INTRAOPERATIVE ESMOLOL ADMINISTRATION IN
MANAGING POSTOPERATIVE PAIN

by
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As members of the DNP Project Committee, we certify that we have read the DNP Project prepared by Alysia Deborah Reina entitled Intraoperative Esmolol Administration in Managing Postoperative Pain and recommend that it be accepted as fulfilling the DNP Project requirement for the Degree of Doctor of Nursing Practice.

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SIGNED: ____Alysia D. Reina______
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ABSTRACT

Background: Managing perioperative pain is an essential goal for all anesthesia providers. The utilization of multimodal methods for analgesia is common. Administration of opioids has traditionally been the primary method to control pain. However, opioids have additional side effects such as nausea, vomiting, respiratory depression and potential for long term misuse, all of which can lead to adverse patient outcomes. Research studies suggest perioperative administration of esmolol, a beta-blocker normally used to control heart rate and blood pressure, can decrease opioid requirements. The purpose of this quality improvement study was to assess anesthesia provider’s knowledge of using esmolol for the purpose as an alternative or adjunct to perioperative opioid administration.

Methods: A non-experimental descriptive quantitative methodology was employed to evaluate knowledge of esmolol as a perioperative pain management method. A convenience sample of four anesthesia providers working in the main operating suite at a 530-bed acute care facility in a southern Texas town participated in this DNP project. Collection and analysis of data was accomplished through use of a pre and post educational intervention survey. A pre and post survey was used to identify provider knowledge and influence on practice after an education intervention. The pre and post surveys contained the same nine questions, two of which were open ended, to assess achieved learning and/or changes in practice.

Results: A total of four anesthesia providers completed the pre survey, educational PowerPoint and post survey. Upon completion of both surveys, the data gathered was entered into SPSS for analysis using a Wilcoxon Signed Rank Test for comparison. No significant changes indicating enhanced knowledge of esmolol use for perioperative pain management was noted post
educational PowerPoint. Commonalities regarding patient characteristics and barriers to esmolol use, such as cost and access were reported in the open-ended question.

**Conclusion:** Results suggest anesthesia providers are knowledgeable about use of esmolol as a perioperative pain management method. Barriers surrounding the use of esmolol, such as cost, ease of access and assessment of pain, exist, limiting its use in pain management. Future educational opportunities to increase provider participation and response may provide additional insight to selection and incorporation of different pain management modalities.
BACKGROUND

Pain is an anticipated and feared postoperative occurrence often leading to the need for additional pharmacological administration, historically via opioids. Postoperative pain as well as postoperative nausea and vomiting (PONV) are frequently cited as the most common anxiety producing complications by patients (Harless, Depp, Collins & Hewer, 2015; Obrink, Jildenstal, Oddby & Jakobsson, 2015; Reina, 2016). Although the administration of opioids is effective at relieving pain, the practice presents its own potential complications such as sedation, respiratory depression, respiratory arrest, unanticipated hospital admissions and further aggravation of PONV.

An additional complication of opioid administration is the potential for long-term use and misuse of opioids past the expected duration of benefit. Over the past two decades, the United States has experienced a marked increase in opioid use for non-cancer related pain. Deaths contributed to opioid use have quadrupled from the prior two decades leading the US Department of Health and Human Services and the Centers for Disease Control to declare deaths due to prescriptive opioid overdose an epidemic (Alam & Juurlink, 2016). Studies indicate more than 10% of patients prescribed opioids after surgery are still using opioids one year later and are 44% more likely to become long term opioid users. It was also found that many patients had transitioned to stronger opioids over time (Macintyre, Huxtable, Flint and Dobbins, 2014). This continued use of opioids may not correlate to the intensity and duration of pain as the main reason for continued use but may instead indicate misuse. Anesthesia providers can help mitigate opioid administration by seeking alternative solutions for pain management.
Less than half of patients report adequate postoperative pain relief (Chou et al, 2016). The most current clinical practice guideline, Management of Postoperative Pain: A Clinical Practice Guideline (2016), gathered information from multiple pain management organizations (e.g. American Pain Society, American Society of Regional Anesthesia and Pain Medicine etc.), all of which recommended using a multimodal approach to postoperative pain management (Chou et al, 2016). Although the guideline mentions multiple methods of providing multimodal pain relief, each plan should be tailored to the patient’s specific needs.

There is increasing concern about the growing opioid epidemic as a complication associated with continued opioid use after a surgical event (Macintyre et al, 2014). If the dose of an opioid can be reduced or even eliminated without resulting in increased pain levels, fewer of these complications may occur (Reina, 2016). Incorporation of non-opioid pain management is an excellent avenue for advanced practice nurses to pursue in order to decrease opioid requirements.

