ketamine Receptor Site Question 1

	Test 2 positive:	Test 2 negative:	
Test 1 positive:	15	0	15
Test 1 negative:	7	0	7
	22	0	22

Note: McNemar chi-squared statistic is 5.142857; Corresponding p-value is 0.023342

Ketamine Knowledge Question 2

Opioid-induced hyperalgesia (OIH) is caused by? (select two). For this question, there was a 27% increase in correct response when compared to pre-test responses. According to the McNemar test, the p-value is 0.001565. With the alpha value set to 0.05 these results indicate statistical significance.

Table 2

Ketamine OIH Question 2

	Test 2 positive:	Test 2 negative:	
Test 1 positive:	9	0	9
Test 1 negative:	10	3	13
	19	3	22

Note: McNemar chi-squared statistic is 10.000000; Corresponding p-value is 0.001565

Ketamine Knowledge Question 3

The utilization of perioperative subanesthetic ketamine infusions have been proven to reduce perioperative opioid consumption and decrease postoperative pain scores with few

adverse side effects (TRUE OR FALSE). For this question, these was an 18% increase in post-test scores when compared to the pre-test. According to the McNemar test, the p-value is 0.133614. With the alpha value set to 0.05, these results do not indicate statistical significance.

Table 3

Ketamine True or False Question 3

	Test 2 positive:	Test 2 negative:	
Test 1 positive:	18	0	18
Test 1 negative:	4	0	4
	22	0	22

Note: McNemar chi-squared statistic is 2.250000; Corresponding p-value is 0.133614

Table 4

Paired t-test Comparing Pre- and Post-test OSA and Ketamine Knowledge Questions

	Pre-Test	*Post-Test*
Mean	55.84409	94.15455
Variance	620.1687	71.14039
Observations	22	22
Pearson Correlation	0.286055	
Hypothesized Mean Difference	0	
df	21	
t Stat	-7.51895	

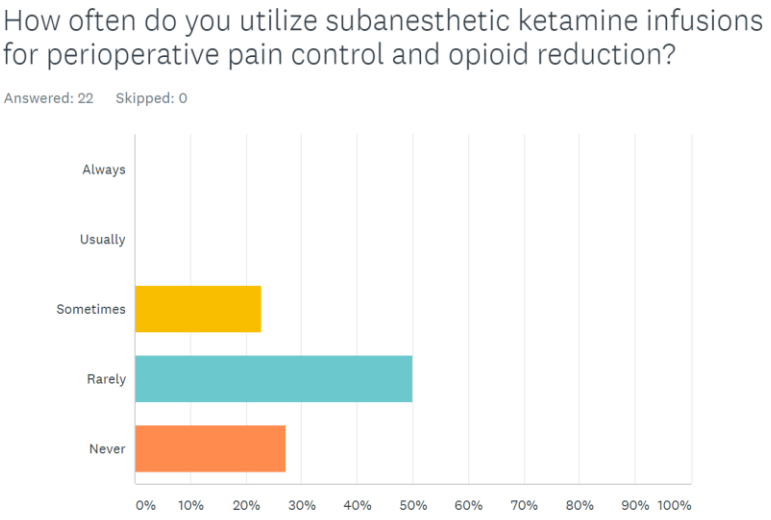
P(T<=t) one-tail	1.1E-07
t Critical one-tail	1.720743
P(T<=t) two-tail	2.19E-07
t Critical two-tail	2.079614

Prior to the pandemic, this project included a gap analysis of Reading Hospital. An interview was held with the chief of anesthesia at this institution, and it was determined there was a need for increased utilization of multimodal techniques for perioperative pain management, specifically, through the use of subanesthetic ketamine infusions. Next, a survey was administered by a Reading Hospital employee, to complete a further needs assessment of the clinical site's anesthesia providers. The specific goal of the survey was to determine the current usage of subanesthetic ketamine infusions among anesthesia providers. Overall, the gap analysis concluded that anesthesia providers were interested in using subanesthetic ketamine infusions for pain control but lacked the knowledge of appropriate administration for patients. Due to the knowledge deficit, there was a lack of use among providers.

Following implementation and review of the data, this project showed that while the module was offered to anesthesia providers outside of the original need's assessment, many providers were also unfamiliar with the use of this anesthetic technique similar to the information found in the gap analysis. According to the pre-test surveys, 50% (n=11) of participants answered 'rarely' when asked about the use of subanesthetic ketamine infusions in practice followed by 27% (n=6) answering 'never' using the infusions. Therefore, 77% of participants 'rarely' to 'never' utilize subanesthetic ketamine infusions (Figure 2).

