PERIPHERAL NERVE BLOCKS AND INTRAOPERATIVE OPIOID CONSUMPTION IN MASTECTOMY AND LUMPECTOMY PATIENTS: A QUALITY IMPROVEMENT PROJECT

By

JULIE DONMEZ, BSN, SRNA

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Faculty Committee Chair: Dr. Christopher Bibro, DNP, APRN-CRNA

Frances Payne Bolton School of Nursing

CASE WESTERN RESERVE UNIVERSITY

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CASE WESTERN RESERVE UNIVERSITY
FRANIS PAYNE BOLTON SCHOOL OF NURSING

We hereby approve the DNP project of **Julie Donmez**

Committee Chair: **Dr. Christopher Bibro DNP, APRN-CRNA**

Committee Member: **Emily Trimble, MSN, APRN-CRNA**

Committee Member: **Kartik Gopal, Ph.D**

May, 2024

*We also certify that written approval has been obtained for any proprietary material contained therein.

Abstract

Background/Significance: In the United States, 1 in 8 women will develop breast cancer in their lifetime, resulting in painful surgical procedures such as lumpectomy and mastectomy and subsequent opioid use. Strategies to reduce both acute and chronic pain have adopted a multimodal approach (local anesthetics, NSAIDS, acetaminophen, alpha-2 agonists) to reduce adverse effects of opioid use. There is evidence that demonstrates that the administration of local anesthetics via a peripheral nerve block (PNB) to mastectomy and lumpectomy patients provides effective pain management; however, it is yet unknown if the administration of PNBs affects intraoperative opioid usage at tertiary care facilities. The purpose of this quality improvement project was to examine PNBs and their impact on intraoperative opioid usage for lumpectomy and mastectomy patients at a tertiary care hospital.

Methods: This quality improvement project utilized retrospective analysis to analyze and compare total intraoperative opioid usage for patients that underwent lumpectomy and mastectomy at the target institution. Each sample (lumpectomy and mastectomy) consisted of deidentified chart data collected from 120 cases (60 patients with PNBs and 60 patients without PNBs). Intraoperative opioid doses were converted to morphine milligram equivalents (MME), a standardized metric to compare varying opioids. Approval was obtained from the Institutional Review Board (IRB) from both the target institution and Case Western Reserve University (CWRU).

Results: Within the mastectomy population, individuals who received a PNB had a mean MME of 0.11, in contrast to 0.12 MME in non-PNB patients. Consequently, patients received a nearly equivalent amount of opioids regardless of PNB status, though the finding was not statistically significant. In contrast, with lumpectomy patients, PNB recipients averaged 0.18 MME compared to non-PNB patients who received an average of 0.03 MME, which was a statistically significant result.

Implications for Practice: This quality improvement (QI) project aimed to investigate the connection between PNB administration and intraoperative opioid use in mastectomy and lumpectomy patients. The project emphasized the importance for Certified Registered Nurse Anesthetists (CRNAs) and Student Registered Nurse Anesthetists (SRNAs) to grasp the potential of these anesthetic techniques in diminishing perioperative opioid use. The unexpected findings suggest the need for further investigation to clarify the relationship between PNB administration and opioid consumption in these patient populations at the target institution.

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Chapter 1

Introduction

Background and Significance

In the United States, 264,000 women and 2,400 men are diagnosed with breast cancer each year, and surgery (lumpectomy or mastectomy) is a routine part of treatment and care (Bashandy et al., 2015). Acute surgical pain leads to chronic pain and poor outcomes. It has been widely documented that it is important (to reduce untoward outcomes of chronic pain) to reduce surgical pain as early as possible in the surgical process, even intraoperatively, (Geradon & Lavand'homme, 2022). Patients that develop chronic postoperative pain are impacted by decreased physical functioning and quality of life, physiological distress, continued health care utilization, and long-term opioid use (George et al., 2022). Mastectomies are not only associated with a high degree of acute surgical pain, but also a 10-15% incidence of developing chronic postsurgical pain (Katz & Page, 2022). Pain is the predictive factor that is most consistently associated with the development of future pain problems (Katz & Page, 2022).

Earlier detection and treatment of breast cancer has allowed for increased survival rates. However, surgical pain during and after treatment remains an impediment to positive outcomes (Fecho et al., 2009). Strategies to reduce both acute and chronic pain have adopted multimodal approaches such as local anesthetics, NSAIDS, acetaminophen and alpha-2 agonists. Although one of the most potent routes to control severe pain, opioids are associated with opposite affects such as hyperalgesia and increased postoperative pain leading to increased risk of chronic pain; and therefore, increased risk of chronic opioid use (Lavand'homme et al., 2017). According to the CDC, nearly 1 million people have died of an opioid-induced drug overdose in the past 12 years. The incidence of new chronic opioid use in adult surgical patients is approximately 6%, compared to a 0.4% incidence rate in non-surgical patients (Soffin et al., 2019).