One recent potential method identified in the literature to reduce postoperative pain is the intraoperative administration of esmolol. The use of esmolol may decrease the overall requirement for opioid pain medication administration as well as other anesthesia adjuncts, which will enhance and improve provider practice and patient safety (Reina, 2016). Research suggests there may be a link between intraoperative esmolol administration and decreased postoperative opioid requirements. The exact mechanism in which this occurs is not known but a few theories exist. One theory explains that beta-blockers may activate G-proteins in certain cells, which leads to a centrally mediated analgesic effect. This is a similar pain-blocking pathway found with the use of clonidine (Celebi, Cizmeci, Canbay, 2014). Another theory
focuses on cytokines. During surgery, cytokines are released as part of the inflammatory pathway elicited by a surgical intervention levels (Kim, Hwang, Cho, Her, Ahn, Lee, 2015; Reina, 2016). (Kim et al, 2015; Reina, 2016). A randomized control trial measuring cytokines found a correlation between esmolol administration and varying dosage with circulating cytokine levels (Kim et al, 2015; Reina, 2016). Patients were randomly assigned to one of three groups: saline only, subclinical esmolol and clinical esmolol dosage. Patients in both esmolol groups had decreased cytokine levels indicating a decrease in the inflammatory pathway. If cytokine secretion can be suppressed, post surgical pain can be decreased, which will then lead to an overall decrease in opioid medication requirements (Kim et al, 2015; Reina, 2016).

**DEFINITIONS**

Definitions are provided below to assist with understanding of terminology frequently used among anesthesia providers and throughout this paper.

- **Beta-blocker**: type of medication administered to lower heart rate and blood pressure; works at Beta receptors in heart, bronchioles, visceral organs and arterioles

- **Cytokine**: peptide molecule that regulates inflammatory actions of immune cells (O’Donnell, 2014).

- **Esmolol**: selective beta-blocker medication administered to lower heart rate and blood pressure.

- **G-proteins**: peripheral guanine nucleotide binding proteins that bind to transmembrane proteins or attach to membranes. Involved in cell signaling or communication

- **Intraoperatively**: time period when patient is physically in the operating room.

- **Multimodal**: more than one method of addressing pain control.

- **Opioid**: narcotic medication administered to alleviate sensation of pain.
• Postoperative: period following a completed surgery.

LOCAL PROBLEM

The purpose of this DNP project was to assess current knowledge and practice among anesthesia providers regarding the use of intraoperative esmolol administration as part of a multimodal pain management approach for reducing perioperative opioid requirements. Through gained knowledge, an anesthesia provider has the ability to incorporate a new method of practice in managing a patient’s postoperative pain experience. The aim was to expand provider awareness regarding additional therapeutic use of the beta-blocker esmolol outside of its primary indication for administration, which is heart rate and blood pressure management.

STUDY QUESTION

For anesthesia providers (P), how does knowledge regarding the use of esmolol intraoperatively as a postoperative pain control modality (I) compared to other pain control measures (C) influence intraoperative administration of esmolol (O)?

CONCEPTUAL FRAMEWORK

A conceptual framework used to focus on practice change is Dobbins, DeCorby and Robeson’s framework (2010) (Appendix A). Dobbins’ et al. framework for implementing evidence-based practice can be utilized on varying organizational levels, from sole provider to an entire healthcare system. Utilization of the most current evidence based information is emphasized in Dobbins’ et al. framework to deliver improved practice decisions leading to better patient outcomes (Dobbins et al, 2010).
FRAMEWORK

Everett Roger’s Diffusion of Innovation Theory has a strong history of application within the field of social sciences and has experienced equal adaptability in other disciplines as well including, technology, education and healthcare (Dearing, 2009) making it a natural choice upon which Dobbins’ conceptual framework is based (FIGURE 1; Dobbins, Ciliska, Cockerill, Barnsley, DiCenso, 2002). The intent of Dobbins’ framework is to provide guidance to individuals and organizations within the health care field in identifying factors needed to facilitate evidence-based practice (Dobbins et al, 2010).

Dobbins’ (2010) framework identifies a series of five phases that take place when contemplating adoption of a new innovation: knowledge, persuasion, decision, implementation and confirmation. The Knowledge phase requires potential adopters to gain awareness of an innovation. In the perioperative setting, the adopters of administering esmolol intraoperatively are the anesthesia providers.

The framework further emphasizes only the highest quality of evidence should be used when disseminating knowledge, mentioning clinical practice guidelines and systematic reviews as two quality resources. For this quality improvement project, the knowledge phase was achieved when education was provided through the use of a PowerPoint to deliver current evidence based research on the use of esmolol as a pain management modality. The educational PowerPoint included a history on the current opioid epidemic, theories on the mechanism of action of esmolol, general dosage guidelines as mentioned in research studies and appropriate patient criteria as identified in research studies (Kim et al, 2015; Harless, 2015; Celebi et al, 2014).
A Framework for the Dissemination and Utilization of Research for Health-Care Policy and Practice

Dobbins, Ciliska, Cockerill, Barnsley, DiCenso, 2002
After the Knowledge phase, adopters enter into the Persuasion phase. During this phase, adopters weigh the risks and benefits of the innovation on patient outcome and personal practice preferences. Anesthesia providers are well versed in clinical use of esmolol surrounding management of hemodynamics, mainly heart rate and blood pressure control. The PowerPoint included patient characteristics that demonstrated the greatest benefit from esmolol administration for pain management. This challenged the anesthesia provider to consider an alternative, rather than traditional use for esmolol. The persuasion phase includes trialing of new knowledge.

