IMPACT ON AN EDUCATIONAL INTERVENTION FOR ANESTHESIA PROVIDERS ON THE BENEFITS OF TOTAL INTRAVENOUS ANESTHESIA (TIVA) IN PATIENTS UNDERGOING LAPAROSCOPIC BARIATRIC SURGERIES: OUTCOMES AND BARRIERS

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Dedication and Acknowledgments

I would like to express my sincere gratitude to my husband Tom and my cats Munjee and Bori. This project could not have come together without their support and encouragement. I would also like to thank Dr. Korogoda, who helped to guide this project in the right direction.

Abstract

Background: Laparoscopic bariatric surgery is associated with a high risk of developing postoperative nausea and vomiting (PONV). PONV causes various complications that delay healing and increase cost. It is one of the most undesirable anesthesia complications. Total intravenous anesthesia (TIVA) with propofol, instead of traditional inhalational anesthesia, is known to reduce risk of PONV. **Purpose:** The purpose of this DNP project was to assess the impact of an educational intervention on knowledge, practice change, patient outcomes, and barriers to TIVA use. **Methods:** An educational intervention on the benefits of TIVA and drawbacks of volatile anesthesia was provided to anesthesia providers. Pre- and post-intervention surveys were administered to assess the impact of the educational intervention on knowledge, practice, and perceived barriers. A retrospective chart review on patients who underwent laparoscopic bariatric surgeries, 28 days before and after the intervention, evaluated the incidence of PONV in the PACU and time to extubation from the end of the procedure. **Results:** There were no statistically significant changes in knowledge, practice, and perceived barriers before and after the educational intervention. Participants reported an increase in TIVA usage in patients with a high risk of PONV after the educational intervention. Perceived barriers to implementing TIVA also increased after the educational intervention. Patient chart review revealed lower incidences of PONV in patients who received TIVA, compared to patients that received inhalational or balanced anesthesia. **Recommendations and Conclusion:** An educational intervention on TIVA and PONV increases utilization of TIVA and improves patient outcomes. Barriers should be addressed to increase the use of TIVA and improve patient outcomes.

Key Words: TIVA, PONV, propofol, volatile anesthetics, emergence, laparoscopic bariatric surgeries, inhalational agents AND drawbacks, TIVA AND benefits, anti-emetic AND propofol, and PONV AND risk factors.

Background and Significance

Laparoscopy has gained popularity over the decades and is one of the most frequently used surgical methods throughout the world. It has become the method of choice for various diagnostic and corrective procedures in the abdominal and pelvic regions (Hurd et al., 2018; Vecchio et al., 2000). Likewise, most bariatric surgeries are done laparoscopically (Golzarand et al., 2017). Patients undergoing laparoscopic bariatric surgeries are especially at high risk for developing postoperative nausea and vomiting (PONV) because of serotonin release related to manipulation of the gastrointestinal tract, higher pressure on the gastroesophageal junction due to obesity, and increased adipose tissue that acts as a reservoir for inhalational anesthetics (Celik et al., 2014; Gan & Habib, 2016; Ma et al., 2019, Mendez et al., 2009; Watcha & White, 1992). According to the study by Macario et al. (1999), PONV is one of the most undesirable anesthesia complications and can cause a delay to discharge which increases costs. It can also lead to dehydration, electrolyte imbalance, hypertension, and increased length of hospital stay (Parra-Sanchez et al., 2012; Watcha & White, 1992; Yoo et al., 2012). Furthermore, PONV results in increased cost of medical care to the patients due to rescue antiemetic medication administration and longer post-anesthesia care unit (PACU) stay (Parra-Sanchez et al., 2012). The act of vomiting or retching increases tension on the surgical site, which can lead to wound dehiscence, increased bleeding, and increased intracranial and intraocular pressures (Watcha & White, 1992; Yoo et al., 2012). Therefore, prevention of PONV should be one of the top priorities for anesthesia providers when caring forhigh-risk patients.

Literature has shown that total intravenous anesthesia (TIVA) lowers the incidence of PONV when compared to traditional inhalational anesthesia (Herling et al., 2017; Schraag et al., 2018; Yoo et al, 2012). The focus of this project is patients undergoing laparoscopic bariatric

surgery, which has high risk of PONV. The primary outcomes examined in this study are prevalence of PONV after bariatric surgery measured by antiemetic medication administration in the PACU and practice change among anesthesia providers after the educational intervention. The secondary outcomes are changes in knowledge and perceived barriers among anesthesia providers after the intervention and length of time from the end of procedure to extubation among patients undergoing laparoscopic bariatric surgeries.

Purpose

The purpose of this DNP project is to assess the impact of an educational intervention on knowledge, practice, perceived barriers of anesthesia providers, and patient outcomes.

Review of Current Evidence

The literature search was conducted using online databases PubMed, Cochrane, and Google Scholar. Keywords used were: TIVA, PONV, propofol, volatile anesthetics, emergence, laparoscopic bariatric surgeries, inhalational agents AND drawbacks, TIVA AND benefits, anti-emetic AND propofol, and PONV AND risk factors. Among the articles reviewed, studies on the pediatric population were excluded from the literature critique. Studies that compared outcomes of TIVA versus inhalational anesthesia in all types of surgeries were included in the review and were not limited to laparoscopic bariatric surgeries. Types of articles reviewed were systematic review, randomized controlled trial, meta-analysis, and clinical trial. For articles that examined TIVA and inhalational anesthesia, the search was limited to within 10 years to only include inhalational agents that are currently being used. There was no search limit on the publication year when searching for other kinds of literature, due to the value of these original articles.

Laparoscopic Bariatric Surgeries and PONV

There are several risk factors for increased incidences of PONV including obesity, laparoscopic procedures, and surgery involving the stomach and duodenum (Celik et al., 2014; Halliday et al., 2017; Ma et al., 2019; Mendez et al., 2009; Watcha & White, 1992). Patients undergoing laparoscopic bariatric surgeries are at high risk for PONV since they meet the criteria for increased risk for PONV – obesity, type of surgery, and location of the surgery. An increased amount of adipose tissue functions as a reservoir for inhalational anesthetics, allowing for lingering effects of the volatile agents, thus increasing the risk for PONV in bariatric patient populations **(**Watcha & White, 1992). Obese patients also have higher pressure on the gastroesophageal junction, possibly increasing the incidence of PONV (Mendez et al., 2009). Performing surgery on the gastrointestinal tract and maneuvering organs cause inflammation and the release of serotonin. Serotonin is one of the triggers of nausea in the brain, thereby increasing the risk for PONV (Gan & Habib, 2016). Therefore, patients that are undergoing laparoscopic bariatric surgeries are likely to have PONV. This is the mechanism for the increased risk of PONV in gastrointestinal surgery.