Figure 2

Assessment of Ketamine Use

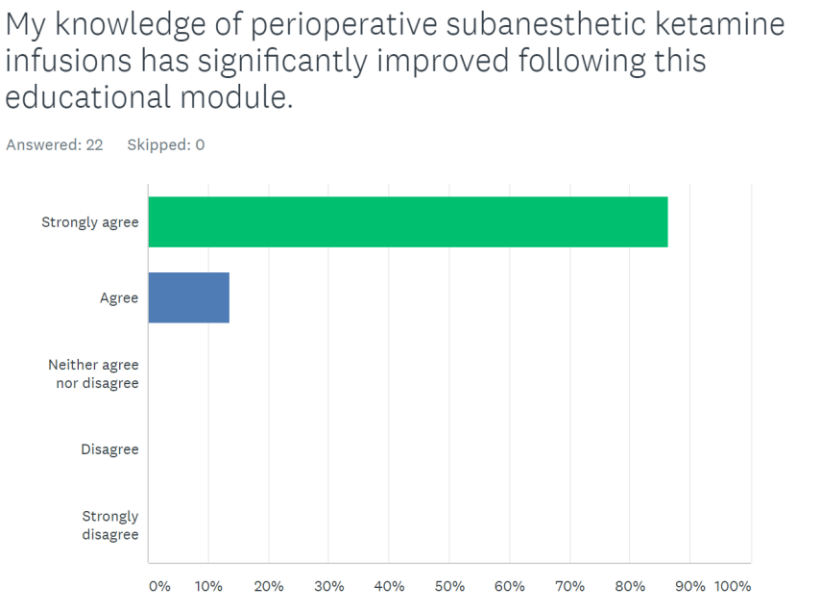


ANSWER CHOICES	RESPONSES	
Always	0.00%	0
Usually	0.00%	0
Sometimes	22.73%	5
Rarely	50.00%	11
Never	27.27%	6
TOTAL		22

Through post-test answer, 100% of participants agreed the information provided stimulated a clinical practice change. Furthermore, 86% (n=19) of participants ‘strongly agreed’ and 13% (n=3) ‘agreed’ that personal knowledge significantly improved regarding subanesthetic ketamine infusions following education (Figure 3).

Figure 3

Assessment of Personal Knowledge Change



ANSWER CHOICES	RESPONSES	
Strongly agree	86.36%	19
Agree	13.64%	3
Neither agree nor disagree	0.00%	0
Disagree	0.00%	0
Strongly disagree	0.00%	0
TOTAL		22

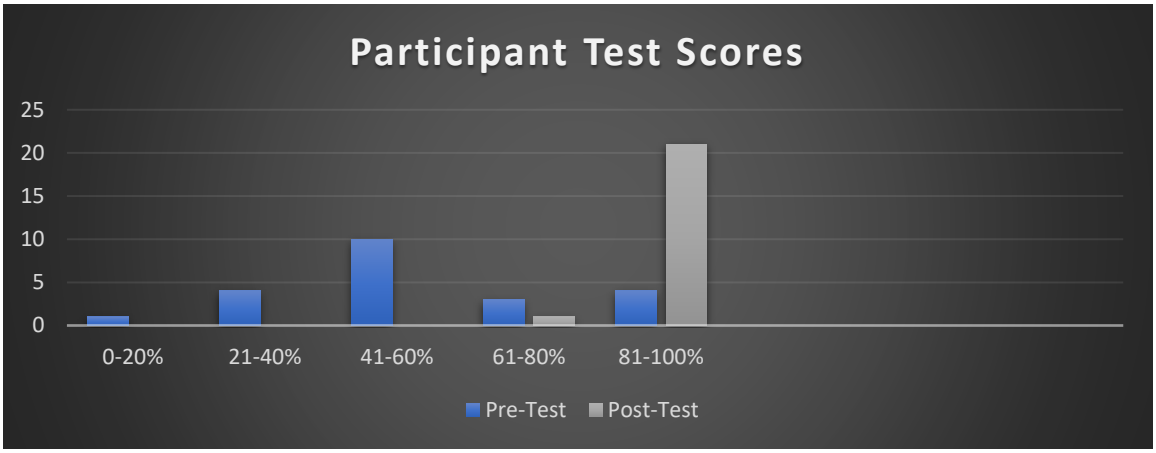
Outcomes

Follow the completion of the education modules, participants were surveyed regarding their experience. The overall purpose of this project was to increase knowledge and determine if anesthesia providers would consider a clinical practice change in accordance with the information provided in the educational module. As discussed above, 19 participants, 86% of the sample size, determine on the post-test that they ‘strongly agreed’ knowledge regarding the use of subanesthetic ketamine infusions improved through the module. According to the project’s specific objectives, a goal was to increase knowledge of subanesthetic ketamine infusions by

increasing post-test scores by 30% when compared to the pretest. This outcome was successfully met with a 38% increase in post-test scores when compared to the pretest (Figure 4). Another specific goal of this project's objective was for at least 50% of participants to indicate a willingness to consider a personal practice change. Furthermore, all 22 participants, 100% of the sample size, agreed the information presented would stimulate a potential practice change. The collective pre-test mean of both topics was 56% and was increased to a mean of 94% following the completion of the educational modules (Figure 4).