Enhanced Recovery After Surgery (ERAS) anesthetic protocols aim to improve postoperative outcomes by standardizing and optimizing intraoperative care through a multidisciplinary approach (Afonso et al.,2021). ERAS anesthetic practice environments aim to enhance patient outcomes by minimizing pain, shortening hospital stays, and reducing the use of intraoperative opioids. Literature suggests that multimodal analgesia and opioid-sparing adjuncts throughout the intraoperative period are cornerstones to interventions that decrease this risk of opioid dependence and have become a standard of care for management of intraoperative pain (Burns et al., 2021). Opioid sparing drugs and protocols such as alpha-2 agonists, gabapentinoids, lidocaine, magnesium, anti-inflammatory drugs, and regional anesthesia have proven their efficacy in intraoperative pain management in comparison with interventions involving opioids (Bugada et al., 2021).

The practice of preventative anesthesia attempts to block the transmission of the primary afferent injury discharge and the inflammatory response to cease acute pain, thereby blocking the evolution into chronic pain (Katz & Page, 2022). Regional anesthesia, specifically peripheral nerve blocks (PNBs), are a mainstay approach in the practice of preventative anesthesia to reduce pain; therefore, reducing the risk of persistent opioid use after surgery (Hah et al., 2017). The pectoral nerve block is the PNB of choice for breast surgery at the target institution. This nerve block is performed under ultrasound guidance to ensure that local anesthetic is properly deposited to block pain transmission to intercostal nerves 3-6, intercostobrachial nerves, and the long thoracic nerve (Battista & Krishnan, 2022). Other painful surgeries have shown success in reducing opioid use intraoperatively using PNB, but there is a gap in the literature regarding research that studies the use of PNBs in mastectomy and lumpectomy patients in an ERAS anesthesia environment, and their impact on intraoperative opioid use in diverse populations.

Purpose

There is evidence that demonstrates that a multimodal anesthetic approach such as the administration of local anesthetics via PNB to reduce both acute and chronic pain is not only effective at pain management, but also at reducing opioid use and its adverse effects (Bugada et al., 2021). It is important for Certified Registered Nurse Anesthetists (CRNAs) and Student Registered Nurse Anesthetists (SRNAs) to understand the relationship between PNBs and opioid usage. At the target institution, mastectomy, and lumpectomy procedures for patients with breast cancer are performed both with and without the aid of PNB. Due to the association between administration of PNB and reduced opioid consumption as demonstrated in the literature, this project was initiated to investigate whether a similar relationship existed at the local institution. The purpose of this Doctor of Nursing Practice (DNP) quality improvement project was thus to examine the relationship of PNBs and their impact on intraoperative opioid consumption, for lumpectomy and mastectomy patients in the operating rooms at the target institution, with the objective of informing practice change toward greater utilization of PNBs within this surgical population.

Review of Relevant Concepts

Enhanced Recovery After Surgery (ERAS)

The ERAS anesthetic protocol is designed to optimize the recovery process for patients undergoing surgery. ERAS protocols are intended to preserve patients' preoperative, physiologic, and psychologic response by minimizing stress throughout the surgical process (Ghatol & Tippireddy, 2022). By utilizing a comprehensive approach that includes preoperative patient education, standardized nausea and vomiting prevention, appropriate fluid management during surgery, and a multimodal pain management plan, the ERAS anesthetic protocol aims to significantly reduce postoperative complications, such as nausea and vomiting, pain, and the need for opioid administration (Afonso et al.,2021). This ensures that patients experience a smoother recovery process and can return to their daily activities as soon as possible.

PNB and Opioid Consumption

Over the past decade, over one million people have died of opioid-induced overdose, and research shows that intraoperative opioid use has increased the risk of chronic opioid use (Soffin et al., 2019). Multimodal approaches to pain management, such as PNBs, have been shown to improve patient outcomes. Literature suggests that the use of PNBs decrease the amount of total opioid consumption throughout the intraoperative period, particularly in non-diverse patient populations, and non-opioid sparing anesthesia settings Kim et al. (2020). The effectiveness of PNBs administered by different practitioners, including experienced professionals and those in training, has been demonstrated across various techniques. However, the diversity of PNB administration methods used in these studies poses challenges to interpretation. As it is not feasible for the same practitioner to administer a PNB to all patients; these studies are hindered by decreased internal consistency which limits generalizability of key findings to a large population (Malay & Chung, 2012).