Closely following the Persuasion phase is the Decision phase, which involves activities illustrating the making of a decision. This is the phase in which anesthesia providers will either adopt or reject a change in practice. For the purposes of this quality improvement project, a demonstration of this would be either incorporation or rejection of esmolol use as a pain management modality. The knowledge, persuasion and decision phases are supported through conversations among anesthesia providers, evidence-based research articles and following up on information seeking behavior.

The Implementation phase marks the decision to adopt the innovation into practice. This can be identified as putting knowledge into action (Dobbins et al, 2010) and involves activities that promote integration of the decision to adopt a practice change on a larger scale, such as increasing medication availability. This phase may also require examination of what additional resources, if any, are needed to successfully implement a practice change and if creation of or updating policies is required.
The Confirmation phase is the final step in the framework and is an opportunity to review the impact on patient outcomes. Expected outcomes of this phase include improved postoperative pain management as demonstrated by a reduction in required opioid administration. The feedback received during the Confirmation phase can be used to determine if previous phases need to be revisited to alter the innovation. Demonstration of this accomplishment would be through verbal feedback as well as a chart review to extract information related to postoperative pain control. Additional information may also include any complications encountered during the Implementation phase since this will alter the implementation of the innovation.

Dobbins’ et al. (2010) conceptual framework is ideal for advanced practice nurses because it is flexible and widely adaptable to many settings. The concepts regarding the five phases as described above fit nicely with the scope of this DNP Project. This framework is a synthesis of literature addressing organizational behavior, culture and decision-making practices and how knowledge translation and exchange takes place (Dobbins et al, 2010). Although Dobbins’ framework is closely tied to Roger’s Diffusion of Innovation Theory, its application is focused on incorporation of evidence-based research into practice and how progression through the five phases can impact practice change.

**SYNTHESIS OF EVIDENCE**

Experiencing pain is one of the top concerns patients have when undergoing surgical procedures (Harless et al, 2015). The use of opioids to help control post-operative pain is common practice in the perioperative setting, regardless of the procedure being performed. Administration of opioids can occur anywhere in the perioperative spectrum including pre-
operative phase, intra-operative phase and post-operative phase. Repeated administration of opioids increases the risk of undesirable side effects commonly associated such as nausea and vomiting, and respiratory depression (Harless et al, 2015). Additionally, as mentioned previously, the rising number of deaths related to opioid use and misuse is cause for alarm (Alam & Juurlink, 2016).

Finding new methods of controlling pain and limiting the number of undesirable side effects of opioids is of interest to all anesthesia care providers. Studies exist that suggest perioperative use of esmolol decreases requirements for several anesthetic management agents including opioids (Harless et al, 2015; Kim et al, 2015; Lopez, Mayo, Zaballos et al, 2012) (Appendix B).

Several research articles discuss esmolol for use in pain management. A variety of search terms were used to locate information specific articles addressing esmolol and pain management. Some examples include: “esmolol and pain”, “esmolol and postoperative pain”, “anesthesia and esmolol”. Approximately 96 articles mentioning esmolol administration as a pain management modality or adjunct to anesthetic gases or infusions were found using PubMed, CINAHL and Google Scholar databases. Several of these articles were duplicates and excluded from review. Filters were then added to the search to limit articles to less than ten years old, Randomized Clinical Trials, Reviews and Humans. With these filters in place, 28 articles were returned. Hand review of the 28 articles further excluded studies listing esmolol administration for hemodynamic attenuation rather than pain management and studies focusing on the effect of esmolol on decreasing intravenous anesthetic or volatile gas consumption. The final review included 14 studies.
<table>
<thead>
<tr>
<th>Author / Article</th>
<th>Qual: Concepts or phenomena Quan: Key Variables Hypothesis Research Question</th>
<th>Design</th>
<th>Sample (N)</th>
<th>Data Collection (Instruments/tools)</th>
<th>Findings</th>
</tr>
</thead>
</table>
Hypothesis: When used as an adjunct for perioperative analgesia and anesthesia, esmolol decreases the amount of perioperative opioid use and side effects associated with opioid use. | Systematic literature review | N=20 articles specifically evaluating analgesia effects of esmolol | Literature review of Randomized Controlled Trials (RCT) | Regarding opioid administration: several studies used in lit review suggested use of esmolol decreases perioperative opioid use (statistical significance noted; <0.05). Groups that were treated with esmolol, required fewer opioid administrations both intraoperatively and postoperatively |
A systematic review and meta-analysis of randomized control trials (RCTs), indicating Level I evidence (Hitchcock, 2017), was performed with emphasis on perioperative pain outcomes associated with administration of beta-adrenergic antagonists (Harkanen, Halonen, Selander, & Kokki, 2015). This systematic review included 11 RCTs that were placebo-controlled, active-controlled or placebo-active-controlled involving 701 adult patients. Ten of the RCTs focused on the use of esmolol and one using propranolol for perioperative pain management. The studies focusing on esmolol provided dosage ranges and indicated if an infusion was also initiated after a bolus dose. The results of the studies indicated that patients receiving clinical and subclinical doses of esmolol had statistically significant (P< 0.05) lowered opioid requirements (Harkanen et al, 2015).