Figure 4

Ketamine and OSA Knowledge Question Results



Discussion

Obese patients in the perioperative period are at an increased risk for complications with the use opioids. This EBP project provided information for utilizing subanesthetic ketamine infusions as a multimodal opioid sparing technique for perioperative pain control. The challenges of the COVID-19 pandemic provided an opportunity to alter the methods of implementation. In cooperation with social distancing guidelines, this project was altered to accommodate an online educational intervention format including a simulation-based educational video and lecture.

Convenience sampling was utilized to recruit anesthesia providers from various institutions to complete the educational intervention. Implementation occurred over a three-week period during which 22 participants completed the learning modules out of 45 recruitment emails.

The challenges of adapting the project format within a reduced timeframe limited options for the site of implementation. Considering changes, this project would seek IRB approval for implementation at originally intended clinical site. Focusing the site of implementation would allow for a better comparison between implementation results and the needs assessment of the site. While this project was able to conveniently sample anesthesia providers through personal emails, it was not able to utilize lists of work emails that would allow for a larger sample size without institutional IRB approval. After obtaining IRB approval, the project would have options to greatly expand efforts of implementation. With additional financial resources, the American Association of Nurse Anesthetist (AANA) provides an extensive emails list of its member for purchase. The purchase of this list would allow for the implementation of this project at a national level.

Another alteration of the project would be to increase the quality of production through enhanced audio and visual effects. While the original video was successful, better quality film equipment may help with the engagement of the learner viewing the module. With purchased editing software, efforts can be made to make the video interactive prompting the learner with survey questions through the module to increase learning. Overall, financial barriers, technical skills with video production and editing were limiting factors in the development of this practice project.

Chapter Seven: Implications for Nursing Practice

Implications for Practice

The purpose of this DNP project was to utilize current research that supports evidence-based practice to enhance awareness of risk reduction strategies in caring for perioperative obese patients. Following education, the goal of this project was to increase the participants' knowledge in caring for this patient population and encourage anesthesia providers to consider a clinical practice change. Successful implementation and dissemination of evidence-based knowledge will influence anesthesia providers to deliver the best care for obese patients throughout the perioperative process.

As discussed in the background and significance, anesthesia providers have been challenged to utilize opioid sparing techniques related to the national opioid crisis. Overall, patient outcomes are improved with effective perioperative pain control. Increased dosing of opioids in the obese population provides analgesia but at the potential cost of worsening side effects. Adverse effects cause an extended length of stay, nosocomial complications leading to increased morbidity and mortality (Mao, 2016). Obese patients throughout the surgical period are sensitive to the ventilatory depressive effect of opioids. The use of subanesthetic ketamine infusions effectively manages perioperative pain while minimizing patient opioid consumption and contribution to the opioid crisis (Weinbroum, 2018). Together, these methods increase patient satisfaction and recovery after surgery optimizes outcomes while minimizing health care costs.

Strengths of the Project

In short, many aspects of this project possessed strengths that will provide opportunities for continual dissemination. The information provided through this project has been stored on a

student created website. This format allows for access to the educational modules and learning materials at the convenience of the leaner. Once accessed, the self-guided nature of this format engages the learner to navigate the educational website through easy-to-follow promptings. The original format of the project would have provided a onetime lecture format, in person via PowerPoint. This would have limited the amount of time learners would be able to access the education and review the information. Another strength of this project's format allows for the information to be continually shared among anesthesia provider through email invitation of the website domain name. A future DNP student may easily view the work of this project and expand on the topic allowing for continued dissemination of evidence-based practice.

Another strength of this project was utilizing the efforts of two students, in a group format, to provide an educational module with expanded clinical implications. Through the use of subanesthetic ketamine infusions and obstructive sleep apnea (OSA) screening tools in perioperative obese patients, learners are provided with a broadened evidence-based practice module for the care of a patient population that is increasing in healthcare today. Additionally, the increased resources of this group project allowed for a higher quality educational module experience for learners.

Limitations of the Project

Despite the clear strengths, there are also limitations to discuss. In total, the implementation occurred over a three-week period. There was a relatively small sample size of 22 anesthesia providers viewing and completing the educational module. This small sample size may be due to the short implementation period and can be considered a limiting factor when determining statistical significance. Sample bias can also be considered a limitation as convenience sampling and personal emails were employed for recruitment of learners. The

inability to achieve IRB approval at a chosen health care institution limited the ability to utilize work-based emails of anesthesia providers. Focusing dissemination to anesthesia providers of a single institution would allow for comprehensive assessment of learners in correlation with the institutions needs assessments. Finally, this project was unable to determine if participants incorporated the information into a clinical practice change.