Consequences of PONV

PONV is the most undesirable anesthesia complication for most patients (Macario et al., 1999). It can also cause dehydration, electrolyte imbalance, hypertension, aspiration, and increased time of hospital stay (Parra-Sanchez et al., 2012; Watcha & White, 1992; Yoo et al., 2012). Furthermore, PONV results in increased cost of medical care to the patients due to rescue antiemetic medication administration and longer post-anesthesia care unit (PACU) stay (Parra-Sanchez et al., 2012). The act of vomiting or retching also increases tension on the surgical site, which can lead to wound dehiscence, increased bleeding, increased intracranial pressure, and increased intraocular pressure (Watcha & White, 1992; Yoo et al., 2012). These are undesirable

and potentially life-threatening complications that make PONV prevention one of the top priorities in anesthesia care.

Definition of TIVA

Traditional anesthetics used for maintenance are inhalational volatile agents (typically sevoflurane, isoflurane, and desflurane in the United States). Total intravenous anesthesia (TIVA) is an alternative method of administering anesthesia maintenance using only the intravenous anesthetic medication, generally propofol (Miller et al., 2018; Watcha & White, 1992). Both inhalational agents and propofol reduce neuronal activity and produce sedation, mainly by activating gamma-aminobutyric acid (GABA) receptors along with several other receptors (Celik et al., 2014; Miller et al., 2018). Since volatile anesthetic gases and propofol do not have analgesic effects, both inhalational anesthesia and TIVA are co-administered with medications for analgesia (Miller et al., 2018).

Pharmacodynamics of Propofol

Sedative and anesthetic effects of propofol are achieved by stimulation of inhibitory GABA receptors (Celik et al., 2014; Miller et al., 2018). In high doses, propofol inhibits nicotinic acetylcholine receptors, which have an important role in cognition, thereby generating anesthesia and amnesia (Miller et al., 2018). It has a fast onset of action and a short elimination half-time, making it a desirable anesthetic choice and the most commonly used one for TIVA (Deballi, 2003).

Anti-Emetic Property of Propofol

Nausea and vomiting can be caused by stimulation of the chemoreceptor trigger zone (CTZ) in the medulla oblongata (Watcha & White, 1992). One of the five receptors in the CTZ in the area postrema of the brain is the 5-hydroxytryptamine (5-HT) receptor (Celik et al., 2014;

Cechetto et al., 2001; Watcha & White, 1992). Propofol is thought to exhibit anti-emetic properties by reducing 5-HT (serotonin) release from its GABA-mediated inhibition **(**Cechetto et al., 2001; Celik et al., 2014). In an experiment with rats, Cechetto et al. (2001) found propofol administered rats had a significantly lower amount of serotonin in area postrema and cerebral spinal fluid, showing propofol's effect on serotonin levels in the brain.

Three double-blinded randomized controlled trials (RCTs) demonstrated the efficacy of the antiemetic property of propofol (Celik et al., 2014; Ewalenko et al., 1996; Niu et al., 2018). In two RCTs, study groups that received propofol infusion during the surgery had a significantly lower incidence of PONV compared to the control groups (Celik et al., 2014; Niu et al., 2018). Patients who received propofol had significantly fewer incidences of nausea and vomiting (3 out of 32 patients – 10%) compared to the control group that received 10% lipid emulsion (21 out of 32 patients – 65%) during the infusion (Ewalenko et al., 1996). In another RCT, patients who received a sub-hypnotic dose of propofol (1 mg/kg/hr) had significantly lower incidences of PONV than the control group in all time periods observed (from 0 to 24 hours postoperatively) (Celik et al., 2014).

Niu et al. (2018) randomized 80 women undergoing elective cesarean section with combined spinal epidural (CSE) into either the propofol group (n=40) or the control group (n=40). The intervention group received a continuous infusion of propofol to maintain a plasma concentration of 100 mg/ml after the delivery of the baby. Incidence of nausea, one of the major complications of CSE, was notably lower in the propofol group (10 out of 40 – 25%) than in the control group (24 out of 40 – 60%). Furthermore, 20 mg of propofol as a rescue antiemetic was significantly effective in treating nausea in both groups. Patient satisfaction level was higher in

the propofol group as well. The antiemetic effect of propofol in multiple doses is well researched but may not be frequently utilized in the clinical setting.

Benefits of TIVA

PONV Prevention

Multiple studies have shown that TIVA with propofol decreases the prevalence of PONV when compared to general anesthesia with inhalational agents (Chen et al., 2013; Herling et al, 2017; Kumar et al., 2014; Schraag et al., 2018; Yoo et al., 2012). Two systematic reviews analyzed data from 247 RCTs and found that PONV among patients who received TIVA with propofol was greatly reduced compared to the patients who received inhalational anesthesia (Kumar et al., 2014; Schraag et al., 2018). Kumar et al. (2014) also noted that 29.2% of patients experienced PONV with inhalational agents while only 13.8% did with TIVA. Schraag et al. (2018) noticed a statistically significant reduction (39% reduction of the relative risk) in PONV in patients who received TIVA administration over volatile agents as their anesthetics.

Yoo et al. (2012) found a reduced incidence and severity of PONV in patients who received TIVA with propofol and remifentanil (TIVA group) when compared to patients who received desflurane and remifentanil undergoing robot-assisted laparoscopic radical prostatectomy. The researchers found the incidence and severity of PONV in the TIVA group to be significantly lower in the first 6 hours of the post-operative period, but not as significantly different after 6 hours. This can be explained by the short half-life of propofol (Deballi, 2003). Another RCT that compared the effects of TIVA to inhalational anesthesia with sevoflurane found a significantly lower prevalence of PONV in patients who received TIVA (14.3%) than in patients who received sevoflurane (50%) during the surgery (Chen et al., 2013).

