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An Educational Module for the Use of the Erector Spinae Plane Block to Control Postoperative Pain and Reduce Opioid Consumption in Adult Patients Undergoing Thoracic Surgery

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ABSTRACT

Background: Illegal use and abuse of opioids is a massive problem in the United States, with significant financial and emotional burdens. Surgeries in the thoracic cavity are some of the most painful surgeries endured by patients. With the discovery of the erector spinae plane block (ESPB), there is an alternate way to control postoperative pain and reduce opioid consumption following thoracic surgery. Further exploration of the use of the ESPB is needed to aid in practice change recommendations.

Objectives: The systematic review is designed to compile the most recent, high-quality randomized controlled trials (RCTs) concerning the use of the ESPB in thoracic surgery to control postoperative pain and reduce opioid consumption. This information will be presented in the form of an educational module to complete the study.

Data Sources: Investigators used CINAHL, PubMed, and EMBASE databases to answer the PICO (i.e., population, intervention, comparison, outcome) question: *In adult patients undergoing surgery in the thoracic cavity (P), does use of the ESPB (I) provide adequate postoperative analgesia (C) and reduce opioid consumption (O)?*

Methodology: Nine articles were included for analysis. The six RCTs and one before and after study had a total combined sample size of 481 adult patients undergoing thoracic cavity surgery. All seven studies showed that the ESPB was able to provide significant postoperative pain control. Four of the studies showed a reduction in intraoperative opioid consumption as well as postoperative. One study showed that the ESPB group had comparable pain scores and opioid requirements as the thoracic epidural (the gold standard for thoracic surgery pain control). Two meta-analyses were included, both showing the ESPB as effective pain control and reducing the opioid requirements. The results were presented as an educational module consisting of a pre-test, voice-over PowerPoint, and post-test administered to anesthesia providers.

Results: When analyzing results from the pre- and post-tests, the findings showed a statistically significant increase in knowledge. Attitudes towards alternative methods of pain management and the ESPB increases as well. More participants answered in favor of using the ESPB and opioid-sparing techniques when questioned on the post-test.

Conclusions: The results of the RCTs show that the ESPB can adequately control postoperative pain in direct comparison to other regional techniques in the thoracic cavity, including the gold standard thoracic epidural. In addition, the studies showed a significant reduction in opioid consumption. The ESPB is also easier to perform and has fewer side effects than the paravertebral block or thoracic epidural. Patients will have better outcomes by adding the ESPB to a balanced pain management routine for thoracic surgeries. Additionally, implementing an educational module provides the benefits of increased knowledge of the anesthesia provider and leads to more favorable views of opioid-sparing anesthesia and the ESPB.

Keywords: Erector spinae plane, erector spinae plane block, thoracic surgery, cardiothoracic surgery, VATS, sternotomy, thoracotomy, opioid-sparing, postoperative pain control, analgesia

INTRODUCTION

Description of the Problem

Opioid use and abuse in the United States is an epidemic that affects many aspects of the healthcare system as well as the physical, financial, and emotional strain of the afflicted individual, their family, and friends. Many patients describe their first encounter with opioids as a legal prescription for pain control in the healthcare setting. More than 47,000 individuals die due to opioid overdose every year, equating to more than 750,000 in the past 20 years.[1] Millions more are affected by addiction and may encounter a nonlethal overdose. With each nonlethal overdose, the person is more likely to have a fatal overdose.[1] While the loss of life is tragic, the implications reach far beyond the physical. The economic impact of this problem is felt in the healthcare system, legal system, and loss of productivity and comes in at an astounding $78.5 billion a year.[1] In addition to the measurable financial aspect, there is an insurmountable emotional toll on the family, friends, and healthcare workers. The opioid epidemic is out of control and perpetuated by unnecessary opioid use in the healthcare setting.

As anesthesia providers, one of the main goals is pain control and opioids are the current gold standard. Opioids, while suitable for pain control, may lead to nausea and vomiting, constipation, ileus, and respiratory depression.[2] Frequently, providers are measured on patient satisfaction, and often it is easier to give fast-acting narcotic relief without thinking of long-term effects when a patient is in pain. Additionally, many anesthesia providers do not provide follow-up care, and the creation of opioid dependence is not at the forefront of decision-making when prescribing or administering opioids. While current techniques are often satisfactory, they are outdated in the ever-changing healthcare setting. A novel new anesthetic technique is the erector spinae plane block (ESPB), which is a relatively easy to perform regional interfascial plane block with minimal side effects. This long-acting local anesthetic technique can help alleviate pain in both thoracic and cardiac surgeries, as both are associated with high postoperative pain and opioid consumption, in addition to untreated pain progressing to long-term neurogenic pain.[2-7]

Healthcare is on the precipice of a pain management revolution. Introducing new techniques, including opioid-sparing regional anesthesia such as the ESPB, is a powerful tool.

Background

Every year over 300 million people cross the threshold of the operating room for various types of procedures. Among those, 30%-80% elicit complaints of moderate to severe postoperative pain.[8] Thoracic cavity surgery is one of the most painful procedures and can lead to long-term neurogenic pain.[9] The side effects and potential dependence on opioids make them undesirable as the primary or even sole analgesic. Multimodal approaches, introduced in recent years, are a step in the right direction, but more needs to be done to truly embrace opioid-sparing or opioid-free anesthetic techniques. With opioid abuse and overdose increasing by 4% every year, healthcare providers need to rethink how freely they use and prescribe opioids.[2]

Forero *et al.* first described the ESPB in 2016.[9] Initially used as an adjuvant for pain, it controlled neurogenic pain in thoracic patients that were refractory to oral and topical analgesics.[2,9] It's a multi-dermal sensory block that acts at both the dorsal and ventral rami of the thoracic spinal nerves and the sympathetic fibers that allow for visceral and somatic pain control.[9,10] This delivers exceptional pain control. As an interfascial plane block, the ESPB can spread cephalad and caudad for multiple levels by utilizing a relatively large volume of local anesthetic, typically 20-30 milliliters (mL) per side. Making it even more attractive is the ease of the block. The ESPB is performed under ultrasound guidance or by landmark technique. When using ultrasound guidance, the transducer is oriented in a paramedian, sagittal approach approximately 2 centimeters (cm) away from the spinous process.[9,10] Above the T5 process, the ESP muscle is the third muscle identified below the trapezius and rhomboid major muscles. Below T5, only the ESP muscle is seen. After needle insertion in a caudad direction, contact with the transverse process is felt. Confirm proper positioning by injecting a small amount of local anesthetic. If proper placement, inject the remaining medication, aspirating every 5 mL to ensure the needle has not migrated.[9,10] When not using ultrasound, identify the landmark by making

needle contact with the transverse process of the desired level. Very slightly withdraw the needle, then inject the local anesthetic in 5 mL increments, aspirating frequently.[9,10]

Additionally, there are fewer side effects, such as lung injury, hematoma, pneumothorax, and nerve injury, than other thoracic level blocks.[9,10] Single-shot injections decreased opioid consumption at 6, 12, and 24 hours as much as 65%. There is an option to leave a catheter for continuous medication infusion, increasing the block's effectiveness and length of analgesia.[7] Currently, the thoracic epidural is the gold standard for pain control in thoracic surgeries.[11] The continuous ESPB is as effective as the thoracic epidural in controlling pain at rest and during coughing. It also decreases opioid usage, length of stay in the intensive care unit (ICU), ventilator duration, breakthrough pain, and maintains lung function in terms of incentive spirometry.[11]

Clinical Significance

Opioid analgesics are remarkable at controlling pain in a variety of settings. However, the highly addictive nature of these medications causes some concern. Easy access allows patients to become reliant on them. In addition to administering a safe anesthetic, the anesthesia provider's goals include alleviating pain as much as possible, with safety remaining the utmost priority. Currently, many anesthesia providers utilize a multimodal approach to pain, which consists of opioids, NSAIDs, and other non-narcotic analgesics. The utilization of opioids leads to side effects, including nausea and vomiting, respiratory depression, constipation, and dependence.[2] Due to the ever-growing opioid epidemic, many providers are exploring the option of opioid-sparing and even opioid-free analgesia when creating their anesthetic plans for patients. While judicious use of opioids is necessary, pain control is also paramount. Regional anesthesia is a relatively new technique that lends itself to the anesthesia provider's arsenal for pain control. In 2016, a new regional anesthetic was discovered, the ESPB. This interfascial plane block aims at controlling postoperative pain in some of the most painful procedures, thoracic cavity surgeries.

The opioid epidemic has significant mortality and financial burdens that can be reduced with the help of the ESPB and diminishing the number of patients exposed to opioids. Reduced

medication needs, shorter hospital stays, and fewer complications can reduce hospital costs.[4,5] Postoperative pain in thoracic and open cardiac surgeries is significant and can lead to chronic pain.[2,3,11-15] By controlling postoperative pain effectively, there is a lower incidence of chronic pain.[12] Current regional anesthesia techniques have mixed effects. Some adequately reduce pain, while others only partially alleviate pain. All have a higher risk of complications than the ESPB.[11,13,14] There is a need for a safe method that reduces postoperative pain and opioid usage.

The gold standard in regional anesthesia for postoperative thoracic pain is the thoracic epidural. While excellent pain control, there are significant side effects such as bleeding, hematoma, infection, postdural puncture headache, local anesthetic toxicity, and paresthesias.[11] The ESPB is placed in the erector spinae muscle lateral to the spine and is a volume plane block.[9] By injecting a local anesthetic into the muscle, there is less chance of local anesthetic toxicity and zero chance of postdural headache. The risk of bleeding, hematoma, and infection are all reduced considerably as well. ESPB can have bilateral continuous infusion catheters left in place to provide more prolonged postoperative analgesia and further decrease the need for opioids and the occurrence of neurogenic pain.[3] The block is technically easier to perform, making the ESPB a more attractive choice than the thoracic epidural.[11]

Other blocks that have been used to provide pain relief include the paravertebral block, serratus plane block, and intercostal nerve. The paravertebral block carries a substantially increased risk of pneumothorax, and the ESPB has shown lower postoperative pain scores when directly compared to the paravertebral block.[6] The serratus plane block carries the same risks as the ESPB. However, the ESPB has demonstrated superior postoperative pain control in direct comparison studies.[13] The intercostal nerve block has one of the highest systemic absorptions for local anesthetics, increasing the risk of toxicity significantly and a higher-than-normal risk of pneumothorax.[12,14] The ESPB has better lung volumes and spirometry values, in addition to greater pain control, when directly compared to the intercostal block.[12] All results point to the ESPB being a superior technique to opioids or other regional methods. Any facility that already

utilizes ultrasound-guided regional anesthesia will possess all necessary materials to implement the ESPB quickly.[9] Combine excellent pain control, ease of implementation, lack of set-up costs, and increased safety for patients, and the ESPB is a clear choice for induction into the multimodal regimen for thoracic cavity surgical patients.

Objectives of the Systematic Review- PICO Question

Due to the current opioid epidemic, there is a need for healthcare practitioners to be more prudent in the use of opioid-sparing techniques. Thoracic surgeries, including open cardiac surgeries with a sternotomy, incur extensive pain postoperatively.[2,3,11-15] A new regional block, the ESPB, is available, easy to perform, utilizes current technology, and is safer than existing techniques.[3-5] The goal of this systematic review is to identify recent research about the use of the ESPB and its ability to control postoperative pain in thoracic surgeries. While many techniques exist to aid postoperative pain control and rapid recovery, the ESPB is new and effective.[11,13,14] The PICO question to be answered by extensive literature review is: Does the ESPB (I) provide adequate analgesia (C) to reduce opioid consumption (O) in adult patients undergoing surgery in the thoracic cavity (P)? The results of this review will be collected and presented in an educational module to anesthesia providers to enhance knowledge and encourage practice change.

METHODOLOGY OF LITERATURE REVIEW

Information Sources and Search Strategy

A comprehensive literature search of online databases was conducted. Databases utilized included Cumulative Index of Nursing and Allied Health Literature (CINAHL), PubMed electronic database, and Excerpta Medical Database (EMBASE). Search terminology included the following: *erector spinae plane block* OR *erector spine plane block* OR *erector spinae plane* OR *erector spine plane*, AND *analgesia* OR *analgesic*, AND *opioid* OR *opioid-sparing* AND *thoracic* OR *thoracotomy*. The CINAHL, Pubmed, and EMBASE databases produced 299, 87, and 181 results, respectively. After removing duplicates, 248 articles remained for appraisal. Further exclusions included non-English language and non-full text articles. The final number of

papers reviewed was 185. The literature search was current as of November 2020. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) checklist helped guide and format the literature review. The goal of the literature review seeks to provide evidence-based research on the ESPB in thoracic surgeries, provide foundational knowledge, identify any inconsistencies or conflicting information, and determine the best and safest regional technique to control postoperative pain in thoracic cavity surgeries while reducing opioid consumption.