Lumpectomy and Mastectomy and Pain

One in eight women develop breast cancer in their lifetime, resulting in painful surgical lumpectomy and mastectomy and subsequent opioid use. Surgical breast procedures are associated with a high degree of pain leading to a 15% incidence of postoperative pain syndromes (Katz & Page, 2022). Some of the authors made note of surgery type including lumpectomy, partial, complete, or elective mastectomy, while others treated the mastectomy surgical population as a cohesive unit. This approach revealed that the nature of the surgery has an impact on reported pain levels, specifically that moderate or severe surgical breast procedures experience a higher degree of pain (Azad et al., 2020).

Theoretical Framework

Good and Moore’s middle range theory of Acute Pain Management: Use in Research was chosen as a guide for this quality improvement project because the focus of the theory is to assess patient outcomes after reduction of acute surgical pain. The theory was developed to apply guidelines into practice for pain management while noting a necessity for a balance between medication usage and the side effects of medication usage (Good & Moore, 1998). Centered around three categories - multimodal intervention, attentive care, and patient participation - Good & Moore hypothesized that the interaction between these different aspects provides a wholesome balance between medicine and side effects. The theory provides a working framework for this quality improvement project because administering PNBs is a multimodal intervention designed to reduce acute pain; therefore, reduce postoperative pain and chronic opioid use (Hah et al., 2017). Good & Moore's theory of balance directly bolsters this quality improvement project by showing the necessity of multimodal intervention, specifically PNBs, to decrease the unwanted side effects acute pain, postoperative opioid administration, and chronic opioid use (see Appendix A).

Research Questions:

1. Among patients undergoing mastectomy at the target institution, is there a difference in intraoperative opioid consumption between patients that receive a PNB and patients that do not receive a PNB?
2. Among patients undergoing lumpectomy at the target institution, is there a difference in intraoperative opioid consumption between patients that receive a PNB and patients that do not receive a PNB?

Implications

The results of this proposed quality improvement project provided information on the efficacy of PNBs as part of an opioid sparing, multi-modal anesthesia plan for patients undergoing mastectomy and lumpectomy procedures at the target institution. This proposed work serves as a foundation for future research on the relationship between regional anesthesia within ERAS protocols, and intraoperative opioid consumption at the target hospital. Ultimately, a more precise understanding of this relationship may guide well-informed decisions in opioid sparing anesthesia delivery, ultimately enhancing the management of surgical pain.

Chapter 2

Literature Review

The purpose of this literature review aimed to provide a more comprehensive understanding of the relationship between peripheral nerve blocks (PNBs) and perioperative opioid usage among patients undergoing mastectomy and lumpectomy. Conclusions drawn from this literature review informed the design of this quality improvement project to improve the perioperative care quality for lumpectomy and mastectomy patients at the target hospital.

Search Strategy

A search was conducted of the PubMed and Cochrane Library databases in August of 2022. Keywords included "peripheral nerve block AND mastectomy" OR "preventative analgesia AND mastectomy" OR "opioid". The primary author performed the search and initially screened abstracts and titles for inclusion. Inclusion criteria were: (a) published in peer-reviewed journals; (b) in English; (c) in mastectomy patients; (d) published between 2017 - 2022; and (e) included assessment of peripheral nerve block application. Reasons for exclusion were: (a) not in English; (b) specific method of PNB administration was not defined; (c) opioid consumption was not directly measured; (d) inconsistent findings. Ten studies met the inclusion criteria, and the forthcoming review will encompass topics such as peripheral nerve blocks and opioid consumption, mastectomy and pain, and sample characteristics.

Review of Relevant Concepts

Peripheral Nerve Blocks and Opioid Consumption

Altiparmak et al. (2020), Kamiya et al. (2018), Kim et al. (2020), Grasso et al. (2020), Matsumoto et al. (2018), Pandey et al. (2018), and Senapathi et al. (2019) found that the use of peripheral nerve blocks decreased the amount of total opioid consumption throughout the perioperative period. Using a Level 1, descriptive study by conducting a retrospective chart analysis, Kim et al. (2020) did not find a difference in post-operative opioid consumption; however, found over a 20% difference in overall opioid consumption. The remaining authors conducted Level 3 Randomized Controlled Trials in a prospective, comparative approach and did find a decrease in opioid requirements both intraoperatively and postoperatively. The control group for all the sources did not receive a PNB and the comparison group did receive a PNB.