The evidence has demonstrated that TIVA with propofol is superior in preventing PONV when compared to inhalational anesthesia with volatile agents (Chen et al., 2013; Herling et al, 2017; Kumar et al., 2014; Schraag et al., 2018; Yoo et al., 2012). Both incidence and severity are reduced when using propofol as a primary anesthetic rather than using inhalational agents (Chen et al., 2013; Kumar et al., 2014; Schraag et al., 2018; Yoo et al., 2012). Some of the additional benefits of TIVA found in the studies include shorter time spent in the post-anesthesia care unit (PACU), less postoperative pain, and higher patient satisfaction scores (Schraag et al., 2018).

Smooth Emergence

Emergence is the final stage of anesthesia where patients make progression from an unconscious phase into recovery of consciousness and wakefulness (Cascella et al., 2018). During this period, patients often experience agitation, delirium, confusion, coughing, and/or bucking, potentially leading to other complications such as tachycardia, hypertension, and/or increased intracranial pressure (Cascella et al., 2018; Jo et al., 2019). Therefore, achieving a smooth transition from an anesthesia state to recovery is crucial.

Jo et al. (2019) found that TIVA significantly lowered the incidence of emergence agitation in nasal surgery. Patients who underwent nasal surgery with intravenous induction and maintenance (TIVA group) were compared to those who received inhalational induction and maintenance (VIMA group). The TIVA group received propofol and remifentanil infusions while the VIMA group received sevoflurane and nitrous oxide. Only 1 out of 40 patients (2.5%) in the TIVA group experienced emergence agitation, compared to 8 out of 40 patients (20%) in the VIMA group. Emergence agitation was measured using the Richmond Agitation-Sedation Scale (Jo et al., 2019). Emergence delirium can increase complications, increase length of stay in the PACU, and may require unplanned hospital admission.

Drawbacks of Volatile Agents

Waste Anesthesia Gas Pollution

Volatile anesthetic gases have a negative effect on atmospheric pollution (Kapoor, 2017; Sherman & McGain, 2016). These halogenated agents go through essentially no metabolism in the human body and are exhaled unchanged into the atmosphere. Released anesthetic gases then linger in the lowest layer of the atmosphere (1.1 years for sevoflurane, 3.2 years for isoflurane, and 14 years for desflurane), causing greenhouse effects that account for global warming and climate change (Sherman & McGain, 2016). In comparison, the greenhouse gas impact of propofol is 10,000 times lower than that of desflurane (Sherman et al., 2012).

PONV

As mentioned above, numerous studies have concluded that the volatile anesthetic agents are related to higher prevalence and severity of PONV when compared to TIVA (Chen et al., 2013; Herling et al, 2017; Kumar et al., 2014; Schraag et al., 2018; Yoo et al., 2012). Although the exact mechanism of how inhalational anesthetic gases cause PONV is unclear, it is thought that the volatile agents augment 5-HT signals in the neural pathway, producing emesis or nausea (Horn et al., 2014). Substituting PONV-provoking inhalational anesthetic agents with propofol is beneficial to patients by reducing PONV and its complications.

Theoretical Framework

The theoretical framework that was used in this project was Solberg's theory of change. According to Solberg (2007), practice quality improvement happens when there is a combination of priority, change process capability, and care process content. Priority is defined as a strong motive and need for a specific change that supersedes other concerns. Change process capability consists of factors that are needed for a practice change to happen, such as strong effective

leadership, adequate resources and time devoted to the change process, a high degree of involvement, and engagement by personnel at all levels. Care process content is a selection of systematic changes to fulfill the need and to improve practice quality. Facilitators and barriers to a quality improvement can be identified once these three necessary factors (priority, change process capability, and care process content) are evaluated, to guide the direction when implementing a practice change.

In this project, complication risks and setbacks caused by PONV, such as prolonged PACU stay, increased risk of aspiration pneumonia, dehydration, and delayed healing (Yoo et al., 2012), serve as an initiative for practice improvement (priority). Data on practice change and limitations to apply new knowledge acquired from the pre and post-educational intervention surveys are used to identify change process capability and care process content, to further guide development of new protocols for quality improvement, or to aid in designing future studies.

Methods

Design

This DNP project used a mixed-methods design with a quality improvement goal using pre- and post-surveys. Quantitative data was used to assess primary outcomes and qualitative data was used to assess barriers to practice change. A retrospective chart review was performed to assess patient outcomes 28 days before and 28 days after the educational intervention. Pre- and post-intervention surveys were distributed to anesthesia providers (Certified Registered Nurse Anesthetists (CRNAs) and Anesthesiologist Assistants (AAs)) that assess for changes in their knowledge, anesthesia practice, and perceived barriers to implementing TIVA. Primary outcomes of this project include the effects of the educational intervention on change in practice, and incidences of PONV in the PACU in patients undergoing laparoscopic bariatric surgeries

pre-and post-intervention periods. Secondary outcomes consist of time from procedure finish to extubation, change in knowledge among anesthesia providers after the educational intervention, and perceived barriers to using TIVA instead of inhalational anesthesia.

Translational Framework

The Iowa model of evidence-based practice (EBP) was used to guide the design and implementation of this project. This EBP model's purpose is to improve healthcare outcomes by guiding clinicians to utilize research evidence to develop and implement a practice change. (original citation for Iowa model needed here). It has a heavy emphasis on gathering and applying research evidence to promote clinical quality improvement (Titler, 2010). After identifying the priorities (consequences of PONV, high risk for PONV in patients undergoing bariatric surgeries), the principal investigator (PI) conducted a literature review to synthesize evidence-based data that support practice change. The educational intervention was based on the newest available evidence on the topic. Barriers to practice change (from traditional inhalational anesthesia to TIVA) were assessed and analyzed to develop a way to integrate and sustain the practice change in the future.

Setting

The project took place in a local community hospital with 196 inpatient beds, along with 11 operating rooms, cystoscopy, and endoscopy suites. Bariatric surgery is one of the facility's surgical specialties. The staff meeting and education intervention took place in the conference room.

Sample

Convenience sampling was used to recruit participants. All anesthesia providers (CRNAs and AAs) at the staff meeting were asked to participate in the educational presentation. The

initial sample size target was 20 anesthesia providers that currently practice at the project site. A retrospective chart review was done to gather patient/case data. All laparoscopic bariatric surgeries during the 28 days prior to the intervention and in the 28 days post-intervention were considered for a review. Exclusion criteria included patients who had requested a "break the glass" restriction on chart access and patients who were deceased at the time of review.