Linkage to DNP Essentials

In accordance with the American Association of Colleges of Nursing (AACN), DNP essentials comprise the educational requirements that define the DNP prepared nurse. Essential I, scientific underpinnings for practice, has been displayed in this project through the application of current evidence-based practice, as well as discussing the pathophysiology of acute pain and the pharmacokinetic properties of subanesthetic ketamine infusions. Essential II, organizational and systems leadership for quality improvement, was fulfilled through an online based educational intervention. During a three-week period, this information was implemented and available to anesthesia providers. Through a pre-educational assessment, this project evaluated the current use of subanesthetic ketamine infusions among anesthesia providers. During the pos-educational assessment, anesthesia providers were asked if they would consider a personal practice change in relation to the evidence-based practice.

This project meets essential III, clinical scholarship and analytical methods for evidence-based practice, in response to the growing national concerns of increasing opioid use. Critically appraised evidence-based research was used to provide an educational intervention to anesthesia providers supporting subanesthetic ketamine infusions for perioperative management as an opioid limiting technique. Combined with preoperative OSA screening tools, the evidence supporting this project increases both the quality and safety of care provider to obese patients in

the perioperative period. The utilization of an online based educational video intervention via a student created website in this project clearly demonstrates essential IV, information systems/technology and patient care technology for the improvement and transformation of health care. This projects technological format allows for effective implementation and dissemination of the information provided in the educational modules.

Essential V, health care policy for advocacy in health care, was met through advocating for evidence base care for obese patients throughout the perioperative period. The specific aspect of this portion of the project advocates for improved perioperative pain control management through an opioid sparing technique. The aspects of essential VI, inter-professional collaboration for improving patient and population health outcomes, were evident in this project via the utilization of evidence-based practice to formulate practice guideline to safely care for at risk obese patients throughout the perioperative period. The members of this project collaborated with anesthesia providers through the implementation of the educational modules. Participants were provided with contact information to further collaborate the creators of the project.

This project met essential VII, clinical prevention and population health for improving the nation's health, through providing methods for risk reduction strategies in the perioperative management of obese patients. Statistical analysis of the educational intervention showed anesthesia providers who completed the module would adopt a clinical practice change for utilizing risk reduction strategies in obese patients. Finally, Essential VIII, advanced nursing practice, was met through delivering an evidence based educational intervention. The information provided through the intervention is continually available through the website of the project for reference. Learners are also provided with the evidence-based materials used for the development of the project. Future DNP student have the opportunity to advance nursing practice

through utilizing the efforts of this project and expanding risk reduction strategies. The contact information to the educational providers is also found in the educational modules and learners were encouraged to contact with questions or comments.

Chapter Eight: Summary of Project

Summary and Conclusions

Appropriate pain management in the postoperative period is a challenging aspect in the role of an anesthesia provider. Despite its efficacy, a unimodal opioid approach to managing this pain increases postoperative risk for adverse events. The national opioid crisis in the U.S. has challenged anesthesia providers to adopt and utilize opioid sparing techniques for the management of perioperative pain (Ladha et al., (2016). Effective management of perioperative pain directly impacts a patient's course of stay and subsequent recovery. The adverse effects of opioids can contribute to extended admissions and nosocomial complications (Mao, 2016).

According to Stokes et al. (2019), U.S. has seen a rapid increase in obesity over the recent decades. In 1980, 15% of the adult population was considered obese. Current assessments revealed that in 2016, 40% of the adult population is considered obese (Stokes et al., 2019). Obese patients through the perioperative period are at an increased risk for morbidity and mortality. A large portion of this risk is due to a sensitivity to repeated narcotic dosing and associated ventilatory depressive effects. Increased opioid administration in obese patients delays postoperative mobility, impairs rehabilitation, and prolongs the patient's length of stay (Weinbroum, 2018).

The utilization of subanesthetic ketamine infusions aids in the effective manage perioperative pain while minimizing a patient's opioid consumption. This EBP project provided an educational intervention for the use of subanesthetic ketamine infusions as a multimodal opioid sparing technique for perioperative pain control. Through obstacles related to the COIVD-19 pandemic, precautions were used to cooperate with social distancing guidelines. More specifically, this project was altered to an online educational intervention format including a

simulation-based educational video and lecture. Anesthesia providers were recruited via convenience sampling to voluntarily complete the pre-test, educational module, and post-test.

Based on the project results, several conclusions can be drawn. From the original need's assessment and pre-test responses, many anesthesia providers lack knowledge regarding the use of intraoperative subanesthetic ketamine infusions. Following the educational intervention, anesthesia providers completed a series knowledge-based post-tests questions and survey questions. In total, all 22 learners indicated a plan to adopt a clinical practice change and utilize subanesthetic ketamine infusions in future practice. Each of the participates also indicated an increase in knowledge following the implementation of the educational intervention. The results from this project show the provided educational intervention was effective in stimulating anesthesia providers to consider a personal practice change. Therefore, the methods of this DNP project effectively disseminated the evidence-based information. This information applied in practice will help to improve healthcare outcomes in perioperative obese patients.