Although experimental methods and findings were similar, there were a variety of different combinations of PNBs used for the experimental group. Therefore, comparing pain outcomes across different studies assumed that the experimental groups were equal in design. Kim et al. (2020) did not mention other pain control options beyond varying doses of NSAIDS and Kamiya et al. (2018) administered opioids to their PNB group which could affect key findings. The nature and quality of the PNB was not assessed after administration in any of the RCTs; they were only assumed to have worked properly. Pandey et al. (2018) administered the PNB via one practitioner, while the other studies utilized a small group of practitioners to administer the PNB. Grasso et al. (2020) had both experienced professionals and professionals in training administering blocks. The variety of administration showed issues. It was not feasible for the same practitioner to administer a PNB to all patients; therefore, generalizing key findings to a large population posed difficulty. When multiple practitioners administered PNB's within the same study, it added another changing variable instead of a constant administration, especially when some of the professionals were in training. However, Grasso et al. (2020) did note that the blocks administered by the surgeon versus by the anesthesiologist showed comparable benefits with no complications.

Breast Surgery and Pain

Azad et al. (2020) found that patients undergoing moderate or severe surgical breast procedures experienced significant amounts of pain. Some of the authors made note of surgery type (partial, complete, elective) while others took the mastectomy surgical population as a whole. Azad et al., (2020) showed that surgery type impacted reported pain; therefore, compiling patients into one group and not distinguishing between severity of surgery could have skewed data from the beginning before patients were randomized into an experimental and control group. In addition, the record showed that patients with mastectomy and reconstruction, specifically implants, reported higher levels of pain. This record was a descriptive study that used a retrospective chart review with no control of variables or interventions that divided participants into three types of breast procedures. The authors of this record found a significant association between younger age and preoperative opioid use and longer length of stay. A significant challenge identified in the correlation between records and pain scores was the inconsistency in the time increments at which pain scores were recorded.

Al Ja'bari et al., (2019) recorded pain at 2, 24, and 48 hours postop compared to Altiparmak et al., (2020) who recorded pain at 15 and 30 minutes, and 1, 2, 6, 12, and 24 hours postop. The drastic difference in pain measurement intervals was a common theme with all authors; therefore, it was difficult to assess and compare results when time measurements were so varied. In addition, pain scores were most frequently recorded using the VAS or NRS scale. While these scales are widely accepted, the authors did not make specific mention of the reliability of the scales they utilized.

Sample

Sample sizes varied across the studies selected. Pandey et al. (2018) and Kamiya et al. (2018) conducted their studies with a total sample size of 60 participates, and Matsumoto et al. (2018) conducted their study with 49 participants. Other studies had a sample size of greater than 100 participates; therefore, there was a range of sample size among the authors. Most authors employed statistical power analysis as a means of justifying their chosen sample sizes. Altiparmak et al., (2020) used a G*Power program for a difference of 10 points between the two groups in relation to the administered questionnaire as statistically relevant. The sample populations exclusively were comprised of adult female participants, with all authors specifying male gender and minor status as exclusion criteria. The sample populations from the chosen records were not diverse. Kamiya et al. (2018) required their participants to speak Japanese which could affect the ability of key findings to be applicable and reproducible in a large, diverse population. Several authors acknowledged variations in surgery types, distinguishing between partial, complete and elective procedures, while others considered the surgical population as a single entity. Azad et al., (2020) demonstrated that surgery type impacted reported pain. Therefore, compiling patients into one group without discerning the severity of the surgery type may have introduced bias into the data, potentially influencing outcomes before patients were randomized into experimental and control groups.

Although key concepts and variables were relatively similar between the different records, a few of the authors did include specific variables that others omitted. Kamiya et al. (2018) recorded food intake postoperatively that was based on the quantity ingested. Pandey et al. (2018) evaluated pain intensity of the ipsilateral upper limb during both rest and abduction. In addition to pain scores and opioid consumption, Matsumoto et al. (2018) looked at serum levels of interleukin to assess for inflammation. Almost all the records looked at age, weight, height, and BMI. Grasso et al. (2020) showed that the mean age in the PECS group was 53.7 years, and in the control group was 54.4 years; the mean weight in the PECS group was 64.8 kg and in the control group was 67.2 kg; the mean height in the PECS group was 164.1 cm and in the control group was 163.9 cm; and the mean BMI in the PECS group was 23.9 kg/m2 and in the control group was 24.9 kg/m2. Reporting these variables demonstrated the similarity between groups to further strengthen the results. Establishing similar characteristics among the comparison groups enhanced the reliability of the reported data, instilling greater confidence in its validity.

Summary

Based on prior research and the studies included in this literature review, it was established that the utilization of peripheral nerve blocks significantly reduced opioid consumption, consequently contributing to improved patient outcomes. However, a significant weakness in the existing literature lies in the limited diversity observed within the studied populations. This limitation raised concerns regarding the generalizability of key findings to the wider population.