Intervention

During a staff meeting, participants were given an information sheet and pre-survey (Appendix A) to complete if they were willing to participate in the project. A 15-minute educational intervention (Appendix B) was presented by the PI on the benefits of TIVA in patients undergoing laparoscopic bariatric surgeries. The presentation focused on the benefits of TIVA with propofol in PONV prevention and decreased emergence delirium. The content included drawbacks of volatile anesthetic agents as well, such as their detrimental environmental factors along with PONV inducing properties. In addition, a flyer (Appendix C) containing the same educational information was posted in the anesthesia lounge. After the presentation, the participants were encouraged to ask questions.

Data Collection

The pre-intervention surveys were administered before the educational intervention. The post-intervention surveys (Appendix D) were distributed 4 weeks after the educational intervention to the anesthesia providers at their staff meeting. All the surveys were on paper and were placed in a sealed envelope prior to submission to the PI. The first question on the post-intervention survey asked if they had participated in the educational intervention or if the anesthesia provider had read the educational flyer. Surveys completed by people that had not participated in the intervention or read the flyer were not included in the analysis. A retrospective chart review was

completed following the post-intervention survey results. Data from patients undergoing laparoscopic bariatric surgeries that met the inclusion criteria during the 4 weeks before and the 4weeks after the intervention were collected. Data collected from patients' charts included types of anesthesia received (inhalational, TIVA, or balanced), use of sub-hypnotic dose of propofol, occurrence of PONV, and time from the end of the procedure to extubation. Administration of rescue antiemetic drugs was counted as an occurrence of PONV. Since data were not available for time spent in the PACU, time from "procedure finish" to "extubation" was collected and analyzed.

Instruments. Both pre-and post-intervention surveys asked for mother's birthday to link the surveys to the same participant. The surveys collected demographics and included questions to assess for changes in knowledge about TIVA with propofol and negative effects of inhalational agents, changes in practice, and perceived barriers to implementing TIVA. The same questions were used on both pre-and post-intervention surveys to assess the change in knowledge, practice, and barriers after the educational intervention. Post-intervention surveys had additional questions to assess practice change following the educational intervention. The post-intervention survey also assessed barriers to implement TIVA. The responses to the questions consisted of dichotomous, checkbox, Likert-scale, and open-ended formats. The surveys were on paper, de-identified, and stored in a secured locked cabinet at UNCG.

Data Analysis

The collected data about patient outcomes were analyzed using a t-test for unequal variance as an approximation to the Mann-Whitney U test, Chi-square test, and two-sample t-test to test for statistical significance. Descriptive statistics were used in combination with the t-tests for pre-and post-intervention surveys' data. Data analysis was done using Microsoft Excel's data

analysis tool pack. Data analysis was completed with guidance from a statistician faculty at the UNCG School of Nursing.

Descriptive statistics were used to describe the demographics of the participants and the free text answers to open-ended questions regarding perceived barriers. T-test for unequal variance was used as an approximation to the Mann-Whitney U test for the participants' survey responses since the normality was not met. Normality was checked using the data analysis tool pack from Microsoft Excel. A Chi-square test was used to check the relationship between the two categorical variables – types of anesthesia received and incidence of PONV. Administration of rescue antiemetic drugs was identified as an incidence of PONV. A two-sample t-test was done to test a relationship between a categorical variable (types of anesthesia received by patients) and a numerical variable (time to extubation).

Results

Demographics of the Participants

All 10 participants who attended the presentation on the benefits of TIVA completed the pre-intervention surveys (n=10). Out of 10, 8 participants submitted the post-intervention survey 4 weeks after the presentation. However, one of the post-intervention surveys was not completed and was discarded. Therefore, only 7 post-intervention surveys were counted towards the data pool (n=7). There was a wide range of years of practice among the participants, spread out anywhere from 1 year to 20 years. All 10 participants who completed the pre-intervention survey's demographic section had more than one year of anesthesia practice. Most participants (80%) had a master's degree, and 20% had a bachelor's degree. Only 2 out of 7 post-intervention surveys had matching identification numbers (mother's birthday) with the ones in pre-intervention surveys. Therefore, the survey data could not be linked and was analyzed as one

pool. See Appendix E for demographics data.

Knowledge

There were 6 questions to test participants' knowledge regarding TIVA and propofol's effect on PONV prevention, negative effects of volatile anesthetics, and risk factors for PONV. The answer choices were in Likert scale from 1 (strongly disagree) to 5 (strongly agree). Although 5 out of 6 knowledge-based questions had slight increase in their post-intervention scores, there was no significant difference in pre-intervention scores and post-intervention scores in all 6 questions regarding the knowledge. There was no significant change ($p = 0.95$) between the pre-intervention score ($M = 4.7$, $SD = 0.48$) and the post-intervention score ($M = 4.71$, $SD = 0.49$) for the question "TIVA with propofol decreases the risks of PONV." It was notable that the question "propofol has anti-emetic properties" had slightly lower post-intervention score ($M = 4.71$, $SD = 0.49$) than the pre-intervention score ($M = 4.73$, $SD = 0.47$), although there was no significant difference ($p=0.96$). However, the participants' knowledge about PONV prevention effect of sub-hypnotic propofol infusion ("sub-hypnotic propofol infusion is effective in PONV prevention") increased in the post-intervention assessment ($M = 4.71$, $SD = 0.49$) compared to the pre-intervention assessment ($M = 4.5$, $SD = 0.71$), although the change was not statistically significant ($p = 0.47$). The knowledge regarding the negative environmental impact of inhalational anesthetic agent had the most score increase among all the other knowledge questions, from the pre-intervention score ($M = 4.2$; $SD = 0.79$) to the post-intervention score ($M = 4.57$; $SD = 0.79$). Questions on risk factors for PONV ("use of volatile anesthetic agents increases a risk of PONV" and "patients undergoing laparoscopic bariatric surgeries have a high risk of PONV") did not have statistical difference ($p = 0.64$, $p = 0.46$; respectively) between pre-intervention scores ($M = 4.6$, $SD = 0.52$; $M = 4.7$, $SD = 0.48$; respectively) and post-intervention

scores (M = 4.71, SD = 0.49; M = 4.86, SD = 0.38; respectively) as well.