Dissemination Plans

The dissemination of a DNP project is a key component of sharing knowledge that aids in promoting improved health care outcomes. There are multiple plans for the dissemination. First, this project will be disseminated to Cedar Crest College faculty and graduate students. Next, in October 2021, this project will also be disseminated at the Pulmonary Critical Care Symposium presented by St Luke's. Finally, this project will be disseminated at the original site of implementation, Tower Health: Reading Hospital.

Future Ideas

There are many opportunities for the expansion of this project for future studies. The evidence provided in this educational module supports the use of subanesthetic ketamine and as

opioid sparing technique for perioperative pain control. According to the results of the 22 post educational intervention surveys, each anesthesia provider agreed to facilitating the use of subanesthetic ketamine in future patient care. A future study could compare the analgesic effects of patients who received subanesthetic ketamine and those who solely received narcotics. With IRB approval from an institution, DNP students would be able to complete a retrospective chart review assessing post-operative pain scores reported by patients from each sample group. Chart review records can also follow patients through out an inpatient admission and assess the length of stay, overall narcotic consumption, and average pain scores.

This project employed the use of subanesthetic ketamine as an infusion during the intraoperative period. This infusion is administered throughout the duration of the surgical case and discontinued before the patient reaches the post-operative phase. Current research also strongly supports the use of subanesthetic ketamine infusions though the post-operative period for pain management. From the original need's assessment at Tower Health: Reading Hospital, Chief of Anesthesiology, Dr. David Matson expressed the opportunity to continue subanesthetic ketamine infusions to the postoperative period. Future research could utilize this information to provide an educational intervention for post anesthesia care unit (PACU) nurses regarding the appropriate use of subanesthetic ketamine infusions for post-operative pain at the original site of implementation.

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Appendix A

Indication of CCC IRB approval

IRB Committee Response - Proposal Number 2020-293

M mycedarcrest@cedarcrest.edu
Fri 8/28/2020 11:24 PM
To: Joel Butala
Cc: Catherine Zurawski; Andrew Hornick

The IRB Committee has reviewed your proposal and has made the following response:

Proposal Name:	Implementation of a Simulation Based Educational Module to Increase Knowledge to Reduce Perioperative Complications in Obese Patients
Lead Researcher:	Joel Butala
Project Advisor:	Catherine Zurawski
Additional Researcher(s)	Andrew Hornick
Committee Response:	Approved with recommendations
Comments:	8/15/2020: Thank you for your submission. There are a few revisions needed: (1) Research Supplement: a) for procedures, this is framed like the informed consent - do not say "you" but rather "Participants will be asked to..."; b) On-line survey - you imply you are using one but attached a paper document, please clarify (if an online survey is being used provide the URL in both your research supplement and informed consent form for review); c) in Assurance of Anonymity and Confidentiality - do not refer to paper documents if you are using an online survey process: d) refer to the Cedar Crest College School of Nursing vs "graduate studies department"; (2) informed consent - a) State the other researchers associated with the project vs. just two - be consistent with the research supplement; b) you imply again an on-line pre- and -post test survey - refer/include to the URL for access; c) remove this language: "but you may share some personal or confidential information by chance. However, we do not wish for this to happen"; (3) survey - implied as online, so provide URL's for a pre- and then post-test version for each set of questions, Ketamine and Sleep Apnea related (Survey Monkey, other) and modify the question sequence so implied informed consent is #1 and answering "yes" is required for participants to answer any other questions (demographics for #2 and 3, then module topic questions after - being clear in both research supplement and informed consent forms that participants will complete a survey twice for pre- and then -post test questions - arguably two surveys) - including a question after #1 asking for participants to provide a code supporting anonymity for linking pre- and -post test (suggestions here for clarity and procedure). We look forward to your follow-up. 8/28/2020: Thank you for your follow-up. Your study is approved with one recommendation for the informed consent form to also refer to the chair of IRB (name and title) for follow-up questions. The surveys look appropriate and refer to implied informed consent though. Thank you for your revisions and best to your team with the project!

This document contains personal information from a student's educational records. It is protected by the Family Educational Rights and Privacy Act (20 U.S.C. 1232g) and may not be re-released without consent of the parent or eligible student.