Table 1 below further outlines the results of the literature results. Table 2 comprises the inclusion and exclusion criteria for the literature review. Appendix L offers the PRISMA flow diagram that describes each step of the literature review process.

Selection Process and Screening of Evidence

Search Criteria Table 1.

Table 1

Concepts/ Topics	**Erector spinae plane block or erector spine plane block**	**Thoracic or thoracotomy**	**Analgesic or analgesia**	**Opioid or opioid-sparing**	**Filters Applied**
CINAHL	(" erector spinae plane block") OR ("erector spine plane block")	AND ("thoracic") OR ("thoracotomy")	AND ("analgesic") OR ("analgesia")		Peer reviewed Years 2016-2020 Results 49
	("erector spinae plane block") OR ("erector spine plane block")	AND ("thoracic") OR ("thoracotomy")		AND ("opioid") OR ("opioid-sparing")	Peer reviewed Years 2016-2020 Results 18
	("erector spinae plane block") OR				Peer reviewed

	("erector spine plane block")				Years 2016-2020 Results 232
EMBASE	'erector spinae plane block' OR 'erector spine plane block'	AND 'thoracic' OR 'thoracotomy'	AND 'analgesic' OR 'analgesia'		Peer reviewed Years 2016-2020 Results 37
	'erector spinae plane block' OR 'erector spine plane block'	AND 'thoracic' OR 'thoracotomy'		AND 'opioid' OR 'opioid-sparing'	Peer reviewed Years 2016-2020 Results 12
	'erector spinae plane block' OR 'erector spine plane block'				Peer reviewed Years 2016-2020 Results 132
PubMed	Erector spinae plane block	Thoracotomy	analgesia		Peer reviewed Years 2016-2020 Results 17
	Erector spinae plane block	thoracotomy		Opioid-sparing	Peer reviewed Years 2016-2020 Results 6
	Erector spinae plane block				Peer reviewed Years 2016-2020 Results 64

Table 2. Inclusion and Exclusion Criteria

Inclusion	**Exclusion**

• Population:
  ○ Adult patients aged 18 to 85-years-old
  ○ ASA I, II, or III
  ○ Either sex
  ○ Thoracic surgery
  ○ Open cardiac surgery with sternotomy
  ○ Thoracotomy
  ○ Mini thoracotomy
  ○ VATS
• Intervention:
  ○ ESPB
• Outcomes:
  ○ Postoperative pain scores using VAS or NRS
  ○ Intraoperative opioid usage
  ○ Postoperative opioid usage
• Type of Study:
  ○ Randomized Controlled Trials
  ○ Systematic reviews
  ○ English language
  ○ Meta-analyses
	• Population:
	  ○ Pediatric patients under 18 years old
	• Intervention:
	  ○ Multiple techniques on the same patient
	• Outcomes:
	  ○ Anything not involving either pain scores or opioid consumption
	• Type of Study:
	  ○ Non-English
	  ○ Dissertations
	  ○ Case reports

Study Screening Method

After an exhaustive literature search, all articles were analyzed for applicability. The relevant question employed during scanning was: In adult patients undergoing thoracic cavity surgery, does the ESPB provide adequate postoperative pain control and reduce opioid consumption? This question guided the investigator during an examination of the studies for appropriateness after initially removing duplicates and non-English studies. Secondly, reading titles, followed by abstracts, determined if a study met the preliminary criteria.

Population inclusion criteria included adult population, scheduled, non-urgent procedures, thoracic cavity surgeries, ASA class 1, 2, or 3. Study characteristics for inclusion were randomized control trials (RCT), meta-analysis, before and after studies, and publication within the last ten years. Variable inclusions were pain score comparison, opioid consumption measurement, thoracic cavity block, and ESPB. Exclusion criteria included case reports,

dissertations, breast surgeries, and no pain score comparison. All inclusion and exclusion criteria are summarized in Table 2. The title and abstract of 185 articles were scanned, 173 were excluded, and 12 underwent full-text review. Three additional articles were excluded for not using a standard pain scale, not utilizing a comparison group, and significant study bias. Nine items were included in the final analysis. The PRISMA analysis is depicted in Appendix L.

Collection, Analysis, and Data Items

Evaluation of approved studies used a systematic method. Appendix A outlines all evaluated study information, including study design and settings, sample size and characteristics, variables, data analysis, measurements, findings, and strengths and weaknesses. Each study was given an evidence rating level based upon the John Hopkins Research Evidence Appraisal Tool criteria. This tool is used to rate evidence to establish the quality of a study and determine if results are credible to base practice change recommendations.[16] Included in this analysis are levels 1 and 2 quality of evidence. Level 1 evidence includes experimental studies, RCTs, and systematic reviews of RCTs. Level 2 evidence includes quasi-experimental studies and systematic reviews that combine RCTs and quasi-experimental studies or are quasi-experimental studies only.[16] Level 3 evidence are non-experimental studies and therefore not included in the final appraisal articles in this review. Evidence is then further graded with letters A-C. Grade A is the highest quality which indicates reliable results, ample sample size, and conclusive results.[16] Grade B indicates good quality, results, and sample size are adequate, while the results are relatively definitive or a reasonably complete conclusion based on literature review. Finally, grade C is poor quality with poor evidence or study flaws, insufficient sample size, indistinct findings, or unreliable results.[16] For this reason, grade C evidence was not included for analysis.

RESULTS OF LITERATURE REVIEW

Study Selection

A combined total of 567 articles were attained from the three databases. After removing 319 duplicates, 248 items remained. An additional 63 were dismissed for either not having a full-

text article or not English language. In the end, 185 articles were read by title and abstract for preliminary eligibility, of which 173 were excluded for various reasons. Twelve articles underwent a full-text review utilizing the strict inclusion and exclusion criteria in table 1. Three others were excluded for not meeting the inclusion criteria. Additionally, a manual evaluation of the reference lists of each full-text review article was completed and returned no additional RCTs that met the requirements to be included in the systematic review. Ultimately, nine articles were included, 6 RCTs, one before and after study, and two meta-analyses, based on the PICO question: In adult patients undergoing thoracic cavity surgery (P), does the use of an ESPB (I) provide adequate analgesia (C) and reduce opioid consumption (O). All included studies were high-quality level 1 or 2 evidence according to Johns Hopkins' appraisal scale.[16]

Study Characteristics

The studies included for this review included six RCTs and one before and after study, including a total of 481 adult patients undergoing thoracic surgery. Also included in the review, two meta-analysis articles had a total of 2059 patients. Participants either received an ESPB, placebo, or another regional thoracic block for comparison. Patient demographics were consistent among the studies, with both genders represented equally. Patients were adults over 18 years old, undergoing scheduled thoracic surgery and ASA class 1-3. Sample sizes ranged from 46 to 106 participants. All studies were done in a hospital setting. The meta-analysis studies related ESPB to thoracic surgery but also had some breast and spinal surgeries included. For the purposes of this literature review, only those undergoing thoracic cavity surgery were included in the analysis.

ESPB Versus Placebo

Macaire *et al*.[3] was a before and after study that compared historical data to current interventions for adult patients undergoing cardiac surgery via a median sternotomy. Historical data was taken from patients' pain scores when treated with postoperative opioids and compared to current patients that received a continuous infusion ESPB for pain control.[3] Pain was measured using the visual analog scale at extubation, upon chest tube removal, during first mobilization, 48

hours postoperative, and one month after surgery. Morphine use during the first 48 hours was also documented.[3] The ESPB significantly decreased intraoperative and postoperative opioid use. While pain during the first mobilization was not substantially reduced, pain one month after surgery was considerably lessened in the ESPB group.[3]

Krishna *et al.*[4] compared a single-shot ESPB to intravenous use of tramadol and paracetamol. The patient population was cardiac patients receiving a sternotomy. Pain measurement used the numerical rating scale every two hours for the first 12 hours postoperatively.[4] Additionally, total opioid consumption was measured. In the ESPB group, total opioid consumption and pain scores were substantially lower than the intravenous analgesics group.[4] Other notable benefits in the ESPB group included earlier extubation and ambulation, shorter intensive care stays, and less need for rescue analgesia.

Cai *et al.*[5] is a meta-analysis study that compared the ESPB to a placebo in 18 RCTs. While the results included ten thoracic, four spinal, and four abdominal RCTs, the majority were thoracic cavity surgeries. All results proved the ESPB reduced opioid consumption and postoperative pain considerably from the placebo group and was thus chosen as applicable to this systematic review.[5] One additional benefit of the ESPB noted in this analysis was the reduction of postoperative nausea and vomiting.[5]

Shim *et al.*[15] compared a single-shot ESPB to a control group that received saline injections. The study design was the best of all included in the analysis because it was a true blinded study, and the patients didn't have a bias by knowing they were receiving the ESPB. Pain scores were measured using the numerical rating scale and assessed upon arrival to the post-anesthesia care unit (PACU) and at 1, 6, and 12 hours postoperatively.[15] Opioid consumption in the PACU and during the first 24 hours was followed. Scores for the ESPB group were considerably lower than the placebo group until six hours postoperatively, where they remained similar, suggesting the single-shot technique had worn off.[15] The result lends to the argument that further RCTs are needed, including a continuous versus single-shot approach and different local

anesthetics in varying concentrations. Shim *et al.* also recorded total postoperative opioid consumption, which was reduced by half in the ESPB patients.[15] Unique to this study, agitation scores were assessed finding that patients receiving the ESPB had lower agitation in the PACU.[15]

ESPB Versus Other Thoracic Regional Techniques

Huang *et al.*[6] is a meta-analysis comparing the ESPB to a paravertebral block or no block. Fourteen RCTs were included in the analysis, seven for thoracic surgery and seven for breast surgery. Measurements included pain scores at 24 hours after surgery utilizing the visual analog scale. When comparing the ESPB to no block, the ESPB had drastically lower pain scores; however, the scores were similar to the paravertebral block.[6] Total opioid consumption was noted with results mimicking pain scores; less opioid consumption in the ESPB group than no block, but similar consumption to the paravertebral block.[6] The ESPB did have fewer side effects and adverse events, making it a superior choice between the two.

Nagaraja *et al.*[11] is an RCT that compared the ESPB to the thoracic epidural in patients undergoing cardiac surgery with a median sternotomy.[11] Considering that the thoracic epidural is the gold standard for pain control in thoracic surgery, this is an important study. A continuous infusion thoracic epidural was compared to bilateral continuous infusion ESPB. Pain scores were measured using the visual analog scale at rest, during coughing, upon extubation, and 3, 6, 12, 24, 36, and 48 hours post-extubation. Pain scores were similar in the two groups, with the scores being slightly less in the ESPB group, but not significantly.[11] Opioid consumption was evaluated, and both groups have similar needs for intraoperative and breakthrough pain coverage. Finally, incentive spirometry and ventilator duration were appraised and found to be comparable.[11] The ESPB is easier to perform than the thoracic epidural with fewer side effects. The study conducted by Nagaraja *et al*. demonstrates the applicability of the ESPB to current practice with supporting evidence that it is comparable to the current gold standard thoracic epidural.