Current Practice

Three questions were used to assess the participants' current practice at the time of the surveys, both in pre-intervention and post-intervention periods. The answer choices were on a Likert scale from 1 (never) to 5 (always). More participants incorporated using TIVA on patients with a high risk of PONV after the educational intervention. Twenty percent of the participants responded "frequently" and "always" to the question "how often do you use TIVA on patients undergoing laparoscopic bariatric surgeries" on the pre-intervention survey. Post-intervention, 14.3% of the participants said they "frequently" and "always" use TIVA on patients undergoing laparoscopic bariatric surgeries. However, for the question "how often do you use TIVA on patients with high risk of PONV," the percentage of participants answering with "frequently" or "always" increased from 60% in the pre-intervention survey to 85.7% in the post-intervention survey, showing a notable difference in current (at the moment of taking the survey) practice. The participants also showed a change in practice regarding sub-hypotonic dose of propofol infusion as a method of PONV prevention. Before the educational intervention, 3 out of 10 participants (30%) answered that they rarely or never administer sub-hypnotic dose of propofol infusion for PONV prevention while giving general anesthesia. However, none of the participants answered "rarely" or "never" on the same question in the post-intervention survey.

Perceived Barriers

Perceived barriers to implementing TIVA were assessed before and after the educational intervention with Likert scale survey questions scored from 1 (strongly disagree) to 5 (strongly agree). There was an increase in the participants' agreement from the pre-intervention period to the post-intervention period on all three statements about the perceived barriers: "I do not have

enough time to set up for TIVA before the cases (M = 2, SD = 1.15; M = 2.57, SD = 0.98; respectively)," "setting up for TIVA prior to the cases is more time consuming than setting up for traditional inhalational anesthesia (M = 3, SD = 0.94; M = 3.14, SD = 1.21; respectively)," and "TIVA increases risks of awareness compared to inhalational anesthesia (M = 2.4, SD = 0.97; M = 2.71, SD = 1.11; respectively)." There was no statistical significance in the increase of the scores (p=0.29, p=0.8, p=0.56; respectively).

A higher percentage of participants agreed that they don't have enough time to set up for TIVA before the start of surgery after the educational intervention. Twenty percent of the participants answered with either "strongly agree" or "agree" to question "I do not have enough time to set up for TIVA before the cases" on the pre-intervention survey, versus 57.1% in the post-intervention survey. Slightly higher percentage of the participants answered "agree" or "strongly agree" to the question "setting up for TIVA prior to the cases is more time consuming than setting up for traditional inhalational anesthesia" in the post-intervention survey (42.9%) compared to the pre-intervention survey (40%). More participants agreed that TIVA increases risks of awareness compared to inhalational anesthesia on the post-intervention survey. Pre-intervention, 70% of participants "disagreed" or "strongly disagreed" that TIVA increases risks of awareness compared to inhalational anesthesia. However, on the post-intervention survey, only 42.9% disagreed or strongly disagreed with the same statement. One statement, "anesthesia providers I work with do not support use of TIVA," was assessed on the post-intervention survey only and just 1 out of 7 participants (14.3%) agreed with that statement.

Responses for open-ended questions to assess any other perceived barriers for TIVA implementation included unavailability of BIS monitors due to backorder, inability to have a propofol infusion ready before bringing the patient back to the operating room due to time

constraints, and occasional lack of 100 cc propofol vials from the pharmacy.

Practice Change

Practice change after the educational intervention was assessed with 4 post-intervention survey questions using a Likert scale from 1 (strongly disagree) to 5 (strongly agree). Overall, the participants changed practice after the intervention, considering a score greater than 3 as a positive change ($M = 3.61$, $SD = 0.79$). Out of 7 participants that completed the post-intervention survey, 4 participants (57.1%) agreed that they have increased TIVA usage when caring for patients undergoing laparoscopic bariatric surgeries. Seventy-one percent of the participants (5 out of 7) "agreed" or "strongly agreed" that they have increased TIVA use when caring for patients with a high risk of PONV. Out of 7 participants, 3 people (42.9%) "agreed" or "strongly agreed" that they have increased usage of sub-hypnotic dose of propofol infusion when caring for patients with a high risk of PONV. After the educational intervention, 6 out of 7 participants (85.7%) agreed that they are more conscious of the amount of inhalational anesthetic agents they use in their practice.

Patient Outcomes

There were 36 laparoscopic bariatric cases in the 28 days before the education intervention. Among those, 11.1% (4 out of 36) of the cases were done under TIVA, by the same anesthesia provider. The post-intervention period consisted of 34 laparoscopic bariatric cases. Only 2 out of the 34 cases (5.9%) were done under TIVA. However, they were done by two different anesthesia providers. The total number of laparoscopic bariatric surgeries during the project period was 70. Among 70, 6 cases were done under TIVA instead of inhalational anesthesia and 8 cases were done under balanced anesthesia with a mix of hypnotic dose of propofol infusion with inhalational anesthetic gases.

Of the patients who did not receive TIVA as a method of anesthesia, 48.4% (31 out of 64) experienced PONV that required rescue anti-emetic medications. In comparison, only 33.3% (2 out of 6) of the patients that received TIVA required rescue anti-emetic medications. Although the correlation between TIVA and its effect on PONV is clinically significant, it was not statistically significant (p=0.48).

The average time from the end of the surgery to extubation was 4.16 minutes in patients who did not receive TIVA (SD = 3.92), and 4.67 minutes in patients who received TIVA (SD = 3.56). The difference was not statistically significant (p = 0.75).

Discussion

The results of this project show the impact of an educational intervention on practicing providers on knowledge, practice, and perceived barriers. Overall, there was no statistical significance on change in knowledge, practice, and perceived barriers after the educational intervention. However, there were clinically significant changes after the educational intervention on anesthesia providers' practice. The majority of participants said that they are now more conscious of the amount of inhalational anesthetic agents they use in their practice. In the practice change assessment on the post-survey, more than half of the participants agreed that they increased TIVA usage in patients with a high risk of PONV and in patients who are undergoing laparoscopic bariatric surgeries. This contradicts the responses in the current practice section on the post-intervention survey, as well as chart review data that both showed decreased TIVA utilization in laparoscopic bariatric surgeries in the post-intervention period.

No statically significant change in knowledge may be attributed to participants that were experienced and familiar with the knowledge regarding TIVA and PONV. The areas that had the most impact on increased knowledge after the intervention were propofol's effect on preventing

PONV when used in sub-hypnotic doses, and inhalational anesthetic agents' negative impact on the environment. This can be due to the more recent attention to these areas in anesthesia literature (Celik et al., 2014; Kapoor, 2017; Sherman et al., 2012; Sherman & McGain, 2016) and the possibility of the providers not learning about them when they were in training. An increase was noted in self-reported TIVA use after the educational intervention from the practice change assessment on the post-intervention survey, although not statistically significant, these results implied that education influenced practice change. Although the changes were not statistically significant, it was clinically significant which can bring on a bigger change in the future with additional education.