Appendix B

Research description supplement

Title of Research: **Implementation of a Simulation Based Educational Module to Increase Knowledge to Reduce Perioperative Complications in Obese Patients**

a. Objective(s) of Research: The purpose of this study is to increase knowledge and awareness of perioperative risk reduction strategies of obesity and Obstructive Sleep Apnea (OSA) which is increasing in prevalence in the United States (U.S.). In the U.S., up to 80% of patients with OSA remain undiagnosed, and nearly 70% of all obese patients also exhibit OSA symptoms. Perioperative complications are significantly increased in OSA, which include increased risk of oxygen desaturation, respiratory failure, emergent intubation, mechanical ventilation, and ICU admission. In this population, the use of opioids can further exacerbate symptoms of OSA due to blunting of chemoreceptor responses to hypoxemia and hypercarbia. These drugs also decrease pharyngeal muscle tone, increase upper airway collapsibility, and exacerbate existing OSA. The goal of this research is to provide an educational module for anesthesia providers to consider adopting current evidence-based interventions in the management of perioperative obese patients. Information gained will serve to further facilitate online modules for risk reduction in obese patients.

b. Researcher(s) Qualifications: This research is being carried out by the following:

Joel Butala; RN, BSN, CCRN, SRNA, jdbutala@cedarcrest.edu
- Chair: Bernard Gilligan CRNA, DNP
    - Email: Bernard.gilligan@cedarcrest.edu

Andrew Hornick; RN, BSN, CCRN, SRNA, ajhornic@cedarcrest.edu
- Chair: Donna Martonik, DNP, ANP, AGACNP,
    - Email: Donna.martonik@cedarcrest.edu
- Mentor: Bernard Gilligan, CRNA, DNP
    - Email: Bernard.Gilligan@cedarcrest.edu

-Each researcher is in satisfactory academic standing along with Citi Training certification of completion for evidence-based research as well as all DNP prerequisite course work as establish by Cedar Crest College DNP Graduate Faculty.

c. Methods to be Used:

- **Participants**: Participants will be Cedar Crest College student registered nurse anesthetists (SRNA) and Lehigh Valley, Reading Hospital, St Luke's, and Penn Medicine certified registered nurse anesthetists (CRNA) who agree to voluntarily participate in the research. The purpose of the research will be explained to SRNA's and CRNA's and they will be asked to participate with the provision that they are free to withdraw at any time without penalty.
- **Procedures**: If participants agree to be in this study, they will be asked to participate in an online educational module regarding risk reducing strategies in perioperative obese patients. Participants will be asked to complete an online module with an estimated duration of 90 minutes. Participants will be asked to complete a pre and post survey

regarding knowledge of the subject materials covered and the likelihood of integrating this information into your anesthesia plan of care.

- **Online Surveys:**
- https://www.surveymonkey.com/r/Q9WHG7Q (Pre-Test)
- https://www.surveymonkey.com/r/Q22TRLW (Post-Test)

d. Recruitment Procedures:

Participants in this study will be recruited through convenience sampling of Cedar Crest College SRNA's, fellow Pennsylvania CRNA programs and CRNA's from Lehigh Valley, Reading Hospital, St Luke's, and Penn Medicine via email. Potential participants will be contacted via email to participate in an online based simulation education module. A detailed summary of the proposed educational module with indication of voluntary and anonymous completion will be provided.

e. Requirements for Participation:

Participants must be greater than 18 years of age and enrolled in a nurse anesthesia program or actively practicing. Before completion, participants must also consent to anonymous surveys present throughout the educational modules.

f. Possible Risks and Benefits:

(Non-sensitive) It is anticipated that participants will be at no physical, psychological, or emotional risk at any time during the research. Nor is it anticipated that participation in the research will place the participants at any risk of criminal or civil liability or damage the participants' financial standing or employability. The intent of this module is to increase knowledge and awareness of perioperative risk reduction strategies in obese patients.

g. Assurance of Anonymity and Confidentiality:

Participants will be informed of the voluntary and confidential nature of the research verbally and/or via instructions on the data collection instruments. Participants will also be instructed not to put their name or any identifying information on the submitted form. When using an identification number for coding purposes, the number associated with a participant will not be linked to the participant by name. Any collected electronic data will be placed on a password protected computer where the password is known only to the researcher and faculty sponsor. All copies of the raw electronic data will be encrypted with a similar password. Any audio or video media will be stored in a locked drawer under the control of either the researcher or the faculty sponsor when not in use. The raw data will only be accessible to **Joel Butala, Andrew Hornick, Bernard Gilligan, and Donna Martonik**. In the event that any information provided by a participant should become known outside the research, it is unlikely that any harm would come to the participant.

h. Security of Data and Data Destruction. All physical and non-electronic media data (e.g., video, audio tape) collected in this study will be stored in a secure location within the **Cedar Crest College School of Nursing** and all electronic data (e.g., MP4 files) will be stored in password protected computers and/or files where the passwords are known only to the researchers**.** Data will be stored for a period of three years, and shall be shredded, erased or otherwise destroyed on or after **5/1/2023.**

Appendix C

Informed Consent

You are invited to participate in a research study to simulate risk reduction strategies in the perioperative care of obese patients. You were selected as a possible participant based on your potential involvement providing anesthesia care to this patient population. We ask that you read this form prior to participating in the study. You must be 18 years of age or older in order to participate**.**