Chaudhary *et al.*[12] compare a single-shot ESPB to the intercostal nerve block in patients undergoing video-assisted thoracotomy surgery (VATS). Opioid consumption was calculated,

and pain scores were measured using the visual analog scale.[12] Opioid consumption did not show a significant decrease; however, the pain scores in the ESPB group were approximately half of the intercostal nerve block group and were better controlled chronically. Other measured variables include PACU length of stay and spirometry values, both of which were better in the ESPB group.[12]

Gaballah *et al.*[13] is an RCT that compares a single-shot ESPB to a serratus plane block in patients undergoing VATS. Using the visual analog scale, pain scores were evaluated every hour for the first 24 hours following surgery.[13] While the scores remained lower in the ESPB group, beginning at hour four, there was a definitive statistical significance noted. The subsequent comparison was the time to first recuse analgesic. The ESPB group did not need additional medication for nearly 100 minutes longer than the serratus plane block group.[13] Also, total opioid consumption was approximately half in the ESPB group. Heart rate, respiratory rate, and mean arterial blood pressures were assessed and were markedly higher in the serratus plane block group, suggesting uncontrolled pain.[13]

Chen *et al*.[14] was a double-blinded RCT comparing single-shot ESPB to the paravertebral and intercostal nerve blocks in patients undergoing VATS. All blocks were performed with identical local anesthetics in terms of both volume and concentration.[14] Pain scores were assessed at rest and during coughing immediately after surgery and at 2, 4, 8, 24, and 48 hours postoperatively. Total opioid consumption was also appreciated.[14] The paravertebral block had lower pain and total opioid consumption, while the ESPB and the intercostal nerve block were comparable. All pain scores were less than four on a scale of ten, showing that all blocks achieved reasonable pain coverage.[14] The results potentially can be attributed to the need for a higher volume of local anesthetics in the ESPB. Whatever the reason, further studies need to be conducted to determine the local anesthetic concentration, volume, and duration (single-shot versus continuous infusion) in addition to a direct comparison of multiple thoracic blocks.

Table 3. Studies Included in the Appraisal

Author (Year) & Level of Evidence	Study, Participants, Interventions, & Setting	Findings in ESPB group
Macaire et al. (2019) Level 2 evidence Quality A	67 total patients, ASA II and III. 20 control group patients (historical data); 47 experimental group patients; age range between 21-77 years old; undergoing cardiac surgery with sternotomy in a hospital setting; BMI <40	ESPB group showed significant decreases in intraoperative sufentanil use and morphine consumption in the first 48 hours. Continuous ESPB did not significantly decrease time to extubation or pain during first mobility but showed a significant reduction in the number of opioids needed to control pain and earlier removal of chest tubes.
Krishna et al. (2019) Level 1 evidence Quality A	106 total patients; 53 in each group. Undergoing cardiac surgery with bypass in a tertiary hospital setting; age range 20-70 years old; Cardiac Anesthesia Risk Evaluation Score 1 and 2	ESPB reduced the total pain score during the first 12 hours after extubation. Compared to the IV analgesia group, the ESPB group had quicker time to extubation (minutes) 63.09 ± 1.30 vs 102.62 ± 2.52, less total rescue analgesia (mcg) 82.92 ± 4.29 vs 214.25 ± 5.09, less total opioid usage (mcg) 231.42 ± 6.95 vs 935.66 ± 21.99, earlier time to first ambulation (hours) 36.17 ± 0.18 vs 62.70 ± 0.40, and shorter length of ICU stay (hours) 42.17 ± 0.18 vs 69.34 ± 0.36.
Cai et al. (2020) Level 1 evidence Quality B	1041 patients; all RCTs including ESPB vs. placebo; 10 thoracic RCTs; 4 spinal RCTs; 4 abdominal RCTs	The ESPB had significantly lower pain scores using VAS at 24 hours than the placebo among all surgeries (WMD: -1.18; 95% CI: -1.44 to −0.91; I 2 = 92.0%). The same results were noted in just the thoracic cases (WMD: -1.31; 95% CI: -1.83 to −0.79; I 2 = 92.8%). Morphine consumption in the first 24 hours was significantly decreased in the ESPB group vs. the control group (WMD: -17.20; 95% CI: -30.14 to −4.26; I 2 = 99.1%). ESPB reduced the incidence of

		PONV (OR: 0.32; 95% CI: 0.17 to 0.61; I 2 = 46.5%).
Huang et al. (2020) Level 1 evidence Quality A	1018 patients; 7 RCTs for thoracic surgery; 7 RCTs for breast surgery	There was less opioid consumption at 24 in the ESPB group vs. the no block group (−14.81 mg; 95%CI −21.18 to −8.44; p < 0.001; I 2 = 96%), but similar results compared to the TPVB group. Pain scores were lower in the ESPB group vs. no block and comparable to the TPVB group.
Nagaraja et al. (2018) Level 1 evidence Quality B	50 total patients; 25 in each group. Undergoing cardiac surgery with median sternotomy in a hospital setting; age range 26-65	Pain using VAS was comparable for both groups (P> 0.05). VAS scores for the TEA group was 1.56±1.08, 1.52±0.65, 1.64±0.64, 1.92±0.90, 2.08±0.64, 2.24±1.05, 2±1.32 at 0, 3, 6, 12, 24, 36, and 48 hours post-extubation respectively. VAS scores for ESPB group were 1.04±0.98, 1.4±1.00, 1.64±1.35, 1.68±1.35, 1.44±0.87, 1.08±0.86, 0.8±0.64. Incentive spirometry was comparable in both groups (P> 0.05). Peak inspiratory flows, at the same time intervals, for the TEA group were 750±129.90, 816±106.77, 852±94.07, 858±110.57, 870±136.93, 888±96.05/ Peak inspiratory flows for the ESPB group were 678±150.75, 744±175.78, 780±183.71, 882±90, 906±110.23, 906±110.23. There were nine episodes of breakthrough pain in the TEA group and 7 in the ESPB group. Neither group needed second rescue analgesia. Intra-op fentanyl use was comparable (P>0.05) with TEA using 330±82.92 mcg and ESPB 364.4±105.39 mcg.
Chaudhary et al. (2020) Level 1 evidence	77 total patients in a hospital setting were undergoing	ESPB group had significantly less pain than the ICB group

Quality A	VATS. 46 experimental group patients; 31 control group patients. English speaking; elective surgery; no active infection; BMI <35; age range 49 to 83	(3.2 vs 6.4), shorter PACU stays (127.3 vs 189.5), preservation of lung volumes (FVC: 40.5% vs 51.4%; FEV 1 : 40.9% vs 53.8%).
Gaballah et al. (2019) Level 1 evidence Quality A	60 total patients, 30 in each group. Undergoing VATS in a hospital setting; age range 25-57; ASA I and II	VAS pain scores remained lower in the ESPB group than the SPB throughout the first 24 hours, but there was a statistical significance from the fourth hour (1.87 ± 0.35 v 2.0 ± 0.01, respectively; p = 0.04) to the sixth hour postoperatively (3.33 ± 0.48 v 3.73 ± 0.45, respectively; p =0.002) and the 14th hour postoperatively. Time to the first analgesic was significantly longer in the ESPB than SPB 379.07 ± 7.78 v 296.04 ± 6.62 minutes, respectively; p< 0.001. Fewer patients needed more than one dose of postoperative opioids in the ESPB group than the SPB, 36.7% v 70%, respectively; p = 0.01. However, NSAID analgesia was comparable, 46.7% in ESB vs. 70% in SPB; p = 0.248. MAP was higher in the SPB group, 95.80 ± 3.24 v 90.90 ± 5.55, respectively; p < 0.001. Respiratory rate was also higher in the SPB group, 13.07 ± 0.87 v 12.27 ± 0.45, respectively; p < 0.001. HR was also higher in the SPB group.
Chen et al. (2020) Level 1 evidence Quality A	75 total patients; 25 in each of 3 groups. Undergoing VATS in a hospital setting; age range 18-75 years old; ASA 1 and 2	There was a significant difference in morphine consumption at 24 h postoperatively among the three groups (PVB, 10.5 [9–15] mg; ICNB, 18 [13.5–22.1] mg; ESPB, 22 [15–25.1] mg; p = 0.000). This difference was statistically significant for PVB group vs. ESPB group (median difference,

		−7.5; 95% confidence interval [CI], −12 to −4.5; p = 0.000) and PVB group vs. ICNB group (median difference, −6; 95% CI, −9 to −3; p = 0.001), but not for ICNB vs. ESPB (median difference, −3; 95% CI, −6 to 1.5; p = 0.192). There was no statistical significance in VAS scores between ICNB and ESPB. There was a statistical significance in VAS scores at 0, 2, 4, and 8 hours postoperatively between the PVB and ESPB. More rescue analgesia was needed in the ESPB group (PVB vs. ICNB vs. ESPB; 13% vs. 29% vs. 46%; p < 0.05).
Shim et al. (2020) Level 1 evidence Quality B	46 total patients; 22 control group; 24 experimental group; Undergoing VATS in a hospital setting; age range 19-85; ASA I-III; BMI <30	Pain was measured using NRS upon arrival to PACU at 1, 6, and 12 hours postoperatively. The ESPB showed significantly lower scores until 6 hours post-op (P=0.001 at 1 hour and P=0.005 at 6 hours). At 1 hour, scores for the ESPB group vs. saline were 5.96±1.68 and 7.59±1.18, respectively; P<0.001. Rescue opioid usage was less in the ESPB group, 25 mg vs. 50 mg; P=0.006. PACU stay was significantly less in the ESPB group 25 minutes $\pm$ 10 minutes vs. 30 minutes $\pm$ 15; P<0.001. Riker SAS agitation scores were also lower in the ESPB group 4 $\pm$ 1 vs. 5 $\pm$ 1.25.

DISCUSSION OF LITERATURE REVIEW

Summary of the Evidence

Nine articles comprised for this literature review included six RCTs, two meta-analyses, and one before-and-after study. Numerous studies were not incorporated for reasons including

non-full text, non-English language, surgery other than the thoracic cavity, no pain score reporting, case reports, and dissertations. Utilizing the John Hopkins Research Evidence Appraisal Tool, eight articles were level 1 evidence, and one was level 2 evidence. Of these studies, the quality was rated quality level A in six articles and quality level B in three articles.[16] Results of the literature review are summarized below.

- Three RCTs were cardiac surgery via median sternotomy.[3,4,11] Four RCTs were VAT surgery.[12-15]
- Both meta-analyses included thoracic surgeries in their analysis.[5, 6] One RCT compared the ESPB to serratus plane block.[13]
- Two RCTs compared the ESPB to intercostal nerve blocks.[12, 14]
- Three RCTs compared ESPB to a placebo or IV analgesia only.[3-5]
- Two RCTs compared the ESPB to a paravertebral block.[6,14]
- One RCT compared the ESPB to a thoracic epidural.[11]

Pain and Variables

- All studies showed decreased pain scores except one that showed equivalent pain scores.
- Seven RCTs evaluated opioid consumption. All but one showed decreased opioid consumption.[3-6, 13] The one study showed equivalent opioid usage.[11]
- Two RCTs compared time to the first ambulation and found that the ESPB had earlier ambulation.[3,4]
- Two RCTs compared the length of PACU stay and found the time in the ESPB group was decreased.[12,15]
- Two RCTs compared spirometry values. One found equivalent values,[11] while one found better numbers in the ESPB group.[12]

- Other noted variables included decreased blood pressure, heart rate, and respiratory rate,[13] decreased agitation,[15] and decreased postoperative nausea and vomiting[5] in the ESPB group.

Limitations of the Systematic Review

There are limitations to this review that must be acknowledged. Studies were limited to the English language, potentially excluding relevant data that presents in a different language. Also, with the ESPB being somewhat new, there is a limited number of studies to appraise. The data favored the ESPB; however, some studies showed equivalent findings warranting further well-designed studies to be conducted to solidify the ESPB as a viable pain management technique for thoracic surgery. Another limitation is the relatively small sample size. All but one study had less than 100 participants, and while the data showed statistical significance, the sample size is much too low to project results onto the population as a whole. A more extensive, possibly multi-center study should be conducted.

Additionally, these studies were conducted on patients in the ASA 1-3 categories. Many patients undergoing thoracic surgery would classify as an ASA 4 or even 5. Many of the studies also excluded the obese and morbidly obese. With the population growing more overweight and obese, this would exclude a great many patients. More studies to show the efficacy in a broader range of patients would be beneficial. Finally, the use of the pain scoring systems was not uniform. The use of both the visual analog scale and the numeric rating scale was used. Different time intervals for measuring pain were also utilized, which could potentially skew results. Despite limitations, the data remains consistent among the nine included studies.

Recommendations for Future Research

More well-designed studies need to be conducted to determine the efficacy of the ESPB against the most popular techniques currently available. Sample sizes should be substantially larger. The inclusion of patients with a higher BMI and ASA status will give a wider breadth of the population that would potentially be needing access to better pain control. Additionally,

studies need to determine if a continuous running catheter of local anesthetic provides any additional benefits from the single-shot injection. Different local anesthetics at varying dosages should be used to determine the most beneficial outcome.