Although all participants agreed that patients undergoing laparoscopic bariatric surgeries have a high risk of PONV and that TIVA with propofol decreases risks of PONV, their post-intervention survey results showed that they utilized less TIVA in laparoscopic bariatric surgeries. Meanwhile, there was approximately a 42.8% increase in participants (from 60% to 85.7%; relative increase) that answered "frequently" or "always" to using TIVA in patients with a high risk for PONV on the post-intervention survey. TIVA usage for patients undergoing laparoscopic bariatric surgeries ($M = 2.86$) was significantly lower ($p=0.060$) than TIVA usage for patients with a high risk of PONV ($M = 4$). This finding does not correlate with the knowledge assessment and suggests that there is a gap in knowledge that patients undergoing bariatric surgeries are at high risk for PONV. This may also be attributed to the small sample size and inability to link the survey data.

Perceived barriers to implementing TIVA increased in all three questions on the post-intervention survey compared to the pre-intervention survey. Increased barriers may be attributed to an increase in TIVA usage and discovering barriers to change. To successfully bring change

and increase TIVA usage for high-risk cases, hospitals can make allowances for more time to set up for TIVA.

Strengths and Limitations

Strengths of this project included a thorough evaluation of current evidence-practice literature that supported the educational intervention, assessment of the barriers to implementing TIVA, and identification of gaps in knowledge (negative environmental factor of volatile anesthetics and PONV prevention effect of sub-hypnotic dose of propofol).

A significant limitation of this project was the small sample size and the inability to link pre and post-intervention surveys. The project site had a small number of anesthesia providers that were potential participants. BIS monitors were on back-order which decreased the use of TIVA since many providers prefer to use BIS monitors when using TIVA. Participants were not tracked or linked pre and post-intervention, so a change in practice from a chart review was not linked to individuals that participated in the project.

Recommendations for Future Study

Future studies on this topic should include RCTs with larger sample sizes to increase the validity of the study. Paired t-tests on the pre-and post-intervention survey results will reduce inter-subject variability and therefore assess the impact of the intervention more accurately. While there are RCT studies that examined the effectiveness of propofol as an anti-emetic medication, more studies should be done to directly compare inhalational anesthesia versus TIVA on patients undergoing laparoscopic bariatric surgeries.

Relevance and Recommendations for Clinical Practice

The survey results of this DNP project can be used to develop new guidelines for clinical practice. Additional education about the increased risk of PONV in patients undergoing

laparoscopic bariatric surgery is needed. Furthermore, 80% of the participants agreed that they do not have enough time to set up for TIVA before the start of the surgery. Readily available supplies and allowing more time to set up for surgeries that are high risk for PONV may help decrease those barriers.

Conclusion

This DNP project aimed to assess the impact of an educational intervention about the benefits of TIVA on knowledge, practice, perceived barriers of anesthesia providers, and patient outcomes. There were self-reported changes in participants' anesthesia practice post-intervention. The participants increased utilization of TIVA after the educational intervention, especially in patients with a high risk of PONV. There was an increase in the sub-hypnotic dose of propofol infusion used as well after the intervention. Perceived barriers to implementing TIVA increased after the intervention, which may be due to the participants' increased TIVA usage. Increasing TIVA utilization will improve patient outcomes by lowering the risks of developing PONV, as evidenced by current literature and the retrospective chart review of anesthesia records showing a reduction in PONV occurrence in patients who received TIVA compared to patients who did not. Addressing the perceived barriers to implementing TIVA and repeating the education will increase this evidence-based practice and improve retention in knowledge among anesthesia providers.

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Appendix A

Pre-intervention Survey

Please write your mother's birthday (mm/dd/yy) _____

This information will only be used to link this pre-intervention survey to the post-intervention survey 4 weeks from now for appropriate data analysis. You will be asked to put the same number on your post-intervention survey.

_____

Demographic questions

Years of Practice	<1year☐ 1-5years☐ 6-10years☐ 11-15years☐ 16-20years☐ >20years☐
Highest Education Degree	Bachelors☐ Masters☐ Doctorate☐

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Total IV anesthesia with propofol decreases risks of PONV					
2. Propofol has anti-emetic properties					
3. Sub-hypnotic propofol infusion is effective in PONV prevention					
4. Inhalational anesthetic agents have a negative impact on the environment					
5. Use of volatile anesthetic agents increases a risk of PONV					
6. Patients undergoing laparoscopic bariatric surgeries have a high risk of PONV					

	Never	Rarely	Sometimes	Frequently	Always
1. How often do you use TIVA on patients undergoing laparoscopic bariatric surgeries?					

2. How often do you use TIVA on patients with high risk of PONV?					
3. How often do you administer sub-hypnotic dose of propofol infusion for PONV prevention while giving general anesthesia?					

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I do not have enough time to set up for TIVA before the cases					
2. Setting up for TIVA prior to the cases is more time consuming than setting up for traditional inhalational anesthesia					
3. TIVA increases risks of awareness compared to inhalational anesthesia					

Appendix B

Educational PowerPoint Presentation

Benefits of TIVA

in patients undergoing laparoscopic bariatric surgeries

Cheahee Kim, SRNA, RN-BSN

What is TIVA

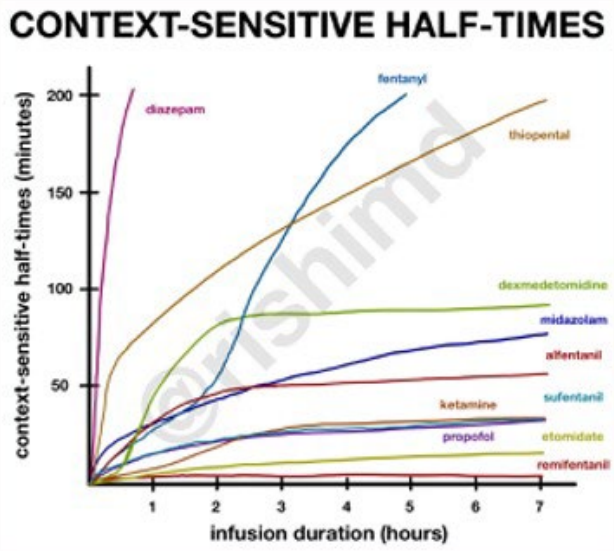
- Total intravenous anesthesia
  - Main drug: propofol
- Both inhalational anesthesia & TIVA works by reducing neuronal activity
  - Mainly by stimulating/modulating inhibitory GABA receptors