This study is being conducted by the following Cedar Crest College SRNA's:

- Joel Butala; RN, BSN, CCRN
- Andrew Hornick; RN, BSN, CCRN

Background Information

The purpose of this study is to increase knowledge and awareness of perioperative risk reduction strategies of obesity and Obstructive Sleep Apnea (OSA) which is increasing in prevalence in the United States (U.S.). In the U.S., up to 80% of patients with OSA remain undiagnosed, and nearly 70% of all obese patients also exhibit OSA symptoms. Perioperative complications are significantly increased in OSA, which include increased risk of oxygen desaturation, respiratory failure, emergent intubation, mechanical ventilation, and ICU admission. In this population, the use of opioids can further exacerbate symptoms of OSA due to blunting of chemoreceptor responses to hypoxemia and hypercarbia. These drugs also decrease pharyngeal muscle tone, increase upper airway collapsibility, and exacerbate existing OSA. It is imperative to provide an educational module for anesthesia providers to consider adopting current evidence-based interventions in the management of perioperative obese patients. Information gained will serve to further facilitate online modules for risk reduction in obese patients. Participants in this study will be recruited through convenience sampling of Cedar Crest College SRNA's, fellow Pennsylvania CRNA programs and CRNA's from Lehigh Valley, Reading Hospital, St Luke's, and Penn Medicine via email. Potential participants will be contacted via email to participate in an online based simulation education module. A detailed summary of the proposed educational module with indication of voluntary and anonymous completion will be provided.

Procedures

If you agree to be in this study, we will ask you to participate in an online educational module regarding risk reducing strategies in perioperative obese patients. You will be asked to complete a pre and post survey regarding your knowledge of the subject materials covered and the likelihood of integrating this information into your anesthesia plan of care. The entire study should take no more than 90 minutes.

Risks and Benefits

There are no anticipated risks, but you may share some personal or confidential information by chance. However, we do not wish for this to happen. You do not have to answer any question or take part in the discussion/interview/survey if you feel the question(s) are too personal or if talking about them makes you uncomfortable. The intent of this module is to increase the

anesthesia provider's knowledge in risk reduction strategies in caring for common complications found in perioperative obese patients.

Confidentiality

Responses to all questionnaire items are anonymous, and all physical and non-electronic media data (e.g., video or audio tape) collected in this study will be stored in a secure location in the simulation lab within the **Cedar Crest College Graduate Department**, specifically, under the supervision of the Cedar Crest College Nurse Anesthesia Program. All electronic data will be stored in password protected computers and/or files where the passwords are known only to the researchers**.** Data will be stored for a period of three years, and shall be shredded, erased, or otherwise destroyed on or after **5/1/2023.** Learner specific tracking identifiers will not be utilized in the data collection of this DNP project. Participation in this research is voluntary with the ability to withdraw at any time without penalty. The completion of this education offers no financial compensation and is not affiliated with any course work or grades awarded.

Right to Withdraw

If you decide to participate, you are free to withdraw at any time. Your decision whether or not to participate will not affect your current or future relations with Cedar Crest College.

Statement of Approval

This research was approved by Cedar Crest College's Institutional Review Board.

Proposal # 2020-293 Date: 08/28/2020

Contacts and Questions

The supervising researchers conducting this study are listed below.

Joel Butala; RN, BSN, CCRN, jdbutala@cedarcrest.edu

- Chair: Bernard Gilligan, CRNA, DNP
    - Email: Bernard.gilligan@cedarcrest.edu

Andrew Hornick; RN, BSN, CCRN, ajhornic@cedarcrest.edu

- Chair: Donna Martonik, DNP, ANP, AGACNP,
    - Email: Donna.martonik@cedarcrest.edu
- Mentor: Bernard Gilligan, C
    - Email: Bernard.Gilligan@cedarcrest.edu

Appendix D

Pre-test

1. How many years of experience do you have as an anesthesia provider?

a. SRNA
b. 0-2
c. 3-5
d. 6-10
e. 10+

2. What percentage of OSA patients remain undiagnosed?

a. Up to 50%
b. Up to 60%
c. Up to 70%
d. Up to 80%

3. High risk of moderate to severe OSA is indicated by a STOP-Bang score greater than or equal to which number?

a. 3
b. 4
c. 5
d. 6

4. The prevalence of OSA among bariatric patients is as high as…

a. 40%
b. 50%
c. 60%
d. 70%

5. I frequently use an OSA screening tool during my preoperative assessment.

a. Yes
b. No

6. How often do you utilize sub-anesthetic ketamine infusions for perioperative pain control and opioid reduction?

a. Always
b. Usually
c. Sometimes
d. Rarely
e. Never

7. Ketamine is a noncompetitive…

a. NMDA receptor antagonist
b. NMDA receptor agonist
c. NMDA receptor agonist-antagonist
d. does not work at the NMDA receptor