Further studies should aim to unify the use of one pain scoring system and standardized measurement time frames. Evaluating opioid usage would be beneficial to determine the extent of benefits beyond a single pain score. Finally, a cost-benefit analysis would help determine if the benefits of the ESPB would outweigh any associated costs. None of the included studies did a cost-benefit analysis, but some did acknowledge the low set-up costs if a hospital is already utilizing ultrasound-guided regional anesthesia.

CONCLUSION OF LITERATURE REVIEW

An extensive literature was performed using the CINAHL, Pubmed, and EMBASE databases. Results returned 567 articles, which were appraised for appropriateness. In the end, nine studies were chosen for inclusion in the systematic review. Among the included studies, four compared the ESPB to a placebo or intravenous analgesics alone, and five directly compared the ESPB to other thoracic regional blocks. All nine studies demonstrated the ESPB as equivalent or superior in pain control and opioid reduction.[3-6,11-15] One study directly compared the ESPB to the gold standard, thoracic epidural showing similar results.[11] All studies showed fewer adverse effects from the ESPB than other blocks[3-6,11-15], indicating the ESPB as an attractive choice for postoperative pain management in thoracic surgeries.

METHODOLOGY OF QUALITY IMPROVEMENT

The primary object of this educational module is to assess the baseline knowledge of anesthesia providers regarding the opioid epidemic, the ESPB, pain management of thoracic cavity surgeries, and opioid reduction techniques. To accomplish the project goals, a group of certified registered nurse anesthetists (CRNA) will voluntarily complete a series of tasks. The intervention portion of the project includes a pre-test, an educational module delivered as a voice-over PowerPoint, and a post-test.

Setting and Participant Recruitment

The educational study took place at a very large, multi-facility, tertiary hospital system in Southeast Florida. With over 1700 beds, there are four hospitals within the system. The hospital consists of a level 1 trauma center and a level 2 trauma center well-versed in thoracic surgery. The target audience was CRNAs working at the facilities but employed by an outside anesthesia company. Using an email list provided by the anesthesia employer, participants were identified and recruited via email. All CRNAs were eligible to participate and emailed an invitation. Participation was voluntary, and all responses were anonymous. Physician anesthesiologists, operating room nurses, surgeons, techs, and surgical reps were all excluded from this study. The anticipated number of participants is between 5-10 CRNAs.

Intervention

For anesthesia providers to advance the field, education is necessary. The primary intervention of the project is an educational module presented online to anesthesia providers about the use of ESPB to control postoperative pain and reduce opioid consumption in thoracic cavity surgery patients. The surveys will be anonymous with an expected time commitment of approximately fifteen minutes. After written consent was obtained, a pre-test was administered to assess current knowledge and evaluate attitudes toward utilizing regional techniques for pain management.

Next, the CRNA watched the educational module presented as a voice-over PowerPoint. The module consists of the detrimental effects of opioids, the toll on the healthcare system, and the need for more opioid-sparing anesthesia. Next, the presentation gives the benefits of the ESPB and the ease of performing. Finally, the results of the studies are presented, showing the efficacy of the ESPB and urging practitioners to change practice habits to include the ESPB when caring for thoracic cavity surgery patients.

Finally, the post-test was administered to assess the efficacy of the education provided. The questions on the post-test were identical to the pre-test. In doing so, the investigator analyzed

if learning occurred. The end of the post-test contains questions regarding the CRNA's likelihood of utilizing the ESPB in routine practice. Asking the questions a second time, assess the possibility of a practice change among CRNAs.

Implementation Procedures

Using the email list provided by the anesthesia employer, an email containing an informative letter that invited them to participate was sent to all CRNAs. There was an anonymous link if they chose to participate. The survey and educational module were connected to the Qualtrics platform. They could complete the study at whatever time and place were convenient to the CRNA via mobile or desktop computer. As the surveys were unidentifiable, a unique code connected the pre- and post-tests to be able to assess learning and run statistical analysis. Once the anonymous link was accessed, the participant was taken to the consent form, followed by the pre-test. Then the educational module opened and played in the same window. Once the module was complete, the page redirected to the post-test. All education and surveys were conducted virtually, and all participants remained anonymous.

Protection of Human Subject

Participation in the survey was completely voluntary. The creation of a unique code and untraceable link, combined with recruitment done over email, ensured the anonymity of the participants. All digital data was stored on a laptop that was password protected and secured by antivirus and spyware. There are no known risks associated with participation, and participants should not experience any harm or discomfort. Potential benefits include increased knowledge related to ESPB and possible practice change to improve patient outcomes. There is no compensation or incentive provided for survey participation. Additionally, there are no penalties if one should choose not to participate.

Data Collection

For this study, the primary data will be collected in the form of a pre-test and post-test. This method was employed to determine the participants' level of knowledge about the ESPB and

its use in postoperative pain control and opioid reduction in thoracic cavity surgical patients. In addition, the pre- and post-test model will verify the efficacy of the educational module in enhancing participants' knowledge about the subject. The entire module was administered in a three-phase fashion through the Qualtrics platform. After obtaining consent, the participant will take the pre-test, demonstrating base knowledge prior to the intervention. Next, the educational PowerPoint video played. Finally, the post-test was given and assessed knowledge gained from watching the presentation to determine if learning occurred. Both surveys consisted of the same ten base knowledge questions. The pre-test included five demographic questions before the knowledge questions. Demographics are only used for statistical purposes, and no identifying data will be collected or stored during any part of this study, and all data will be kept confidential. After the knowledge questions, both the pre- and post-tests included two questions about the prospect of using the ESPB and opioid-sparing techniques in practice. Inferential statistics analyzed the reliability and validity of the data. A paired t-test was conducted to determine if there was a statistically significant increase in learning or the likelihood of utilizing the ESPB in future practice.

Data Management and Analysis Plan

The DNP candidate is the co-investigator and is responsible for administering the survey to all participants through the Qualtrics platform. Once responses are collected, the statistical package for social science (SPSS) software will be employed to ascertain if learning occurred due to the intervention. All answers for the pre- and post-tests will be recorded, followed by each question being measured for statistical analysis on education obtained. Again, no personal identifiers will be amassed, and confidentiality will be upheld. The intervention effect will be based on the analysis of the pre- and post-tests. Through statistical analysis, the study results will likely identify patterns that will determine the effectiveness of educational intervention and how it affects the provider’s actions and behaviors. The co-investigator will store the data collected in a password-protected laptop computer equipped with antivirus and spyware for added protection.

RESULTS OF QUALITY IMPROVEMENT

Demographics

The participant demographics were collected only for statistical analysis and in no way identified the participants. The results are displayed in Table 4 below.

Table 4: Demographics	**n (%)**
Total Participants	7 (100%)
Gender	
Male	3 (42.86%)
Female	4 (57.14%)
Age	
18-29	0 (0%)
30-49	5 (71.43%)
>50	2 (28.57%)
Ethnicity	
Caucasian	2 (28.57%)
Hispanic	4 (57.14%)
Asian	1 (14.29%)
African American	0 (0%)
Other	0 (0%)
Education	
Bachelors	0 (0%)
Masters	4 (57.14%)
Doctorate	3 (42.86%)
Years of practice	
0-2	3 (42.86%)
3-5	2 (28.57%)
6-10	0
More than 10	2 (28.57%)

A total of seven participants enrolled in the study. All seven completed both the pre-test and the post-test. The gender demographic revealed almost an equal number of males (n=3, 42.86%) and females (n=4, 57.14%), with females having the slight majority. The age range showed that most participants were in the 30 to 49 age range (n=5, 71.43%), with the remainder in the greater than 50 range (n=2, 28.57%). There were a variety of ethnicities represented, with Hispanic (n=4, 57.14%) accounting for the most, followed by Caucasian (n=2, 28.57%) and Asian (n=1, 14.29%). Education level was asked, and participants were nearly even with a slight nod to those with a master's degree (n=4, 57.14%) over those with a doctorate (n=3, 42.86%).

Finally, the participants were questioned about the length of time they have been a CRNA. The results showed that the majority have been practicing less than two years (n=3, 42.86%) with an even number in each of the three to five years (n=2, 28.57%) and greater than ten years (n=2, 28.57%) groups.

Pre-test and Post-test Sample

In total, seven CRNAs completed both the pre-test and the post-test. On the pre-test, the average score was 3.71 (SD=1.496), with the post-test average score of 6.86 (SD=1.345). The average score on the post-test increased by 3.16 points. The statistically significant indicator value is $p<0.05$. When a paired T-test was run, the p-value was 0.00, proving there was a statistically significant increase in knowledge from the pre-test to the post-test, confirming the educational module provided supplemental education. Below and appendix H display the full paired T-test.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	postfinal	6.8571	7	1.34519	.50843
	prefinal	3.7143	7	1.49603	.56544

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	postfinal & prefinal	7	.887	.008

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	postfinal - prefinal	3.14286	.69007	.26082	2.50465	3.78106	12.050	6	.000

Pre-Test Findings

The pre-test evaluated participants' baseline knowledge related to opioids and the opioid epidemic, the ESPB, and postoperative pain management in thoracic cavity surgery. The CRNAs did reasonably well when tested on knowledge of opioids and addiction. Two participants

correctly chose the risk factor not associated with opioid addiction (n=2, 28.57%). Approximately half chose the correct number of opioid-related deaths each year (n=3, 42.86%) and the economic impact of opioid addiction (n=3, 42.86%). However, the knowledge was significantly less when tested on the ESPB. Considering this technique is relatively new, this trend is not surprising. All participants knew that the ESPB was performed in the spine's thoracic region (n=7, 100%). While all the CRNAs knew that the ESPB was a sensory and motor block (n=7, 100%), only one of them knew that it was also a volume plane block (n=1, 14.29%). In the select all the apply questions, none of the participants understood that the ESPB could prevent neurogenic pain, but all knew that it could avert somatic and visceral pain. When asked how well the ESPB controlled pain, three people knew that the ESPB managed pain the same as the thoracic epidural (n=3, 42.86%). At the same time, three thought it was better than the thoracic epidural (n=3, 42.86%), and one thought it was less effective than the thoracic epidural (n=1, 14.28%). Understanding the benefits of the ESPB was mixed. While no one was able to choose all the correct answers for the select all, most were able to pick at least two benefits. Finally, three CRNAs were able to identify the proper procedure that the ESPB is not effective on (n=3, 42.86%). Of the remaining people, two thought it was a mastectomy (n=2, 28.57%), and two thought it was an open heart (n=2, 28.57%).

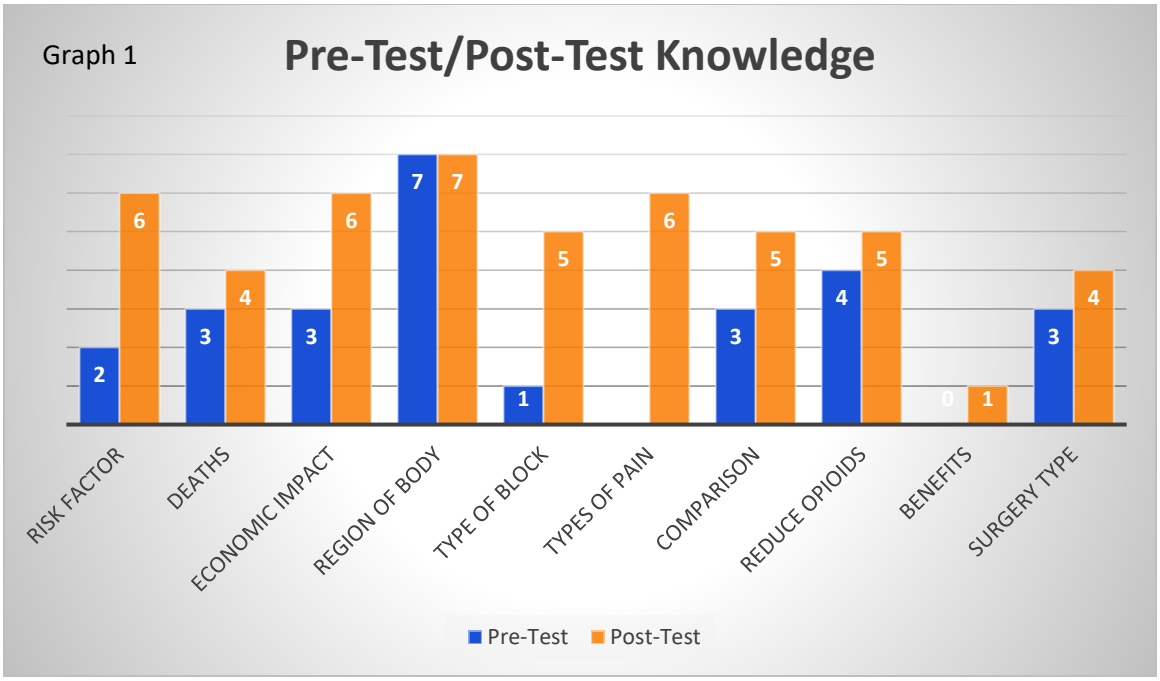
Pre-Test Confidence

When it comes to using alternative techniques to reduce opioid consumption, the pre-test findings revealed that none of the CRNAs were very likely to use alternative methods (0.00%). Among the seven participants, one was somewhat likely (14.28%), three were somewhat unlikely (42.86%), and three were very unlikely (42.86%) to use opioid-sparing techniques. When asked directly about the likelihood of recommending the ESPB to help control postoperative pain, again, none were very likely to recommend it (0.00%). Three responded they would be very unlikely to recommend (42.86%), while four were somewhat unlikely to recommend the ESPB for pain control (57.14%).