Another weakness evident in the literature was the wide variety of time intervals at which pain was assessed in different studies, making it difficult to compare outcomes. In addition, the administration of peripheral nerve blocks varied significantly, not only in terms of provider techniques, but also in reference to the type of block used. This diversity in administration methods complicated data analysis, as it failed to specify whether one combination of PNBs was superior to another, leading to skewed analysis when comparing data across multiple studies.

Furthermore, none of the records included data from male patients. Although the occurrence of mastectomy and lumpectomy in males is not as prevalent as it is among females, exploring post procedure pain in this demographic merits exploration. A common theme across all chosen records for this literature review was the absence of testing the efficacy of the peripheral nerve block prior to inducing general anesthesia. As such, potential exists for patients with incomplete pain relief from incomplete blocks to have skewed recorded pain data. Thus, testing the quality of blocks prior to general anesthesia is an avenue that also warrants further investigation.

In summary, this literature review highlighted notable gaps in our current understanding of the impact of PNB administration on opioid consumption in mastectomy and lumpectomy patients. Given that breast cancer is the most common cancer among females in the United States (Kim et al., 2020), addressing these gaps is crucial for optimizing anesthesia care in individuals undergoing mastectomy and lumpectomy procedures.

Chapter 3

Methods

Purpose

Research has shown that using a combination of anesthetic techniques, such as administering local anesthetics through a peripheral nerve block, can effectively manage pain and reduce the need for opioids (Bugada et al., 2021). This can lead to fewer negative side effects from opioid use. It is important for anesthesia providers to understand how peripheral nerve blocks and opioid use are related. The goal of this DNP quality improvement project was to study the relationship between peripheral nerve blocks and postoperative outcomes for patients undergoing lumpectomy and mastectomy at the target institution, with a focus on opioid consumption during the intraoperative period.

Research Questions:

1. Among patients undergoing mastectomy at the target institution, is there a difference in intraoperative opioid consumption between patients that receive a PNB and patients that do not receive a PNB?
2. Among patients undergoing lumpectomy at the target institution, is there a difference in intraoperative opioid consumption between patients that receive a PNB and patients that do not receive a PNB?

Project Design

The quality improvement project utilized descriptive analysis of deidentified data obtained through a retrospective chart review. Utilizing this framework, the researcher assessed the use of PNBs and opioid consumption in mastectomy and lumpectomy patients at the target institution. A descriptive analysis of deidentified data obtained through retrospective chart review was the most appropriate method to achieve the objective of this quality improvement project, which was to enhance our understanding of the effectiveness of a current clinical practice.

Sample and Population

The sample consisted of mastectomy and lumpectomy patients at the targeted institution. There was a statistically relevant sample size chosen for patients that had a PNB prior to mastectomy or lumpectomy, and an equal sample of patients that did not receive a PNB prior to mastectomy or lumpectomy.. The total target sample size was 240: 120 lumpectomy and 120 mastectomy cases. Within each group (lumpectomy and mastectomy), the target sample was 60 patients that received PNB and 60 that did not receive PNB. Inclusion criteria were patients 18 years or older with an ASA score of 1-3. Exclusions were made for patients with documented history of opioid use disorder, patients undergoing reconstruction immediately following mastectomy, and those that had comorbidities that prevented administration of PNB, such as infection.

Setting

The setting of this quality improvement project was the intraoperative suite at the target facility, a 648-bed tertiary care Level 1 trauma hospital. The surgical department contains 24 general operating rooms that performs over 100 mastectomies a year. The anesthesia department functions under a medically supervised model, where a team of 10 anesthesiologists work in collaboration with 79 Certified Registered Nurse Anesthetists (CRNAs) to provide anesthesia care. Under this practice model, CRNAs serve as the primary providers of anesthesia care and receive guidance and support from the anesthesiologists. At the target hospital, all surgical patients receive celecoxib, acetaminophen, gabapentin, and famotidine as pre-operative medications unless there are any contraindications. In the operating room, a tailored selection of multimodal agents such as lidocaine, ketamine, dexamethasone, ketorolac, dexmedetomidine, and ondansetron are selected based on patient characteristics and provider preference. For eligible surgeries, patients also receive PNB administered by a team of 18 CRNAs who have received advanced special PNB training. These PNBs may be performed prior to the start of surgery or during anesthesia, depending on the specific type of PNB and comfort level of the patient.

At the target institution, with regards to breast surgery (mastectomy and lumpectomy), not all the surgeons routinely request the use of PNBs for their patients. This allowed for ease of identification of two cohorts, patients that received a block versus patients that did not receive a block.

Operational Definitions

The Center for Disease Control (CDC) defines opioids as natural, synthetic, or semi-synthetic chemicals that interact with opioid receptors on nerve cells in the body and brain, and that reduce the intensity of pain signals and feelings.