A meta-analysis conducted by Harkanen et al (2015) identified patients in the intervention groups required 32-72% less opioid analgesics than patients who did not receive a beta-adrenergic antagonist. This reduction in opioid requirement was present in groups that received clinical and subclinical doses when compared to placebo. Adverse cardiovascular effects of beta-adrenergic antagonists were evaluated in eight out of the eleven studies but showed no difference in hemodynamic stability between patients in the trial group versus those in the control group. Only two studies indicated the need to treat bradycardia (4-7%) and hypotension (2-10%) but did not mentioned what treatment was required to correct both (Harkanen et al, 2015).

A variety of surgical procedures during which esmolol was administered as an analgesic modality have been mentioned. For example administration of esmolol was found to be more effective in reducing postoperative pain when compared to a ketamine-remifentanil mixture in
patients who underwent laparoscopic cholecystectomy (Lopez, Mayo, Zaballos et al, 2012). Another example was an intraoperative infusion of esmolol during a septorhinoplasty which showed a reduction in anesthetic requirements and postoperative opioid administration (Celebi, Cizmeci & Canbay, 2013). Finally, a study done by Kim et al (2015) focused on different dosage ranges of esmolol in relation to postoperative levels of circulating cytokines, which are associated with inflammation, in patients who underwent laparoscopic gastrectomy. This study suggested that esmolol played a role in suppressing certain cytokines, leading to less inflammation and therefore less pain. The study further suggested that the extent of cytokine suppression is related to the dose of esmolol administered intraoperatively (Kim et al, 2015).

To date, the current research does not address how knowledge of esmolol administration for perioperative pain management influences the anesthesia provider’s decision to incorporate esmolol into practice. Despite querying several research databases, no articles were found regarding the specific phenomena of interest: the anesthesia provider’s knowledge of the use of esmolol as an analgesic modality. Furthermore, no research exists regarding the likelihood of anesthesia providers to administer esmolol due to having specific knowledge regarding its use in pain management.
<table>
<thead>
<tr>
<th>Author / Article</th>
<th>Qual: Concepts or phenomena</th>
<th>Design</th>
<th>Sample (N)</th>
<th>Data Collection (Instruments/tools)</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kim, Y., Hwang, W., Cho, M.-L., Her, Y.-M., Ahn, S., &amp; Lee, J. (2015). The effects of intraoperative esmolol administration on perioperative inflammatory responses in patients undergoing laparoscopic gastrectomy: a dose-response study. Surgical Innovation, 22(2), 177-182. doi:<a href="http://dx.doi.org/ezproxy1.library.arizona.edu/10.1177/1553350614532534">http://dx.doi.org/ezproxy1.library.arizona.edu/10.1177/1553350614532534</a></td>
<td>Hypothesis: administration of esmolol intraoperatively to block beta-adrenergic receptor stimulation in response to surgical stress will decrease the level of cytokines released.</td>
<td>Patients randomly separated into 1 of 3 groups: 1) Saline (no esmolol) 2) clinical dose (0.5mg/kg induction followed by 0.30mcg/kg/min infusion) 3) subclinical dose (0.25mg/kg followed by 0.15mcg/kg/min infusion)</td>
<td>Adult patients undergoing laparoscopic gastrectomy due to gastric cancer; American Society of Anesthesiologist (ASA) class I or II</td>
<td>Blood drawn at three perioperative time periods to check cytokine (IL-6, IL-4, IL-10) levels: 1) after induction (T0) 2) at peritoneal closure (T1) 3) 60 minutes after surgery (T2) IL concentrations in plasma determined using conventional ELISA Blood Levels of C-reactive Protein (CRP) drawn on postoperative day 1 via a complete blood count (CBC) and assessed using nephelometry One-way analysis of variance (ANOVA), Kruskal-Wallis test or X² test used to compare demographic and anesthetic data</td>
<td>Duration of surgery and anesthetic requirements were comparable between all three groups No significant difference between groups detected at baseline draw (T0) IL-6 level increased in saline and subclinical group (T1) No change in IL-6 expression in clinical dose group IL-4 levels significantly lower in clinical dose group compared to saline and subclinical dose group IL-10 levels increased significantly in saline group after surgery (T2); no change in expression in clinical and subclinical dose group CRP levels lower in clinical and subclinical dose groups</td>
</tr>
</tbody>
</table>
METHODS

Design

The design of this DNP project was intended to initiate the components of Dobbins’ five-phase framework: knowledge, persuasion, decision, implementation and confirmation. Using information gathered from evidence-based research a pre and post survey of six nominal, one frequency and two open-ended questions (Appendix D) was created to assess the anesthesia provider’s knowledge, considerations for use and potential barriers to adoption regarding intraoperative esmolol administration to aid in postoperative pain management. This information was also used to design the educational PowerPoint, which served as a tool for dissemination of knowledge.

Word of mouth as well as an informational flyer (Appendix A) detailing the live educational event was posted in the anesthesia break room and served as the recruitment strategy. Inclusion criteria included any current practicing anesthesia provider who was willing to participate in completing a pre survey, followed immediately by attending the educational PowerPoint and then completing a post survey one week later. Exclusion criteria included non-anesthesia providers and individuals who did not participate in pre survey and educational event.

The educational event was scheduled from 0645 to 0900 a.m. This time frame allowed for access to a larger number of anesthesia providers as compared to other time points in the day. The PowerPoint presentation viewing started at random times due to varied morning break routines among the anesthesia staff.