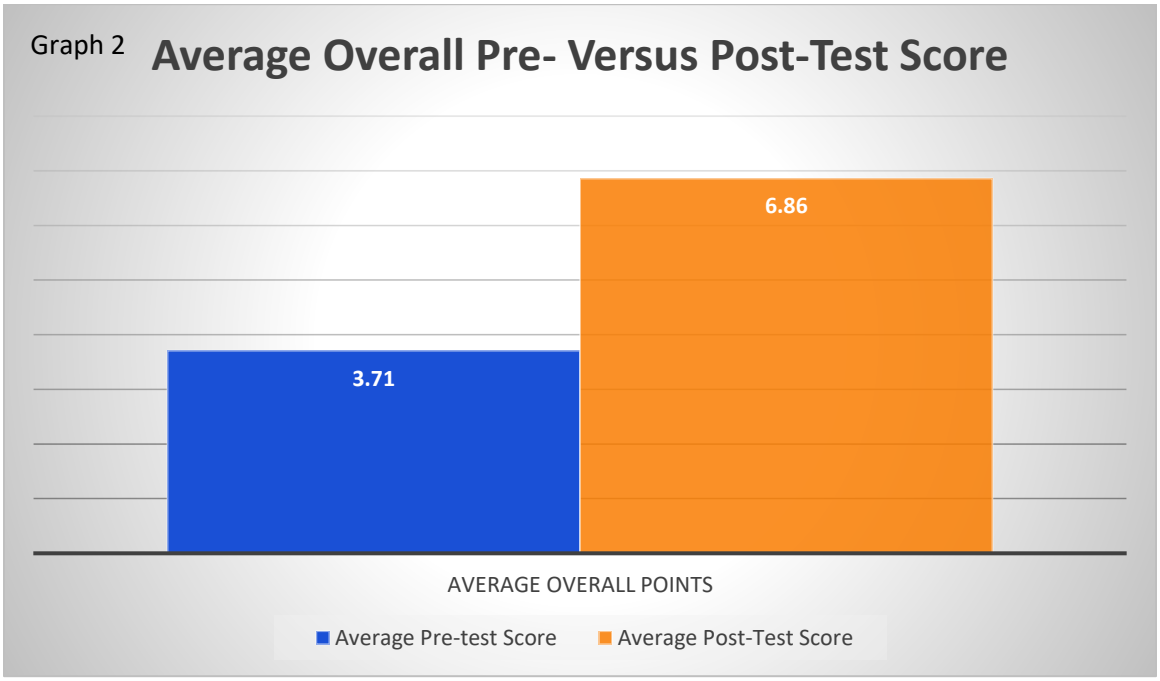
Post-Test Findings

The post-test shows that all questions show an increase in learning, with the exception of the one question all participants got right in the pre-test. One additional CRNA was able to identify the number of drug-related deaths (14.28%). Six of the seven were able to identify the economic impact of opioid addiction (85.71%). The highest increase in score was in determining the type of pain control offered by the ESPB (n=6, 85.71%). One additional participant recognized that opioid consumption could be reduced by as much as 65% (14.28%), while two others identified the efficacy of the ESPB compared to the thoracic epidural (28.57%) and the correct procedure not to use the ESPB on (28.57%). Table 5 and Graph 1 further depict the details of the pre-test versus post-test answers.

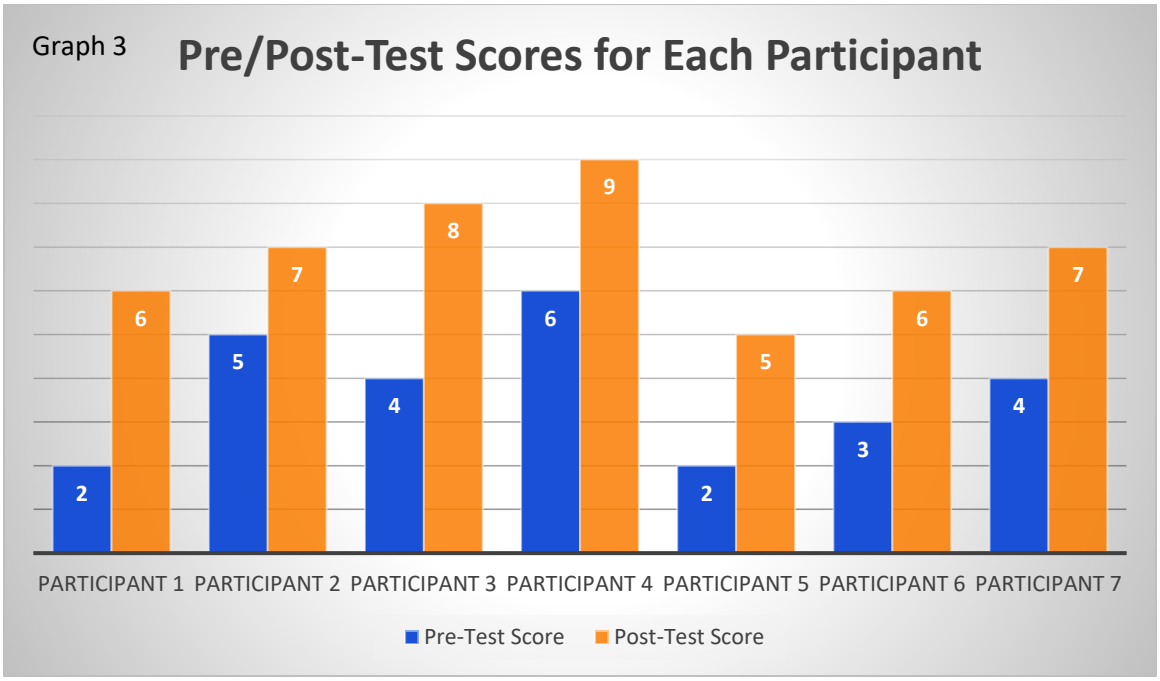
Table 5: Difference in Pre- and Post-Test Findings	**Pre-Test**	**Post-Test**	**Difference**
Which of the following is NOT a risk factor for opioid addiction: high socioeconomic status	28.57%	85.71%	57.14%
The number of drug-related overdose deaths each year is approximately: 70,000	42.86%	57.14%	14.28%
The economic impact of opioid addiction surpasses _____ per year: $79 billion	42.86%	85.71%	42.85%
The erector spinae plane (ESP) block is placed in what region of the body: thoracic spine	100%	100%	0%
The ESP block works by (select all that apply): Sensory block, Motor block, Volume block	14.28%	71.29%	57.01%
The ESP block controls _____ pain (select all that apply): somatic, visceral, neurogenic	0.00%	85.71%	85.71%
The ESP block reduces postoperative pain _____ the thoracic epidural: the same as	42.86%	71.29%	28.43%
The ESP block can reduce opioid consumption by as much as: 65%	57.14%	71.29%	14.15%
Benefits of the ESP block include (select all that apply): Easy to perform, Less side effects, Reduced ICU length of stay, Improved spirometry	0.00%	14.28%	14.28%
Which surgery is NOT a good candidate for an ESP block: Whipple	42.86%	71.29%	28.43%



Graph 2 displays average pre-test scores to average post-test scores.



Graph 3 shows the individual scores for each participant.