Instruments

Total intraoperative opioid consumption was compared between the two groups. Opioid usage was standardized into morphine equivalents (MME), a standard conversion factor that was developed by the CDC to equate all opioids into one standard value that is based on morphine and its potency (Dept. of Health Maryland). The daily total of each opioid was multiplied by a specific standardized conversion factor (hydromorphone (1:5), fentanyl (1:100)). These standardized conversions were totaled, and then evaluated to show a difference in opioid consumption between mastectomy and lumpectomy patients that received a PNB and patients that were not administered a PNB.

Data Collection Procedures

Initially, patient charts were identified and reviewed by the anesthesia department's Senior Research Analyst to ensure relevant information was gathered. Charts were accessed and mined for pertinent data, which were then de-identified to protect patient privacy before being entered into a secure Excel spreadsheet. Data collection began with patient charts from January, 2020, and continued forward chronologically until the targeted sample size was achieved. The resulting timeframe for data retrieval included anesthesia records from cases performed between January of 2020 and September of 2021.

Data Management and Protection of Human Subjects:

Data was stored on a Datalocker SentryOne flash drive provided by the Senior Research Analyst. A key code was used that linked patient data to the data management spreadsheet (see Appendix B). The key code was stored separately on a network drive and did not leave the target institution. After obtaining IRB approval from both the target institution and Case Western Reserve University, the investigator accessed data from electronic medical records (EMR). Relevant data was then extracted, and identifiable markers were removed. The data retrieved included surgery type, age, gender, and total opioid consumption. To ensure maximum protection of patient confidentiality, data was password protected and only available to the investigator of this quality improvement project.

Analysis

Microsoft Excel was utilized for statistical analysis. The mean, median and standard deviation of each sample (patients that received PNB and patients that did not receive PNB) was reported. Independent sample t-tests were used to determine whether a statistically significant difference existed in opioid consumption between patients that received a PNB versus those that did not receive a PNB in both the mastectomy and lumpectomy groups, with statistical significance set at a $p \leq 0.05$.

Chapter 4

Results

This chapter contains a description of the dataset and analysis of the data. The researcher performed a comprehensive analysis by retrospectively reviewing charts that were compiled by the Senior Research Analyst, from a database covering all anesthesia-related services. Through an extensive analysis, the researcher applied the stated exclusion criteria to refine the dataset. The final dataset was processed using Microsoft Excel to execute a descriptive analysis and independent t-test.

Sample Demographics Results

The sample size was created by selecting 120 charts each for both lumpectomy and mastectomy patients (total N=240), categorized into two groups: 60 charts with PNB and 60 charts without PNB for each cohort. Patients meeting specific exclusion criteria, such as those with chronic pain patients, an ASA greater than 3, and patients undergoing immediate reconstruction following mastectomy, were removed from the final selection. The final data set for lumpectomy patients included 50 patients that received PNB and 44 that did not. For mastectomy patients, the final data set included 59 patients who received PNB and 54 patients who did not. The descriptive statistical analysis and independent t-test results for both the mastectomy and lumpectomy data sets is shown in Table 1 and Table 2, respectively.

Table 1

Descriptive Statistics for Mastectomy Dataset

	Without PNB	With PNB
Mean MME	0.12	0.11
Standard Deviation	0.31	0.35
Observations	54	59
Variance	0.09	
dF	111	
P(T<=t) two-tail*	0.93	

*t-Test: Two-Sample Assuming Unequal Variances

Table 2

Descriptive Statistics for Lumpectomy Dataset

	Without PNB	With PNB
Mean MME	0.03	0.18
Standard Deviation	0.12	0.51
Observations	44	50
Variance	0.01	
dF	54	
P(T<=t) two-tail*	0.05	

*t-Test: Two-Sample Assuming Unequal Variances

Research Question 1

Among patients undergoing mastectomy at the target institution, is there a difference in intraoperative opioid consumption between patients that receive a PNB and patients that do not receive a PNB?

Regardless of PNB status, the average Morphine Milligram Equivalents (MME) administered to the total population of mastectomy patients within the final data set is 0.12. Within the total population, patients that received a PNB had a mean MME was 0.11, while those without a PNB received an average MME of 0.12. Thus, based on this data, mastectomy patients received nearly equal average of opioids regardless of PNB status. The data set was comprised of a total population of 113 patients, with 89 of these patients not receiving opioids which indicates that on average 79% of mastectomy patients did not receive opioids, regardless of PNB. Among the 59 patients who received nerve blocks, 78% did not receive opioids, whereas among the 54 patients who did not receive PNB, 80% did not receive opioids.