The pre survey was handed out to participants during the live educational event and served as a knowledge/practice assessment. Upon completion and collection of the pre surveys
the educational PowerPoint was narrated by and displayed from the primary researcher’s personal laptop computer. The educational PowerPoint included evidence-based information about perioperative opioid use, the current opioid crisis and current research surrounding use of esmolol to decrease perioperative opioid requirements. The PowerPoint also addressed theories on the mechanism of action of esmolol in relation to decreased opioid requirements as well as a recommended dosing regimen based off of suggestions from previous research studies.

Information covered in the PowerPoint was used to create several survey questions. The allotted time for completion of the pre survey and PowerPoint viewing was 15 minutes.

One week following the pre survey and educational PowerPoint, participating anesthesia providers completed a post survey containing the same questions as the pre survey (Appendix B). The pre and post survey was administered to assess for a change in knowledge/practice. A knowledge/practice assessment helps provide insight into the population of interest, which, for the purpose of this DNP project, was the anesthesia provider. The approximate time to complete the post survey was five minutes per anesthesia provider.

**Setting**

The quality improvement project took place in the main operating suite at a 530-bed acute care facility in a southern Texas town. The pre survey and educational PowerPoint was administered in the anesthesia provider break room, which is its own designated space separate from other operating room staff. The post survey was administered on May 4th at various times and locations within the facility throughout the day as deemed convenient by the participating anesthesia provider.
Participants

A total of 15 anesthesia providers consistently work in the main operating suite at the facility. On average, nine anesthesia providers are scheduled daily. All current practicing anesthesia providers were encouraged to attend the education event.

Seven anesthesia providers were present in the break room during the scheduled educational event. Two declined to participate due to time constraints and one requested information but was ultimately excluded from the study results due to not being able to complete the post survey.

Confidentiality of participant’s survey responses was maintained through a coding system. The coding system included the letter “A” for pre survey and the letter “B” for post survey responses. Following the letter distinguishing order of survey completion, the participant used the last four numbers of his or her phone number.

Data Collection

Data collection consisted of participant responses to nine pre and post survey questions. The surveys were hand delivered to participants. Seven questions were of nominal type design and two were open ended. The pre and post surveys contain the same questions for later comparison during data analysis. The pre survey was administered prior to the educational PowerPoint. The post survey was administered one week after the pre survey and educational PowerPoint. All surveys were hand collected upon completion and responses were kept confidential in a non-transparent, zipped document holder.
Data Analysis

Information from the pre and post survey was analyzed using descriptive quantitative and qualitative analysis methods. The pre and post survey contained the same questions and consisted of two demographic, seven nominal and two open-ended questions. The analysis of the nominal and qualitative questions enabled comparison across the provider population and explored collection of data regarding provider knowledge of multimodal pain management techniques, specifically the use of esmolol pre and post educational intervention. Through use of SPSS, a statistical software program made available through the University of Arizona College of Nursing, descriptive analysis presented the data in the form of frequency tables for the seven nominal questions. Frequencies were run separately on pre and post survey variables. A Wilcoxon Signed Rank Test was then run to compare pre and post survey responses. The qualitative data was analyzed for recurring commonalities regarding knowledge, attitude and practice using esmolol as a postoperative pain management medication.

ETHICS

Ethical considerations for this project surround maintenance of confidentiality of provider participation and the data collected. Provider participation confidentiality is important to protect privacy of answers, which are a reflection of provider knowledge and practice. Failure to maintain confidentiality can result in provider stress from altered peer interactions and perception of performance.

Participation in the survey was strictly voluntary and in no way did the provider feel pressured or coerced into completing the survey. Disclosure of voluntary participation was emphasized prior to survey distribution. Voluntary completion of the survey acted as consent to
participate in the study, free from coercion. Additional emphasis included data collected that was compiled, summarized and compared as a whole and not on an individual basis. If at any time the provider elected to no longer participate, a blank survey was returned.

RESULTS

Four anesthesia providers met inclusion criteria and agreed to participate in the study. Table 1 summarizes the anesthesia provider’s years in practice:

<table>
<thead>
<tr>
<th></th>
<th>Years in Practice</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provider 1</td>
<td>1</td>
<td>1</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Provider 2</td>
<td>4</td>
<td>1</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>Provider 3</td>
<td>11</td>
<td>1</td>
<td>25</td>
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<td>75</td>
</tr>
<tr>
<td>Provider 4</td>
<td>14</td>
<td>1</td>
<td>25</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>4</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

N=4; Mean=7.5; Standard deviation=6.028

All four participants completed the pre survey in its entirety before the educational PowerPoint was displayed. As mentioned previously, one week later, the same four anesthesia providers completed the post survey. Bar graphs were developed to display pre and post survey responses to questions 1, 2, 3 and 7 (Q1, Q2, Q3, Q7; APPENDIX B).
Figure 1
Q1: Within the last 30 days did you use esmolol to treat pain?

Figure 2
Q2: Does esmolol decrease opioid requirements?
Figure 3
Q3: Do all surgical patients require narcotics to manage pain?