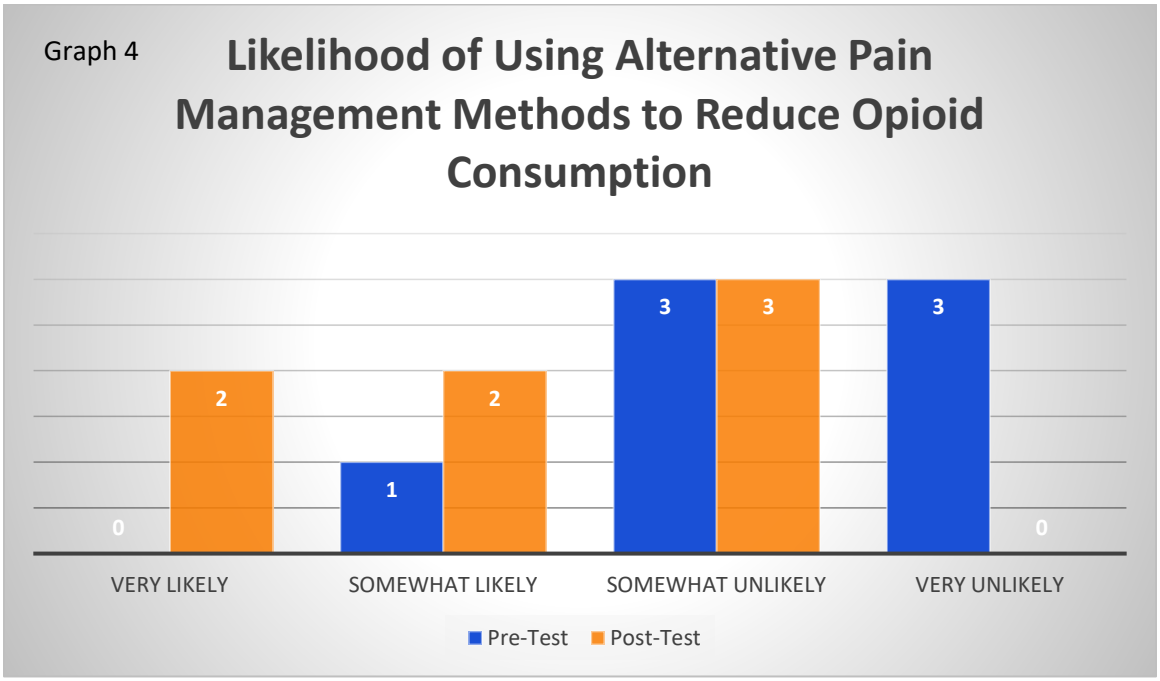


Post-Test Confidence

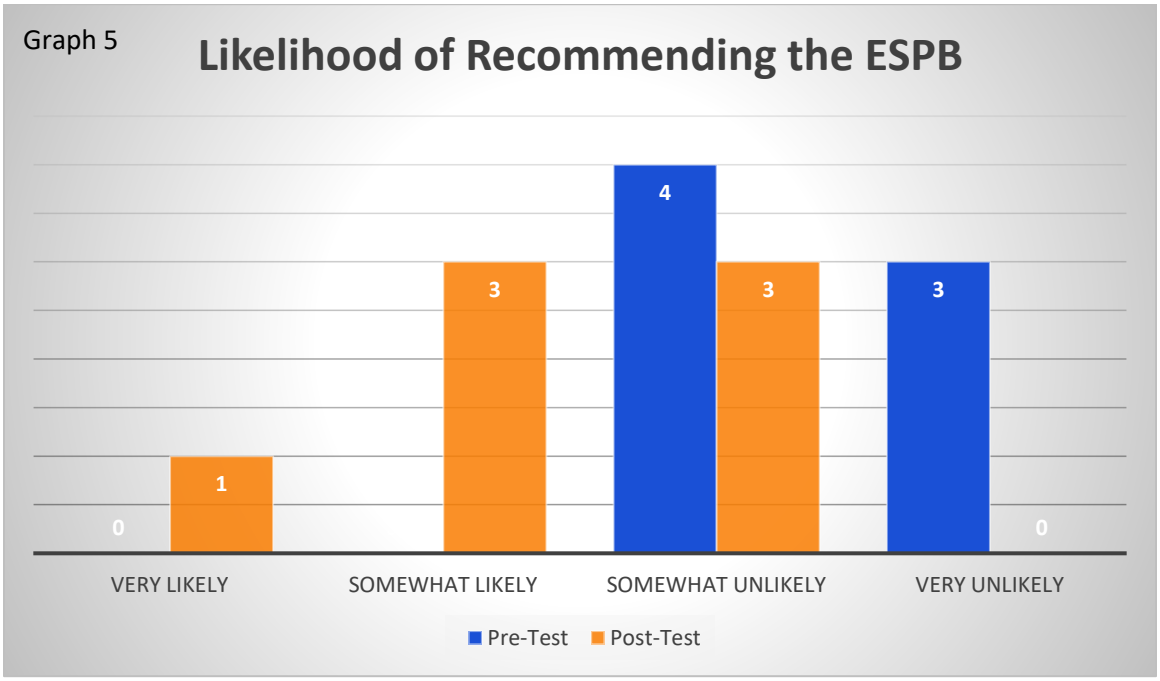
After watching the educational module, the participants had greater confidence in utilizing alternative methods to reduce opioid usage. Three are still somewhat unlikely to use new techniques (42.86%). The remaining four CRNAs were split evenly between somewhat likely (28.57%) and very likely (28.57%). There was a similar increase in confidence in recommending the ESPB for postoperative pain control in thoracic surgeries. Three of the CRNAs were somewhat unlikely to recommend (42.28%). Three were somewhat likely to recommend (42.28%), and one was very likely to recommend the ESPB (14.28%). Once again, this proves that the education worked, and the participants are willing to have a practice change to incorporate new techniques and aid in reducing opioid consumption. The comparison of the pre-test and post-test confidence levels is depicted in Table 6 and the graphs below.

Table 6: Difference in Pre- and Post-Test Confidence	**Pre-test**	**Post-test**	**Difference**
How likely are you to use alternative methods of pain management to reduce opioid consumption?	14.28%	57.14%	42.28%
How likely are you to recommend the erector spinae plane block for postoperative pain management?	0.00%	57.14%	57.14%

Graph 4



Graph 5



DISCUSSION OF QUALITY IMPROVEMENT

The literature review has proved that the ESPB is as effective or superior to other pain management techniques, including other thoracic regional blocks. Since the ESPB is a relatively new block, utilization in practice is lacking, and education of CRNAs is necessary, as evidenced

by the pre-test scores. The pre-test results also showed education regarding the opioid epidemic is severely lacking. After implementing the education module, the CRNAs showed increased knowledge of both the opioid epidemic and the ESPB and increased likelihood of using the ESPB in future practice. Analysis proved the learning that took place from the pre-test to the post-test was statistically significant.

Limitations of the Study

The most significant limitation to this study is the minimal sample size (n=7). To truly understand the attitudes of CRNAs toward opioid-sparing and regional techniques, there needs to be a much larger scale sample obtained. Additional participants would also give insight into the effectiveness of online learning and the applicability to teaching anesthesia providers in this manner. Other limitations include restricting the study to one hospital system, which can skew the results if the system is already regional anesthesia friendly or, similarly, if they are not used to practicing regional techniques. The same can be said for opioid-sparing methods. If the practice is already in place on a day-to-day basis, the CRNA will be more comfortable utilizing those techniques, and, again, this can skew the results. Another drawback to the study is the fact that the invitations were sent by email. The email list provided had multiple returned email addresses and was not updated with the most recently hired CRNAs. Attitudes among providers may be different depending on exposure to various facilities as well as time in practice. Finally, self-selection bias was present. Participants were able to choose if they wanted to participate or not after seeing the title of the project and the time commitment, potentially recruiting more people with strong feelings, either good or bad, about regional anesthesia or opioid-sparing techniques.

Future Implications to Advanced Practice Nursing

As evidenced by the results of the educational intervention, learning occurred. However, more education is needed on a larger scale to truly change and advance the practice of anesthesia as it relates to postoperative pain management in the setting of thoracic cavity surgeries. While online methods seem to work in the ever-growing technology generation, not everyone will open

and view them. If education is provided as a virtual option, a different in-person option also needs to be available. CRNAs and anesthesia providers have foundational knowledge from schooling and practice, but as new techniques emerge, that knowledge needs supplementing and enhancing.

As the opioid epidemic grows, prudent providers need to seek alternative ways to help with postoperative pain control. For many years, providers utilized opioids as primary pain control. As regional anesthesia came into popularity, some have added this into practice, but the ESPB is new even in the field of regional anesthesia. Research has shown that the ESPB is better than familiar blocks and equivalently effective as the gold standard thoracic epidural. Employing fewer side effects and a more straightforward technique makes the ESPB a superior choice than other regional methods in the thoracic spine. This educational module proved that there is a knowledge gap and further education is needed. The current environment warrants a practice change, and education is required on a large scale on both the implications of opioid use and abuse and the use of the ESPB in thoracic surgeries. The new standard of care for thoracic surgery patients should include regional anesthesia, namely the ESPB.

CONCLUSION

Postoperative pain is something that requires immediate attention and intervention by the healthcare practitioner. With the opioid problem churning in America, there is a need to reduce postoperative opioid consumption. Regional anesthesia, specifically the ESPB, is an innovative way to control visceral and somatic pain in the postoperative thoracic patient. Nine studies were chosen to evaluate the effectiveness of the ESPB. Collectively, all nine studies found that the ESPB was as effective or more effective at controlling postoperative pain than the currently available regional blocks with and added benefits of fewer side effects and adverse outcomes. Additionally, seven studies directly measured and compared opioid consumption, and six found that the ESPB reduced total opioid consumption, with the seventh finding equivalent use in the compared groups. Based on this evidence, current practice changes should occur by utilizing the ESPB in thoracic surgery to control pain and reduce opioid consumption.

Once the appraisal of the included articles concluded, an educational module was created and implemented. Following participation from CRNAs, Qualtrics and SPSS were used to run the analysis. Based upon the pre-test, which assessed base understanding about opioids and the ESPB, there is a great need for further teaching to educate anesthesia providers as the scores proved knowledge is lacking. The post-test findings demonstrated a statistically significant increase in knowledge of opioid reduction and use of the ESPB based on the educational module implementation. Still, further research is needed to determine the best use of the ESPB in thoracic surgery to reduce opioid consumption maximally.

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Appendix A: The Matrix

Author(s) and year	Design/Method	Sample/ Setting	Major Variables	Measurement and Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Macaire et al. (2019)	Controlled before and after trials of 67 patients. 20 in the control group (historical data); 47 in the experimental group (continuous bilateral ESPB with 0.25 mL/kg/side of ropivacaine 0.5%; 8 hours after the loading dose, a pump gives intermittent automatic boluses of ropivacaine every 6 hours)	67 total patients (ASA II and III) n=20 control group patients (historical data); n=47 experimental group patients; adult population age range between 21-77 years old; undergoing cardiac surgery with sternotomy in a hospital setting; BMI <40	Independent variable: administration of ESPB Dependent variables: morphine consumption at 48 hours; intraoperative sufentanil use; time to chest tube removal; first mobilization; VAS pain values 2 hours after chest tube removal; pain one month after surgery; postoperative adverse events; time to extubation; pain during the first mobilization	Pain was measured using the VAS pain scale after extubation, chest tube removal, first mobilization, 48 hours, and 1-month post-op. The time to extubation and chest tube removal was recorded. Any adverse events were recorded. Morphine use during the first 48 hours was measured.	ESPB group showed significant decreases in intraoperative sufentanil use and morphine consumption in the first 48 hours. Also, the time to drain removal and first mobilization after extubation decreased. Pain VAS values at rest 2 hours after chest tube removal, and pain VAS values at rest one month after surgery were less than the control group. There was no difference between the control group and the ESPB group for time to extubation, pain at rest, and pain during the first mobilization.	Continuous ESPB did not significantly decrease time to extubation or pain during first mobility but showed a significant reduction in the number of opioids needed to control pain and earlier removal of chest tubes.	ESPB leads to decreased opioid consumption, time to drain removal, and pain 1-month after surgery. It also led to rapid mobilization.	Strength: consistent anesthetic protocols Limitations: small number of participants; nonrandomized; level of spread not assessed; Feasibility of use: adequate; all supplies and medications are already available in the hospital setting. The only additional need is teaching providers.

Krishna et al. (2019)	Prospective, randomized, single-blinded, controlled trial; 106 patients; 53 in the control group received paracetamol (1 gm every 6 hours) and tramadol (50 mg every 8 hours) intravenously; 53 patients in the experimental group (ESPB) received 3 mg/kg of 0.375% ropivacaine.	106 total patients n=53 control group patients; n=53 experimental group patients; Undergoing cardiac surgery with bypass in a tertiary hospital setting; adult population age range 20-70 years old; either sex; Cardiac Anesthesia Risk Evaluation Score 1 and 2	Independent variable: single-shot ESPB vs. paracetamol and tramadol IV Dependent variable: pain at rest using NRS, time to extubation, total rescue analgesia, total opioid usage, time to first ambulation, length of ICU stay	Pain was measured using NRS scores every 2 hours up to 12 hours post-extubation. The ESPB group showed significantly lower pain scores and reported pain <4 for 8 hours. The length of ICU stay, time to first ambulation, and time to extubation were recorded, significantly decreasing from the control group. Use of rescue analgesia and total opioid use was measured, and the ESPB group used substantially less	ESPB reduced the total pain score during the first 12 hours after extubation. Compared to the IV analgesia group, the ESPB group had quicker time to extubation (minutes) 63.09 ± 1.30 vs 102.62 ± 2.52, less total rescue analgesia (mcg) 82.92 ± 4.29 vs 214.25 ± 5.09, less total opioid usage (mcg) 231.42 ± 6.95 vs 935.66 ± 21.99, earlier time to first ambulation (hours) 36.17 ± 0.18 vs 62.70 ± 0.40, and shorter length of ICU stay (hours) 42.17 ± 0.18 vs 69.34 ± 0.36.	The ESPB showed significantly better pain scores, time to extubation, time to ambulation, length of ICU stay, rescue analgesia, and total opioid consumption than the IV analgesia group.	ESPB provides significant analgesia during cardiac surgery, which helps the recovery process proceed more quickly.	Strength: randomized; blinded; Limitations: single-shot injection; unable to assess pain before extubation; no dynamic pain score Feasibility of use: adequate; all supplies and medications are already available in the hospital setting. The only additional need is teaching providers.