Statistical analysis included descriptive statistics and a Two-Sample T-test Assuming Unequal Variances that were employed to test the null hypothesis that the mean MME between mastectomy patients who received PNB, and those who did not receive MME are equal. The analysis produced a p-value of 0.93. Since the p-value is >0.05, the null hypothesis was not rejected. Thus, there was no statistically significant difference between the mean MME of mastectomy patients who received a peripheral nerve block and those that did not. Regarding standard deviation, patients that received nerve blocks had a mean MME of 0.11 with a standard deviation of 0.35, while those not administered nerve blocks had a mean MME of 0.12 with a standard deviation was 0.31, which suggests that the mean MME is on average a 0.31 difference than the data points.

Research Question 2

Among patients undergoing lumpectomy at the target institution, is there a difference in intraoperative opioid consumption between patients that receive a PNB and patients that do not receive a PNB?

The average Morphine Milligram Equivalent (MME) administered to the total population of lumpectomy patients is 0.11. Patients who received a PNB had a mean of 0.18, whereas those without a PNB were administered an average MME of 0.13. Therefore, based on this data, patients that received a PNB received nearly 6 times more opioids than those without a

PNB. The dataset consisted of a total population of 94 patients who underwent lumpectomy, with 74 of them not receiving opioids; therefore, indicating that on average, 85% of lumpectomy patients did not receive opioids regardless of whether they received a PNB. Out of the 44 patients without a PNB, 89% did not receive opioids, while among the 50 patients who received nerve blocks, 80% did not receive opioids.

Statistical analysis included descriptive statistics and a Two-Sample T-test Assuming Unequal Variances. The null hypothesis suggested equality of mean MME between lumpectomy patients who received a PNB and those who did not. The t-test produced a p-value of 0.05, which demonstrated statistical significance and the null hypothesis was rejected. Thus, for patients undergoing lumpectomy at the target institution, those that did not receive a PNB were administered statistically significant lower mean MME intraoperatively versus patients that did receive a PNB. Regarding standard deviation, patients that received nerve blocks had a mean MME of 0.18 with a standard deviation of 0.51, while those not administered nerve blocks had a mean MME of 0.03 with a standard deviation of 0.11.

Chapter 5

Conclusion, Limitations, Implications and Recommendations

Conclusion

Current literature supports the use of a multimodal, opioid sparing approach to anesthesia practice, specifically utilizing peripheral nerve blocks, to alleviate pain and decrease opioid administration (Bugada et al., 2021). Consequently, is imperative for Certified Registered Nurse Anesthetists (CRNAs) and Student Registered Nurse Anesthetists (SRNAs) to understand the connection between PNBs and perioperative opioid administration. A primary aim of this quality improvement project was thus to deepen understanding of the potential opioid-sparing effects of PNBs in the studied surgical population.

However, the findings of this quality improvement project were inconsistent with current literature. Peripheral nerve blocks did not uniformly reduce opioid administration across all variables. For research question 1, mastectomy patients received comparable opioid consumption levels irrespective of their PNB status, though this result was not statistically significant. In contrast, the mean MME administered to lumpectomy patients that received a PNB was nearly 6 times more than that given to patients that were not administered a PNB, which was a statistically significant finding.

Finally, although, opioid administration varied significantly in certain groups, nearly 80% of both mastectomy and lumpectomy patients did not receive perioperative opioids in any capacity. This observation is likely a manifestation of the success achieved by the ERAS (Enhanced Recovery After Surgery) program and the adoption of opioid-sparing anesthesia practices at the target institution. These strategies have proven to be highly effective in minimizing the overall consumption of opioids during the perioperative process.

Limitations

This quality improvement project encountered several significant limitations. First, retrospective data collection primarily hindered the establishment of cause-and-effect relationships. Secondly, the collection of data from one medical center limited the generalizability and scope of the findings. Additionally, several factors affected the accuracy of this analysis. When comparing various breast surgery options such as bilateral and unilateral mastectomies, as well as lumpectomies, it's crucial to consider that the choice of surgery and the diverse surgical techniques employed (given that data in this dataset is from five surgeons) may lead to different levels of baseline pain. Furthermore, the study lacked control over the variability in the number of anesthesia providers administering the PNBs, which potentially impacted their effectiveness. In addition, peripheral nerve blocks for mastectomy and lumpectomy patients were performed while the patient was under anesthesia, and the efficacy of the block was assumed without verification. Finally, while this quality improvement project thoroughly accounted for perioperative opioid consumption, postoperative opioid use was unable to be collected. Due to a change in the hospital's record system, retrospective postoperative data was not accessible.