Figure 4
Q7: Does administration of esmolol pre-operatively decrease opioid requirements post-operatively?
Pre and post survey responses remained the same for questions 4 and 5 (Q4, Q5; APPENDIX B). Question 4 (Q4; Figure 6) asked the anesthesia provider about frequency of using non-pharmacologic pain management interventions. Question 5 (Q5; Figure 7) asked about cytokine levels related to esmolol administration and was derived from the educational PowerPoint to assess for a change in knowledge. Pie graphs were created to display results for questions 4 and 5 to illustrate the different responses:

![Figure 5](image)

*Figure 5*

**Q4:** How many times in the last year did you use non-pharmacological interventions to manage pain in the perioperative setting?

- Never: 50%
- Twice: 25%
- Three or more times: 25%
Question 6 asked how many times within the past 30 days was esmolol administration considered for postoperative pain. All the participants on both the pre and post survey selected the same response of “0-2 times”, which was one of four selections available.

Question 8 asked the anesthesia provider to identify patient characteristics that have been deemed appropriate for esmolol administration. The educational PowerPoint listed patient characteristics as age range between 18 to 65 years of age, no chronic opioid or beta-blocker use, and no current diagnosis of sepsis or steroid use. Pre survey responses included: surgery type (e.g. abdominal, thoracic, long bone, open), normal or increased hemodynamics (e.g. hypertension, increased heart rate), obesity and history of obstructive sleep apnea.

The post survey responses regarding patient characteristics differed from the pre survey responses, with the exception of hemodynamic influence. However, only one provider accurately answered the question based off of listed criteria covered in the educational PowerPoint. Other
responses provided included: high-opioid requirements and chronic pain, neither of which was listed as patient selection criteria.

The final question (Q9; Appendix B) was open-ended and asked the anesthesia provider to identify barriers to using pharmacologic non-opioid pain management techniques. Pre and post survey responses were similar and indicated various factors taken into consideration when choosing a non-opioid pain medication. Specific barriers were listed more than once and indicated cost, availability and inability to determine adequacy of pain management as factors for consideration. Additional barriers included minimal awake time with patients, patients with history of opioid dependence will still require narcotics and perception of use.

A Wilcoxon Signed Rank Test was performed on the first seven survey questions to compare pre and post responses. The results of the Wilcoxon Signed Rank Test indicated no significant (p > 0.05) difference was found between pre and post survey responses for the first seven questions.

**DISCUSSION**

Results from this quality improvement project suggested anesthesia providers are knowledgeable about the perioperative use of esmolol as a method to decrease opioid requirements. They are also knowledgeable about the administration of esmolol in the context of its traditional purpose, hemodynamic control.

Questions 2 and 7, both of which asked about esmolol’s effect on opioid requirements, showed the most notable changes (*Figure 3; Figure 5*) between pre and post survey responses. However, the similarity in responses is most likely a reflection of how closely the two questions were worded.
The first question (Q1; APPENDIX B) asked the anesthesia provider if they had administered esmolol within the last 30 days as a pain management modality had similar responses both pre and post educational PowerPoint. The possibility exists that the respondents were in fact knowledgeable and administered esmolol perioperatively specifically for the purpose of pain management as indicated in the question. It is also possible that the anesthesia providers simply responded due to their use of esmolol, albeit for other reasons, failing to notice that the question was asking about perioperative pain management specifically. Question 6 (Q6, APPENDIX B) may be a reflection of this assumption since it asked how many times the anesthesia provider considered using esmolol for postoperative pain within the last 30 days to which all providers circled the first response of “0-2 times”; the additional options to choose from included: 3-5 times, 6-8 times and 9 or more times. By answering “0-2 times” for question 6, one possibility exists that none of the anesthesia providers administered esmolol within the last 30 days for postoperative pain. This would be in conflict with two of the answers provided in question 1 (Q1, APPENDIX B), asking if esmolol had been administered in the last 30 days as part of a multimodal approach to pain management. A second possibility exists that two of the anesthesia providers did in fact administer esmolol specifically for pain management and two did not, leading to all four anesthesia providers selecting the first answer choice of “0-2 times”.

One anesthesia provider out of the four reported all surgical patients require narcotics to manage pain. The pre and post survey responses remained unchanged for this question after the educational PowerPoint.

Anesthesia providers were asked to list two patient characteristics, as identified in the research, and covered in the educational PowerPoint, in which esmolol administration could be
considered (Q8, APPENDIX B). The pre survey responses citing hemodynamic reasons were expected since this reflects the normal patient characteristics under which esmolol is administered. However, the post survey responses showed limited understanding of patient characteristics recommended for esmolol to be administered perioperatively specifically for pain management. Only one anesthesia provider accurately listed a patient cannot currently take beta-blockers as mentioned in the educational PowerPoint. One anesthesia provider did not answer post survey question 8 (Q8), but the remaining two participants listed chronic pain as indication to use esmolol for pain management. This indication was listed in the educational PowerPoint as exclusion criteria in the published research studies.

The question that provides the greatest insight to potential for practice change is the last question on the survey (Q9, APPENDIX B). This question specifically asked the anesthesia provider to identify barriers to using esmolol as part of a pain management plan. The primary barriers cited were 1) cost 2) availability of esmolol and 3) the inability to adequately determine the adequacy of pain management directly related to esmolol administration. Through a series of informal conversations, several anesthesia providers mentioned cost as a factor in determining analgesic choices in a multimodal approach to pain management. This was partly reflected in the survey responses provided. An additional response indicated the culture of the environment in which the anesthesia provider practices may play a role in which medications are used in pain management. One participant answered “Perception” on the post survey. The culture of the environment may not support administration of esmolol as a pain management technique.