BIS monitoring

- FDA approved to assess the hypnotic effects of drugs
- It processes EEG signals to obtain a value -> reflects the level of consciousness of the patient.
  - Collects raw EEG data through its sensors and uses an algorithm to analyze and interpret the data
- Goal: 40-60 for general anesthesia
- Benefits
  - ↓ time to extubation, orientation in time and place, and discharge from both the operating room and PACU
- The risk of nausea and vomiting after surgery was reduced by 12% in patients monitored with bispectral index

Propofol

- Sedative and anesthetic effect by modulating inhibitory GABA receptors & glycine receptors
  - Decreases the rate of GABA dissociation from the receptor
  - Increases transmembrane Cl- conduction -> hyperpolarization -> inhibits depolarization
  - Increases the duration of the opening of the Cl- channels -> prolongs hyperpolarization -> sedation and hypnosis
- Rapid return of consciousness with minimal residual nervous system effects
- In high doses: inhibits neuronal nicotinic acetylcholine receptors -> anesthesia and amnesia
- Fast onset of action: < 60 seconds
- Short duration of action: 5-10 minutes
- Short elimination half-life: 0.5-1.5 hours
- Context sensitive half-time: < 40minutes after an 8hr infusion
- TIVA doses: 100mcg/kg/min – 300mcg/kg/min



Benefits of TIVA

Benefits of TIVA

- *PONV prevention
  - Reduction in both incident and severity of PONV
- Smooth emergence
- Higher patient satisfaction score

PONV Prevention and reduction

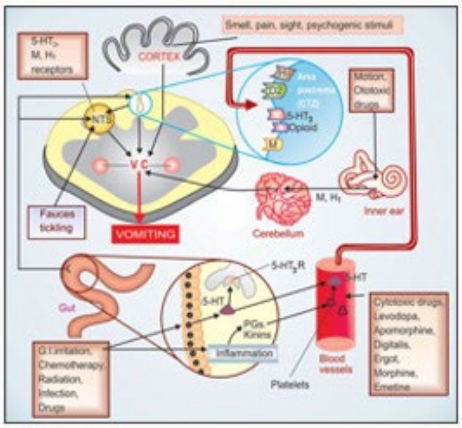
- Systematic reviews analyzed 247 RCTs (Kumar et al., 2014; Schraag et al., 2018)
  - Incidence of PONV among patients who received TIVA with propofol was greatly reduced compared to the patients who received inhalational anesthesia
  - Kumar et al. (2014)
    - 29.2% of patients experienced PONV with inhalational agents while only 13.8% did with TIVA
  - Schraag et al. (2018)
    - statistically significant reduction (39% reduction of the relative risk) in PONV in patients who got TIVA administration over volatile agents as their anesthetics.

PONV Prevention and reduction

- RCT by Yoo et al. (2012): TIVA vs inhalational anesthesia for robotic laparoscopic prostatectomy
  - TIVA group: propofol + remifentanil
  - Inhalational anesthesia group: desflurane + remifentanil
  - The researchers found incidence and severity of PONV in TIVA group to be significantly lower in the first 6 hours in post-operative period
- RCT by Chen et al. (2013): TIVA vs inhalational anesthesia in breast surgery
  - TIVA group: propofol
  - Inhalational anesthesia group: sevoflurane
  - significantly lower prevalence of PONV in patients who received TIVA (14.3%) than in patients who received sevoflurane (50%)

Antiemetic property of propofol

- N/V: caused by stimulation of the chemoreceptor trigger zone (CTZ) in medulla oblongata



- Reduces 5-HT (serotonin) release from its GABA-mediated inhibition

Evidences from RCT

- Celik et al. (2014): sub-hypnotic propofol infusion during surgery
  - Propofol group (n=40), control group (n=40), decadron group (n=40)
  - 65% in control group (26/40) had n/v compared to 30% in propofol and decadron groups (12/40 each)
  - Sub-hypnotic dose of propofol infusion is as effective in preventing PONV as decadron
- Niu et al. (2018): propofol infusion after delivery of the baby in C/S for pt who got CSE
  - propofol group (n=40) and control group (n=40)
  - Incidence of nausea was notably lower in the propofol group
  - 60% in the control group (24 out of 40) had nausea compared to 25% in propofol group (10 out of 40)
  - 23% in the control group (9 out of 40) had vomiting compared to 8% in the propofol group (3 out of 40)
  - 85% of pt needing rescue antiemetic had relief after receiving 20mg of propofol as the drug
- Ewalenko et al. (1996): sub-hypnotic propofol infusion postoperatively
  - Propofol group (n=32) and control group (n=32)
  - 65% in control group (21 out 32) had n/v compared to 10% in propofol group (3 out of 32)

Smooth emergence

- Emergence: from an unconscious phase into recovery of consciousness and wakefulness
- Jo et al. (2019) found TIVA significantly lowered incidence of emergence agitation in nasal surgery
  - TIVA group (n=40): propofol + remifentanil
    - Only 1 pt out of 40 experienced emergence agitation (2.5%)
  - VIMA group (n=40): sevoflurane + nitrous oxide
    - 8 out of 40 experienced emergence agitation (20%)
  - Emergence agitation was measured by Richmond Agitation-Sedation Scale
- Juckenhöfel et al. (1999): TIVA (propofol + remifentanil) maintenance vs. Sevoflurane maintenance on laparoscopic gynecology surgery
  - Spontaneous ventilation: 4.1min (TIVA) vs 6.3min (Sevo)
  - Eye opening: 4.4min (TIVA) vs 8.2min (Sevo)
  - Stating name: 5.3min (TIVA) vs 13.2min (Sevo)
  - Very satisfied: 73% (TIVA) vs 23% (Sevo)

Drawbacks of volatile agents

- Higher risk for PONV
  - volatile agents augment 5-HT signals in the neural pathway, producing emesis or nausea
- Waste anesthesia gas pollution