8. Opioid-induced hyperalgesia (OIH) is caused by (select two):

a. stimulation of the NMDA receptor
b. blocking of the NMDA receptor
c. ketamine
d. repeated high dose administration of narcotics

9. The utilization of perioperative sub-anesthetic ketamine infusions have been proven to reduce perioperative opioid consumption and decrease postoperative pain scores with few adverse side effects.

a. True
b. False

Appendix E

Post-test

1. What percentage of OSA patients remain undiagnosed?

a. Up to 50%
b. Up to 60%
c. Up to 70%
d. Up to 80%

2. High risk of moderate to severe OSA is indicated by a STOP-Bang score greater than or equal to which number?

a. 3
b. 4
c. 5
d. 6

3. The prevalence of OSA among bariatric patients is as high as…

a. 40%
b. 50%
c. 60%
d. 70%

4. I plan on integrating the STOP-Bang Questionnaire into my preoperative assessment.

a. Very likely
b. Likely
c. Neither likely nor unlikely
d. Unlikely
e. Very unlikely

5. My knowledge of OSA and its screening methods have significantly improved following this learning module.

a. Strongly agree
b. Agree
c. Somewhat agree
d. Neither agree nor disagree
e. Somewhat disagree
f. Disagree
g. Strong disagree

6. Ketamine is a noncompetitive…

a. NMDA receptor antagonist
b. NMDA receptor agonist

c. NMDA receptor agonist-antagonist
d. does not work at the NMDA receptor

7. Opioid-induced hyperalgesia (OIH) is caused by (select two):

a. stimulation of the NMDA receptor
b. blocking of the NMDA receptor
c. ketamine
d. repeated high dose administration of narcotics

8. The utilization of perioperative sub-anesthetic ketamine infusions have been proven to reduce perioperative opioid consumption and decrease postoperative pain scores with few adverse side effects.

a. True
b. False

9. Did the information provided in this presentation about sub-anesthetic ketamine encourage you to reconsider your current anesthesia practices regarding perioperative pain control?

a. Yes
b. No

10. My knowledge of sub-anesthetic ketamine infusions has significantly improved following this educational module.

a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree

Appendix F

Resource Budget

Resource	**Cost**
Cedar Crest College Simulation Lab	Included in cost of tuition
32 GB SD Card	$29.99
Rhode Shotgun™ Microphone	$129.99
Panasonic™ Video Camera	$225.00
Camera Tripod	$50.00
Wix,com, Inc. Website Builder	$120.00
Screencast-O-Matic™	Free Version
DaVinci Resolve 16™	Free Version
Survey Monkey™	Free Version
HP Envy 16™ Laptop	$1,200.00
Microsoft Office 365™	Included in cost of laptop
Total	**$1,754.98**

Appendix G

Recruitment Email

Dear Participant,
You are invited to participate in a doctoral project designed by two students in the Cedar Crest College Nurse Anesthesia Program. The project's key aims are to increase knowledge and elicit a practice change among student registered nurse anesthetists and certified registered nurse anesthetists through an online educational module on **perioperative risk reduction strategies in obese patients**. The main topics include obstructive sleep apnea (OSA) screening and multimodal analgesia, with a specific emphasis on sub-anesthetic ketamine infusions. This project was transitioned from a hospital-based setting to an online setting due to the coronavirus pandemic. As education around the world has shifted to a virtual platform, we feel strongly that the online educational module we have created will have a positive impact on students and experienced nurse anesthetists.

Participation in this project is entirely voluntary. If you decide to participate, we invite you to visit our website. Upon entering the website, you will find informed consent and research description supplement documents. Next, we ask that you complete our pre-test on OSA and ketamine. Then, you will view three educational videos on risk reduction strategies in obese patients, which include individual presentations on OSA and sub-anesthetic ketamine infusions in addition to a simulation where the information will be applied to a clinical scenario. Finally, you will take the post-test. Completion of the pre- and post-tests indicates your consent to participate in this project.

Completion of the module will take approximately 30 minutes. We understand that your time is extremely valuable, but we feel this educational module is important for future and current nurse anesthetists. A key goal of the DNP-prepared nurse is to bridge the research-practice gap, and by creating this educational module, we hope that you incorporate this evidence into your clinical practice. A link to our website can be found below. We greatly appreciate your participation. Please contact us if you have any comments, concerns, or questions. Thank you!

Website Link: https://butalajoel.wixsite.com/osaandketamine

Warm Regards,
Joel Butala, BSN, RN, CCRN, SRNA
Email: jdbutala@cedarcrest.edu
Phone: 570-578-9367
Andrew Hornick, BSN, RN, CCRN, SRNA
Email: ajhornic@cedarcrest.edu
Phone: 610-844-1509