Reflecting on Dobbin’s et al. (2010) framework, the anesthesia providers in this quality improvement project appear to fall between the knowledge and persuasion steps. Although there
appears to be knowledge of the potential to use esmolol in managing pain, the specific patient characteristics presented in the educational PowerPoint (e.g. not on beta-blocker therapy, no chronic opioid use etc) leading to the successful results as indicated by the research, were not listed on the post survey. A possibility for this could be that the patient characteristic inclusion criteria are unclear for the anesthesia provider. Additional education focusing on patient selection may provide better guidance for those wanting to incorporate esmolol into non-opioid pain management strategies.

As mentioned, cost, availability and verification of adequate pain relief are deterrents for consistent use of esmolol for perioperative pain management. At this point, anesthesia providers do not appear to be persuaded to change their current practice by adopting use of esmolol. If barriers surrounding use of esmolol, such as cost and availability can be overcome, additional research on esmolol in comparison to other non-opioid medications may potentially lead to reconsideration for incorporation into a multimodal pain management strategy.

**STRENGTHS AND LIMITATIONS**

Several limitations can be identified throughout the process of this DNP project. One of the more pronounced weaknesses was bias on the part of the primary investigator. As mentioned previously, through a series of informal conversations with multiple anesthesia providers at multiple clinical sites, this investigator frequently received feedback indicating limited knowledge regarding the potential of esmolol to decrease opioid requirements in the perioperative setting. This then became the focal point of the DNP project.

An additional weakness was reflected in the development of the survey questions. As illustrated in the bar graph (FIGURE 2 & 3), question 2, asking if esmolol decreased opioid
requirements, was very similarly worded to question 7, asking if pre-operative administration of esmolol decreases post-operative opioid requirements. This resulted in duplicate data, which did not contribute to information regarding knowledge, attitude or likelihood of practice change among anesthesia providers.

Lastly, the logistics of setting up a live educational event was challenging. The hospital in which the quality improvement project took place did not have formal staff meetings where educational material could be presented or distributed. Staff members communicate predominantly through email. The anesthesia provider break room became the most likely location for reaching the greatest number of anesthesia providers available each day. However, this presented its own limitations in the ability to conduct the DNP project as designed with completion of the pre survey before viewing the educational PowerPoint. Breaks are taken as available and not at scheduled times making the sequence of the project process challenging. Requesting participation during one’s break time also limited the number of participants since many reported a time pressure to return to their operating rooms.

One strength that can be identified throughout the project process was the interest anesthesia providers expressed in learning about new ideas for pain management that do not involve the use of opioids. Even though the opioid epidemic was not specifically mentioned as a reason to pursue alternatives to opioid administration, other patient comorbidities such as obesity and obstructive sleep apnea were identified as indicators for alternative pain management modalities. Patients with comorbidities such as obesity and obstructive sleep apnea present additional concerns for anesthesia providers in the perioperative setting. Obesity and obstructive sleep apnea increase a patient’s risk for airway compromise, which can be further exacerbated
with opioid administration. Another concern is the increased risk for a surgical wound to reopen, or dehisce. This could occur as a result of nausea and vomiting, which is a known side effect associated with opioids (Harless et al, 2015; Obrink et al, 2015). Both of these risks can be decreased with use of non-opioid pain management strategies.

**DISSEMINATION PLAN**

A poster summary of this project is planned for presentation at the New Mexico Association of Nurse Anesthetists annual conference to be held in October 2017.

**CONCLUSION**

Anesthesia providers share a common goal to deliver a quality perioperative experience for patients and frequently develop tailored anesthetic plans to achieve this goal. With the increased risk for adverse side effects and potential for misuse of opioids, anesthesia providers express knowledge of alternative opioid sparing anesthetic plans. This DNP project indicated that there is interest among anesthesia providers to learn about alternatives to opioid administration in perioperative pain management. In addition, the results of this project also suggested that anesthesia providers are cognizant of cost and availability of various non-opioid pain medications, which affects choices surrounding pain management strategies. Although anesthesia providers may not currently consider esmolol a first line non-opioid choice in pain management, anesthesia providers are knowledgeable about non-opioid alternatives. One limiting factor for this DNP project was the small, convenience sample of anesthesia providers which may be a reason for the non-significant results post educational PowerPoint. Further investigation exploring non-opioid alternatives, including non-pharmacologic methods for pain
control are recommended especially more evidence regarding the effective analgesic properties of utilizing beta blockers for this purpose.
APPENDIX A

EDUCATIONAL EVENT RECRUITMENT FLYER
You are invited to attend an educational event:

**Intraoperative Esmolol Administration in Managing Postoperative Pain**

**APRIL 28TH**

Presented by Alysia Reina, BSN, SRNA, University of Arizona

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**AN INSTITUTIONAL REVIEW BOARD RESPONSIBLE FOR HUMAN SUBJECTS RESEARCH AT THE UNIVERSITY OF ARIZONA REVIEWED THIS RESEARCH PROJECT AND FOUND IT TO BE ACCEPTABLE. ACCORDING TO APPLICABLE STATE AND FEDERAL REGULATIONS AND UNIVERSITY POLICIES DESIGNED TO PROTECT THE RIGHTS AND WELFARE OF PARTICIPANTS IN RESEARCH.**