Negative environmental effects of inhalational anesthetics

- Volatile anesthetic gases are responsible for 2.5% of the greenhouse gas emissions
- Isoflurane, sevoflurane, desflurane, and N2O have higher global warming potential than the CO2 does
- Waste anesthesia gases remain nondegraded for prolonged periods of time -> traps radiant heat
  - Sevoflurane: 1.1 years
  - Isoflurane: 3.2 years
  - Desflurane: 14 years
  - Nitrous oxide: 114 years
- Isoflurane and N2O actively damage the ozone
- In comparison, greenhouse gas impact of propofol is 10,000 times lower than it of desflurane

Why do we care about PONV

- Named most undesirable anesthesia complication among patients
- Dehydration
- Hypertension
- Aspiration
- ↑ time of hospital stay
- ↑ medical cost
- ↑ tension on the surgical site
- Wound dehiscence
- ↑ bleeding
- ↑ ICP, IOP, IAP

Why bariatric patients

- ↑ ↑ ↑ risk of having PONV
- Obesity
  - ↑ adipose tissue -> ↑ reservoir for inhalational anesthetics -> ↑ lingering effects of volatile agents (including their effect on ↑ n/v)
  - ↑ pressure on the gastroesophageal junction
- Type of surgery
  - Laparoscopic surgery has been associated with high incidence of PONV
- Location of the surgery
  - GI tract
  - Release of serotonin with inflammation and maneuvering

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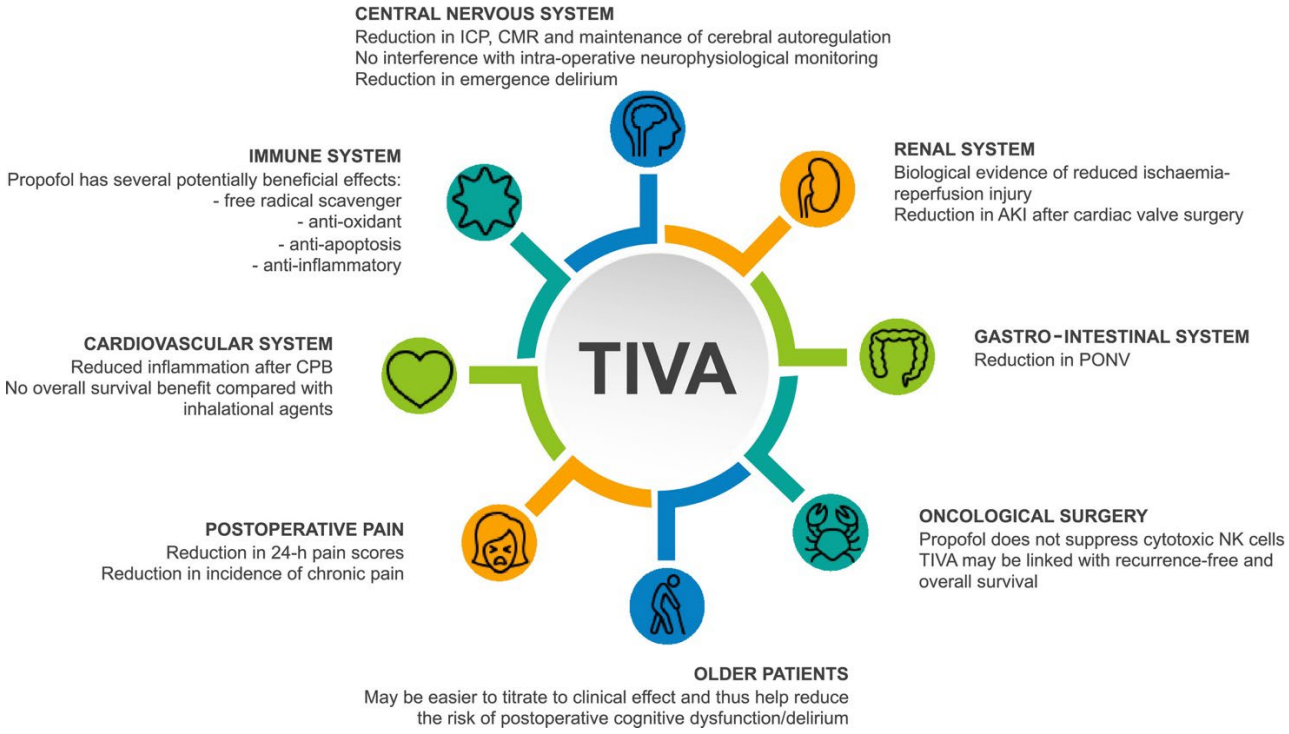
Appendix C

Flyer



Appendix D

Post-intervention Survey

Screening question

Did you participate in the educational presentation or read the informative flyer in the breakroom about benefits of TIVA?	Yes ☐ No ☐

Please write your mother's birthday (mm/dd/yy). _____

Knowledge

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Total IV anesthesia with propofol decreases risks of PONV					
2. Propofol has anti-emetic properties					
3. Sub-hypnotic propofol infusion is effective in PONV prevention					
4. Inhalational anesthetic agents have a negative impact on the environment					
5. Use of volatile anesthetic agents increases a risk of PONV					
6. Patients undergoing laparoscopic bariatric surgeries have a high risk of PONV					

Post-intervention assessment

	Never	Rarely	Sometimes	Frequently	Always
1. How often do you use TIVA on patients undergoing laparoscopic bariatric surgeries?					
2. How often do you use TIVA on patients with high risk of PONV?					
3. How often do you administer sub-hypnotic propofol infusion for PONV prevention while giving general anesthesia?					

Following the education…	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

1. I have increased TIVA usage when caring for patients undergoing laparoscopic bariatric surgeries					
2. I have increased TIVA usage when caring for patients with high risk of PONV					
3. I have increased sub-hypnotic propofol infusion usage when I cared for patients with high risk of PONV					
4. I am more conscious of the amount of inhalational anesthetic agents I use in my practice					

Barriers to implement TIVA over inhalational anesthesia

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I do not have enough time to set up for TIVA before the cases					
2. Setting up for TIVA prior to the cases is more time consuming than setting up for traditional inhalational anesthesia					
3. Anesthesia providers I work with do not support use of TIVA					
4. TIVA increases risks of awareness compared to inhalational anesthesia					

Barriers that prevent me from utilizing TIVA include:

_____

_____

_____

_____

Thank you! ☺

Appendix E

Demographics

Years of Practice	n (%)
<1	0 (0)
1-5	2 (20)
6-10	1 (10)
11-15	3 (30)
16-20	1 (10)
>20	3 (30)
Highest Education Degree	**n (%)**
Bachelors	2 (20)
Masters	8 (80)
Doctorate	0