Cai et al. (2020)	Systematic review with meta-analysis; 18 RCTs included; 1041 patients total	1041 patients; all RCTs including ESPB vs. placebo; 10 thoracic RCTs; 4 spinal RCTs; 4 abdominal RCTs	Independent variable: ESPB vs. placebo Dependent variable: VAS scores during the first 24 hours; total morphine consumption at 24 hours; the rate of PONV	STATA was used for meta-analysis. For continuous data, the weighted mean difference with 95% confidence intervals was calculated. For dichotomous data, the odds ratio with a 95% confidence interval was used. Heterogeneity was assessed using Cochran's Q test	The ESPB had significantly lower pain scores using VAS at 24 hours than the placebo among all surgeries (WMD: -1.18; 95% CI: -1.44 to −0.91; I 2 = 92.0%). The same results were noted in just the thoracic cases (WMD: -1.31; 95% CI: -1.83 to −0.79; I 2 = 92.8%). Morphine consumption in the first 24 hours was significantly decreased in the ESPB group vs. the control group (WMD: -17.20; 95% CI: -30.14 to −4.26; I 2 = 99.1%). ESPB reduced the incidence of PONV (OR: 0.32; 95% CI: 0.17 to 0.61; I 2 = 46.5%).	ESPB significantly lowered pain scores over the first 24 hours postoperatively and significantly reduced the amount of morphine used in the first 24 hours. The ESPB group showed reduced rates of PONV compared to the control group.	ESPB provides significant analgesia that can be used in different types of surgery to reduce postoperative pain, morphine use, and PONV.	Strength: multiple studies; high-quality data Limitations: multilingual; small study sizes; substantial heterogeneity; publication bias

Huang et al. (2020)	Systematic review and meta-analysis of RCTs; 14 RCTs included; 1018 patients total	1018 patients; 7 RCTs for thoracic surgery; 7 RCTs for breast surgery	Independent variable: ESPB vs. TPVB or no block Dependent variable: opioid consumption in the first 24 hours post-op; time to first rescue analgesia; pain during first 24 hours using VAS; PACU length of stay; hospital length of stay	Review manager and STRATA were used for meta-analysis. For continuous data, mean differences with 95% confidence intervals were calculated. The odds ratio with a 95% confidence interval was analyzed using the Mantel-Haensel method for dichotomous data.	There was less opioid consumption at 24 in the ESPB group vs. the no block group (−14.81 mg; 95%CI −21.18 to −8.44; $p < 0.001$; $I 2 = 96\%$), but similar results compared to the TPVB group. Pain scores were lower in the ESPB group vs. no block and comparable to the TPVB group.	Compared with no block, the ESPB showed significantly less opioid consumption at 24 hours postoperativ ely. When compared to the TPVB, the ESPB showed comparable results. Pain scores were also significantly less in the ESPB group than no block and similar to the TPVB.	ESPB has shown to have adequate pain control in thoracic surgeries comparable to TPVB with fewer side effects.	Strength: multiple studies Limitations: lack of quantitative data; potential selection bias

Nagaraja et al. (2018)	A pilot study with post hoc VAS scores; 50 patients: 25 in the control group (TEA) bolus dose of 0.25% plain bupivacaine 15 ml, followed by a continuous infusion of 0.125% plain bupivacaine at the rate of 0.1 ml/kg/h till 48 h post-extubation; 25 on the experimental group (ESPB) bolus dose of 0.25% plain bupivacaine 15 ml in each catheter, followed by a continuous infusion of 0.125% plain bupivacaine at the rate of 0.1 ml/kg/h till 48 h post-extubation	50 total patients n=25 control group patients; n=25 experimental group patients; Undergoing cardiac surgery with median sternotomy in a hospital setting; adult population age range 26-65 years old; either sex; EF >40%	Independent variable: continuous ESPB bilateral infusion vs. continuous TEA infusion Dependent variable: Pain measured by VAS at rest and coughing at extubation, 3, 6, 12, 24, 36, 48 hours; incentive spirometry at extubation 3, 6, 12, 24, 36, 48 hours; intraoperative fentanyl consumption; ventilator duration; length of ICU stay	Pain was measured using VAS both at rest and during coughing at extubation, 3, 6, 12, 24, 36, and 48 hours post-extubation. Incentive spirometry was measured at the same intervals. Breakthrough pain needing analgesia was documented. ICU length of stay, ventilator duration, and intra-op fentanyl use were recorded.	Pain using VAS was comparable for both groups (P> 0.05). VAS scores for the TEA group was 1.56±1.08, 1.52±0.65, 1.64±0.64, 1.92±0.90, 2.08±0.64, 2.24±1.05, 2±1.32 at 0, 3, 6, 12, 24, 36, and 48 hours post-extubation respectively. VAS scores for ESPB group were 1.04±0.98, 1.4±1.00, 1.64±1.35, 1.68±1.35, 1.44±0.87, 1.08±0.86, 0.8±0.64. Incentive spirometry was comparable in both groups (P> 0.05). Peak inspiratory flows, at the same time intervals, for the TEA group were 750±129.90, 816±106.77, 852±94.07,	All measured aspects of pain, incentive spirometry, ICU stay, breakthrough pain, intra-op fentanyl consumption, and ventilator duration were comparable in the TEA and ESPB groups.	TEA and ESPB are comparable in pain VAS scores, fentanyl consumption, incentive spirometry, and ventilator duration. These results make the ESPB a good option in place of TEA.	Strength: closed envelope blind patient selection; consistent induction techniques; consistent administration through catheters Limitations: small study; Feasibility of use: adequate; all supplies and medications are already available in the hospital setting. The only additional need is teaching providers.

					858±110.57, 870±136.93, 888±96.05/ Peak inspiratory flows for the ESPB group were 678±150.75, 744±175.78, 780±183.71, 882±90, 906±110.23, 906±110.23. There were nine episodes of breakthrough pain in the TEA group and 7 in the ESPB group. Neither group needed second rescue analgesia. Intra-op fentanyl use was comparable (P>0.05) with TEA using 330±82.92 mcg and ESPB 364.4±105.39 mcg.			

Chaudhary et al. (2020)	A prospective cohort study of 77 total patients; 46 patients in the ESPB group (up to 40 ml 0.25% bupivacaine) and 31 patients in the ICB group (up to 30 ml of 0.25% bupivacaine)	77 total patients in a hospital setting were undergoing VATS. n=46 experimental group patients; n=31 control group patients. Either sex; English speaking; elective surgery; no active infection; BMI <35; age range 49 to 83	Independent variable: ESPB vs. ICB Dependent variable: visual analog scale pain score, spirometry (FEC and FEV_1), PACU length of stay.	Pain was measured using the VAS in PACU and on the floor for the first 24 hours. Analgesic requirements were recorded for the first 24 hours. Chronic pain at the surgical or chest tube site was recorded at the 2-month follow-up. Spirometry was measured 2 hours and 24 hours post-op in the PACU	ESPB group had significantly less pain than the ICB group (3.2 vs 6.4), shorter PACU stays (127.3 vs 189.5), preservation of lung volumes (FVC: 40.5% vs 51.4%; FEV 1 : 40.9% vs 53.8%).	Opioid consumption was not significantly decreased with the ESPB, but post-op pain and chronic pain were better controlled with the ESPB. Lung volumes were also better in the ESPB group.	ESPB is an excellent option to include in a multimodal anesthetic approach to VATS. With lower pain and better lung volumes, there is an enhanced recovery for patients.	Strength: blinded data collectors (post-op RNs) Limitations: not RCT, a greater volume of LA due to greater area of ESP muscle, small study group Risk of harm: potential harm from regional techniques including epidural injection, nerve injury, and intravenous injection. Feasibility of use: adequate; all supplies and medications are already available in the hospital setting. The only additional need is teaching providers.

Gaballah et al. (2019)	pilot, phase II, randomized, single-blinded, controlled trial; 60 patients; 25 in control group (SPB) received 20 mL of 0.25% bupivacaine; 25 patients in experimental group (ESPB) received 20 mL of 0.25% bupivacaine	60 total patients n=30 control group patients; n=30 experimental group patients; Undergoing VATS in a hospital setting; adult population age range 25-57; either sex; ASA I and II	Independent variable: single-shot ESPB vs. single-shot SPB Dependent variable: VAS scores during first 24 hours; time to the first analgesic; total analgesic consumption; MAP; heart rate; respiratory rate	Pain was measured hourly throughout the first 24 hours using the VAS. Heart rate, respiratory rate, and MAP were also measured and recorded every hour during the first 24 hours. Time to the first analgesic and total analgesic consumption were recorded.	VAS pain scores remained lower in the ESPB group than the SPB throughout the first 24 hours, but there was a statistical significance from the fourth hour (1.87 ± 0.35 v 2.0 ± 0.01, respectively; p = 0.04) to the sixth hour postoperatively (3.33 ± 0.48 v 3.73 ± 0.45, respectively; p =0.002) and the 14th hour postoperatively. Time to the first analgesic was significantly longer in the ESPB than SPB 379.07 ± 7.78 v 296.04 ± 6.62 minutes, respectively; p < 0.001. Fewer patients needed more than one dose of postoperative opioids in the	The ESPB had lower VAS scores during the first 24 hours postoperatively and longer time to the first analgesic. There was less need for opioid analgesia, but the need for NSAID analgesia is comparable. Heart rate, respiratory rate, and MAP were all significantly higher in the SPB group.	The ESPB had significantly lower pain scores and longer time to the first analgesic needs, proving it would be a good option for VATS and thoracotomies .	Strength: computer randomization; use of LA to help spread; injections were done after patients were asleep Limitations: small study; single-shot injection; no control group without a block Feasibility of use: adequate; all supplies and medications are already available in the hospital setting. The only additional need is teaching providers.

					ESPB group than the SPB, 36.7% v 70%, respectively; p = 0.01. However, NSAID analgesia was comparable, 46.7% in ESB vs. 70% in SPB; p = 0.248. MAP was higher in the SPB group, 95.80 ± 3.24 v 90.90 ± 5.55, respectively; p < 0.001. Respiratory rate was also higher in the SPB group, 13.07 ± 0.87 v 12.27 ± 0.45, respectively; p < 0.001. HR was also higher in the SPB group.			

Chen et al. (2020)	RCT, double-blinded; 75 patients; 25 patients given PVB with 20 ml of 0.375% ropivacaine (multiple injections); 25 patients given ICNB with 20 ml of 0.375% ropivacaine (single injection); 25 patients given ESPB with 20 ml of 0.375% ropivacaine (single injection)	75 total patients n=25 PVB group patients; n=25 ICNB group patients; n=25 ESPB patients; Undergoing VATS in a hospital setting; adult population age range 18-75 years old; either sex; ASA I and II	Independent variable: single-shot ESPB vs. single-shot ICNB vs. multiple injection PVB Dependent variable: total morphine consumption at 24 hours; pain at rest using VAS at 0, 2, 4, 8, 24, and 48 hours postoperatively; pain with coughing using VAS at 0, 2, 4, 8, 24, 48 hours postoperatively	Pain was measured using VAS both at rest and during coughing at 0, 2, 4, 8, 24, and 48 hours postoperatively. Total morphine consumption and rescue analgesia were recorded.	There was a significant difference in morphine consumption at 24 h postoperatively among the three groups (PVB, 10.5 [9–15] mg; ICNB, 18 [13.5–22.1] mg; ESPB, 22 [15–25.1] mg; p = 0.000). This difference was statistically significant for PVB group vs. ESPB group (median difference, −7.5; 95% confidence interval [CI], −12 to −4.5; p = 0.000) and PVB group vs. ICNB group (median difference, −6; 95% CI, −9 to −3; p = 0.001), but not for ICNB vs. ESPB (median difference, −3; 95% CI, −6 to 1.5; p = 0.192). There was no statistical significance in	PVB showed lower pain scores using VAS as well as lower morphine consumption and less rescue analgesia. ESPB was comparable to ICNB in terms of pain scores and morphine consumption.	Multiple injection PVB block showed superior analgesia compared to the ESPB and ICNB and lower morphine consumption. The ESPB and ICNB were comparable in terms of analgesia and morphine consumption. The VAS scores for all blocks were less than 4 out of 10, showing all blocks are options for postoperative thoracic pain control. The ESPB is easier to use and has fewer risks making it a viable option for	Strength: double-blinded, RCT Limitations: small study; single-shot injection; given after induction and unable to assess block success; healthy patients only Feasibility of use: adequate; all supplies and medications are already available in the hospital setting. The only additional need is teaching providers.