You are invited to attend an educational event that is part of a research project designed to assess anesthesia provider knowledge of esmolol’s role in managing postoperative pain. This event will take place in the anesthesia break room on April 28th from 0645 until 1000. The event will consist of a pre survey and educational PowerPoint. A post survey will be administered one week from the initial education event, on May 4th. All survey responses will remain confidential.
APPENDIX B

PRE AND POST SURVEY
Years in practice:

Practice setting (please circle one): Rural                  Metropolitan

Q1) Within the last 30 days, when using a multimodal approach to treat perioperative pain, did you use esmolol?   Y    N

Q2) Does esmolol decrease opioid requirements?   Y     N

Q3) Do all surgical patients require narcotics to manage pain?   Y   N

Q4) How many times in the last year did you use non-pharmacological interventions to manage pain in the perioperative setting?
   a. Never
   b. Once
   c. Twice
   d. Three or more times

Q5) What effect does esmolol have on cytokine IL-6 and IL-4 levels?
   a. No effect at all
   b. Lowers the cytokine levels
   c. Increases the cytokine levels

Q6) Within the last 30 days, how many times did you consider using esmolol for postoperative pain?
   1. 0-2 times
   2. 3-5 times
   3. 6-8 times
   4. 9 or more times

Q7) Does administration of esmolol pre-operatively decrease opioid requirements post-operatively?  Y   N

Q8) List two patient characteristics in which esmolol administration can be considered.

Q9) What would be one barrier to using pharmacologic non-opioid pain management techniques?
APPENDIX C

INSTITUTIONAL REVIEW BOARD DETERMINATION
Date: April 25, 2017  
Principal Investigator: Alysia Deborah Reina  
Protocol Number: 1704373752  
Protocol Title: Intraoperative Esmolol Administration in Managing Postoperative Pain  
Level of Review: Exempt  
Determination: Approved  

Documents Reviewed Concurrently:  
- Data Collection Tools: PRE AND POST SURVEY.docx  
- HSPP Forms/Correspondence: DNP_f107_v2016-07_0-1-1.doc  
- HSPP Forms/Correspondence: DNP_f200_Revised_v2016-07(updated).kp-1.doc  
- HSPP Forms/Correspondence: DNP_IRB_Revised_appendix_f-1.docx  
- HSPP Forms/Correspondence: Signature page.pdf  
- Informed Consent/PHI Forms: DNP_Revised_Disclosure template-Survey-1.doc  
- Other Approvals and Authorizations: Site AuthLetter DHR Doc Apr 13, 2017, 17_47.pdf  
  
- Participant Material: DNP_EducationTool_CON-PowerPoint.pptx  
- Recruitment Material: DNP_Recruitment_Flyer.docx  

This submission meets the criteria for exemption under 45 CFR 46.101(b). This project has been reviewed and approved by an IRB Chair or designee.

- The University of Arizona maintains a Federalwide Assurance with the Office for Human Research Protections (FWA #00004218).  
- All research procedures should be conducted according to the approved protocol and the policies and guidance of the IRB.  
- Exempt projects do not have a continuing review requirement.  
- Amendments to exempt projects that change the nature of the project should be submitted to the Human Subjects Protection Program (HSPP) for a new determination. See the Guidance on Exempt Research information on changes that affect the determination of exemption. Please contact the HSPP to consult on whether the proposed changes need further review.  
- You should report any unanticipated problems involving risks to the participants or others to the IRB.  
- All documents referenced in this submission have been reviewed and approved. Documents are filed with the HSPP Office. If subjects will be consented, the approved consent(s) are attached to the approval notification from the HSPP Office.
APPENDIX D

SITE AUTHORIZATION LETTER
April 10, 2017

University of Arizona Institutional Review Board
e/c Office of Human Subjects
1618 Helen St
Tucson, AZ 85721

Please note that Alysia Reina, UA Graduate Student, has permission from McAllen Anesthesia Consultants, P.A. to conduct research at our McAllen facility for her study, “Intraoperative Esmolol Administration in Managing Postoperative Pain.”

Alysia Reina will recruit anesthesia providers by inviting them through word of mouth to a live educational event to be held in the anesthesia break room. During the educational event, a pre survey will be administered and then followed by a powerpoint presentation. The pre surveys will have deidentified participant information for correlation to post surveys to be completed one week after powerpoint presentation. Alysia Reina’s onsite research activities will be completed by May 4th, 2017.

Alysia Reina has agreed to not interfere with daily flow of operating room staff or schedules. Employees will not leave assigned duties to complete surveys or watch the powerpoint presentation; however, they may do so of their own choosing, during periodic break times. Alysia Reina has also agreed to provide to my office a copy of the University of Arizona IRB-approved stamped disclosure form before recruiting anesthesia providers to the educational event.

If there are any questions, please contact my office.

Raymond B. Walker, Chief CRNA
Doctor’s Hospital at Renaissance
REFERENCES