Implications

The primary aim of this quality improvement project was to enhance our understanding of multimodal anesthetic practices, specifically the relationship between PNB administration and intraoperative opioid administration for mastectomy and lumpectomy patients. Given that peripheral nerve blocks have been demonstrated to be effective opioid sparing interventions, it is imperative for CRNAs and SRNAs to better understand how utilization of these techniques may assist in decreasing perioperative opioid administration. Due to the established negative impact of the opioid epidemic on the health of the greater population, anesthesia providers have a responsibility to refine their practice when techniques are supported by evidence. Thus, this project sought to better understand the relationship between PNB administration and opioid consumption, in effort inform practice change toward a wider utilization of PNBs with mastectomy and lumpectomy patients.

While the dataset for mastectomy patients did not show statical significance, those that received a PNB were administered fewer opioids compared to those who did not receive a PNB. In contrast, lumpectomy patients who received a PNB were administered significantly greater quantities of perioperative opioids, in stark contrast to widespread reporting in current literature. As described in chapter 2, current literature and clinical practice support the relationship between utilization of multimodal anesthesia, including PNBs, and decreased opioid administration. Hence, these unexpected findings, inconsistent with current understanding, are likely a result of the previously discussed limitations. Nevertheless, as this analysis does not demonstrate a significant clear relationship between PNB administration and opioid consumption for mastectomy and lumpectomy patients, there is insufficient evidence to recommend a practice change based on the results described above. Therefore, the primary implication of this quality improvement project is that further redesigned investigation is needed to elucidate the relationship between PNB administration and intraoperative opioid administration among lumpectomy and mastectomy patients at the target institution.

Recommendations

As the findings of this analysis did not align with existing literature, further inquiry is required. With a commitment to reducing opioid usage and bolstering ERAS protocols, future examination of the questions raised in this project should be pursued utilizing a refined project design. Primarily, future inquiry should focus on addressing the limitations identified above through utilization of a more controlled study design. For both research questions posed by this project, a prospective, randomized controlled inquiry utilizing a more robust sample, and with a standardized set of anesthesia providers is recommended in effort to produce reliable findings capable of influencing the implementation of practice change.

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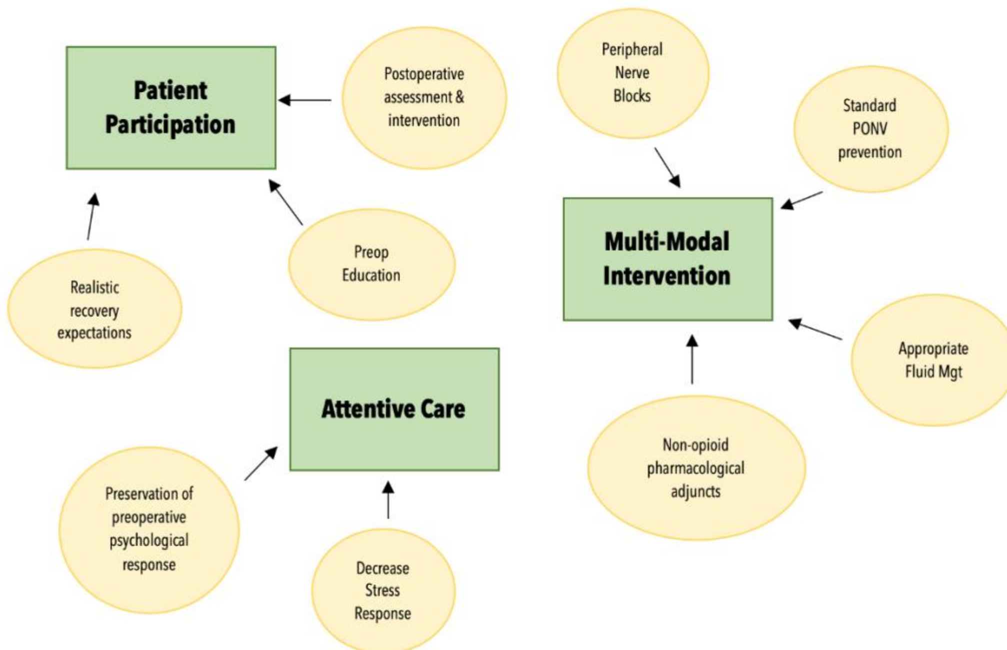
Appendix A

Theoretical Framework



Appendix A. The concept of implementation of an Enhanced Recovery After Surgery (ERAS) protocol. Figure displays the relationship between multi-modal pain management and psychological and physiological factors. Adapted from Good, M. (1998). *A middle-range theory of acute pain management: Use in research.* Nursing Outlook, 46(3), 120–124. https://doi.org/10.1016/S0029-6554(98)90038-0

Appendix B

Data Extraction Tool

Case	Date	Surgery Type	Fentanyl (mcg)	Dilaudid (mg)	Nerve Block?	MME Conversion	Age	ASA
1								
2								
3								
4…								
…200								