					VAS scores between ICNB and ESPB. There was a statistical significance in VAS scores at 0, 2, 4, and 8 hours postoperatively between the PVB and ESPB. More rescue analgesia was needed in the ESPB group (PVB vs. ICNB vs. ESPB; 13% vs. 29% vs. 46%; $p < 0.05$).		pain control after VATS. Further studies are needed to determine optimal LA concentration and dose for ESPB	

Shim et al. (2020)	RCT; 46 patients; 22 in control group received physiologic saline; 24 patients in experimental group (ESPB) received 25 mL of 0.5% ropivacaine.	46 total patients; n=22 control group patients; n=24 experimental group patients; Undergoing VATS in a hospital setting; adult population age range 19-85; either sex; ASA I-III; BMI <30	Independent variable: single-shot ESPB vs. saline Dependent variable: NRS scores during first 12 hours; SAS score for postoperative agitation; total analgesic consumption; the incidence of PONV; PACU length of stay	Pain was measured using NRS scores upon arrival to PACU, at 1, 6, and 12 hours postoperatively. Total opioid consumption in PACU and at 24 hours was recorded. Incidence of PONV and postoperative agitation were recorded.	Pain was measured using NRS upon arrival to PACU at 1, 6, and 12 hours postoperatively. The ESPB showed significantly lower scores until 6 hours post-op (P=0.001 at 1 hour and P=0.005 at 6 hours). At 1 hour, scores for the ESPB group vs. saline were 5.96±1.68 and 7.59±1.18, respectively; P<0.001. Rescue opioid usage was less in the ESPB group, 25 mg vs. 50 mg; P=0.006. PACU stay was significantly less in the ESPB group 25 minutes $\pm$ 10 minutes vs. 30 minutes $\pm$ 15; P<0.001. Riker SAS agitation scores were also lower in the ESPB group 4 $\pm$ 1 vs. 5 $\pm$ 1.25.	Pain scores using NRS scores were significantly lower in the ESPB group until 6 hours post-op. PACU stay was considerably less in the ESPB group. Agitation decreased in the ESPB group.	ESPB offers adequate analgesia in the postoperative period as well as decreases the incidence of post-op agitation. Opioid consumption was also reduced in the ESPB group.	Strength: RCT; control group with saline Limitations: small study; single-shot injection; no chronic pain follow-up; length of stay opioid consumption lost to follow-up issues

Appendix B: Broward IRB Approval

BROWARD HEALTH

Institutional Review Board - Human Research Protections

Broward Health Medical Center
Broward Health Coral Springs
Broward Health Imperial Point
Broward Health North

Salah Foundation Children's Hospital
Broward Health Weston
Community Health Services
Broward Health Physician Group

DATE: 05/24/2021

TO: Ashley Kelley, BSN, RN, CCRN

FROM: Broward Health Institutional Review Board

RECORD NUMBER: 2021-066

STUDY TITLE: Use of Erector Spinae Plane Block to Control Postoperative Pain and Reduce Opioid Consumption in Adult Patients Undergoing Thoracic surgery: An Educational Module

RE: NOT HUMAN SUBJECT RESEARCH DETERMINATION

Dear Ashley Kelley, BSN, RN, CCRN:

This is to advise you that your project, "Use of Erector Spinae Plane Block to Control Postoperative Pain and Reduce Opioid Consumption in Adult Patients Undergoing Thoracic surgery: An Educational Module " was reviewed on behalf of the Broward Health Institutional Review Board and was declared "not research involving human subjects" based on the definitions provided in the U.S. Department of Health and Human Services Code of Federal Regulations found at 45 CFR 46.102.

Please note, this determination does not absolve the Principal Investigator from complying with other federal, state, or local laws or institutional policies and procedures that may be applicable in the conduct of this project.
This determination applies to your project in the form and content as submitted to the IRB for review. Any variations or modifications to this project involving the participation of human subjects must be approved by the IRB prior to implementing such changes. Please maintain a copy of this determination for your records.

Thank you for submitting your project to the IRB for consideration.

The Broward Health Institutional Review Board – FWA00001248 operates in accordance with the Office of Human Research Protections and U.S. Food and Drug Administration (FDA) regulations. The Broward Health Institutional Review Board complies with the ICH guidelines on Good Clinical Practice (GCP) where they are compatible with the FDA and HHS regulations.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Broward Health IRB's records.

Appendix C: FIU IRB Approval

FLORIDA INTERNATIONAL UNIVERSITY

Office of Research Integrity
Research Compliance, MARC 414

MEMORANDUM

To:	Dr. Vicente Gonzalez
CC:	Ashley Kelley
From:	Maria Melendez-Vargas, MIBA, IRB Coordinator
Date:	April 9, 2021
Protocol Title:	"Use of Erector Spinae Plane Block to Control Postoperative Pain and Reduce Opioid Consumption in Adult Patients Undergoing Thoracic surgery: An Educational Project"

The Florida International University Office of Research Integrity has reviewed your research study for the use of human subjects and deemed it Exempt via the **Exempt Review** process.

IRB Protocol Exemption #: IRB-21-0158 **IRB Exemption Date:** 04/09/21
TOPAZ Reference #: 110241

As a requirement of IRB Exemption you are required to:

1) Submit an IRB Exempt Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved prior to implementation.
2) Promptly submit an IRB Exempt Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.
3) Submit an IRB Exempt Project Completion Report Form when the study is finished or discontinued.

Special Conditions: N/A

For further information, you may visit the IRB website at http://research.fiu.edu/irb.

MMV/em

Appendix D: Letter of Support

March 1, 2021

Vicente Gonzalez, DNP, CRNA, APRN
Clinical Education Coordinator
Department of Nurse Anesthesiology Practice
Florida International University

Dr. Gonzalez

Thank you for inviting Broward Health to participate in Doctor of Nursing Practice (DNP) project conducted by Ashley Kelley entitled "Use of Erector Spinae Plane Block to Control Postoperative Pain and Reduce Opioid Consumption in Adult Patients Undergoing Thoracic surgery: An Educational Module" in the Nicole Wertheim College of Nursing and Health Sciences, Department of Nurse Anesthetist Practice at Florida International University. I have warranted him permission to conduct the project using our providers.

This project intends to evaluate if a structured education targeting providers will increase knowledge of the anesthetic management of the patients undergoing thoracic surgery. Prior to the implementation of this Educational project, the Florida International University Institutional Review Board will evaluate and approve the procedures to conduct this project.

We understand the educational intervention will be via ZOOM, with pretest and posttest questionnaire, any data collected by Ashley Kelley is confidential and will be stored in a locked filing cabinet at our office. We expect that Ashley Kelley will not interfere with normal hospital performance, behaving in a professional manner and following standards of care.

We support the participation of our provides and staff in this project and look forward to working with you

March 1, 2021

Edward Punzalan, DNP, CRNA, APRN
Date
Administrative Director of Nurse Anesthesia
Healthcare Performance ANESCO
Broward Health

Appendix E: Recruitment Letter

FIU | FLORIDA INTERNATIONAL UNIVERSITY

Nicole Wertheim College of Nursing and Health Sciences
Department of Nurse Anesthetist Practice

Use of Erector Spinae Plane Block to Control Postoperative Pain and Reduce Opioid Consumption in Adult Patients Undergoing Thoracic surgery: An Educational Module

Dear Broward Health Anesco Anesthesia Provider:

My name is Ashley Kelley and I am a student from the Anesthesiology Nursing Program Department of Nurse Anesthetist Practice at Florida International University. I am writing to invite you to participate in my quality improvement project. The goal of this project is to improve health care provider knowledge on the use of erector spinae plane blocks for postoperative pain management and reduced opioid consumption in thoracic cavity surgery. You are eligible to take part in this project because you are a member of the Anesthesia Department for Anesco at Broward General.

If you decide to participate in this project, you will be asked to complete and sign a consent form for participation. Next, you will complete a pre-test questionnaire, which is expected to take approximately 5 minutes. You will then be asked to view an approximately 15 minute long educational presentation online. After watching the video, you will be asked to complete the post-test questionnaire, which is expected to take approximately 5 minutes. No compensation will be provided.

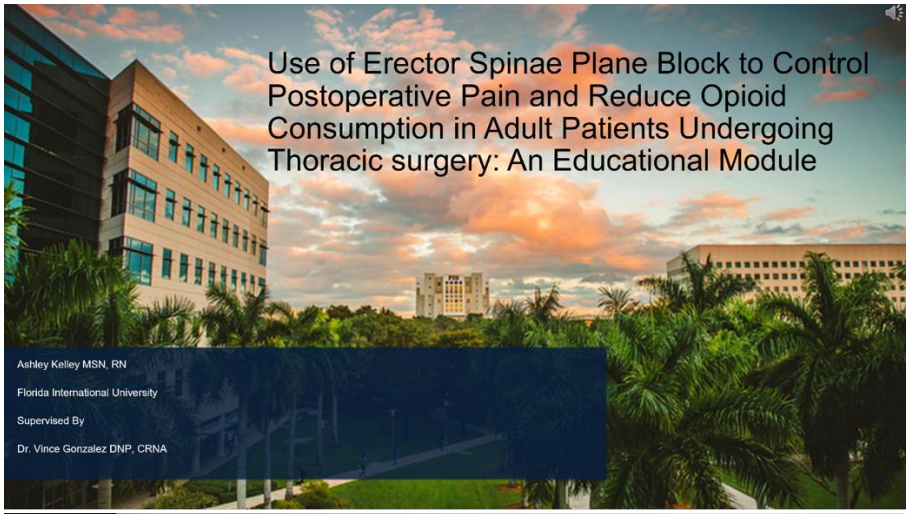
Remember, this is completely voluntary. You can choose to be in the study or not. If you'd like to participate or have any questions about the study, please email or contact me at akell061@fiu.edu or 954-243-6410.

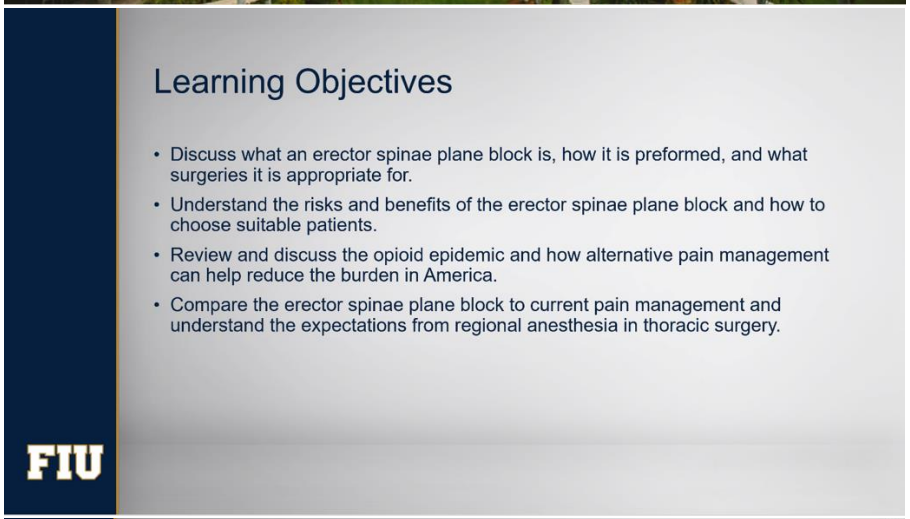
Thank you very much.

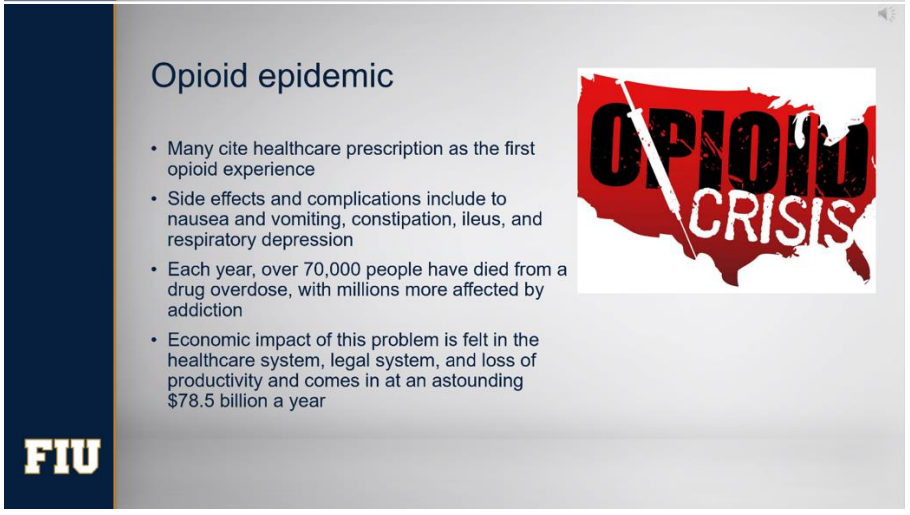
Sincerely,

Ashley Kelley, SRNA, BSN, CCRN

Appendix F: Education Module





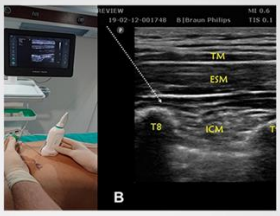


Risk factors for opioid addiction

- Unemployment
- Poverty
- Young age
- Heavy smoking
- History of severe depression or anxiety
- Risk-taking or thrill-seeking behavior

FIU

Erector spinae plane block



- First described in 2016 as an adjunct for neurogenic pain in thoracic patients
- Multi-dermal sensory block that acts at both the dorsal and ventral rami of the thoracic spinal nerves and the sympathetic fibers that allow for visceral and somatic pain control
- Spreads cephalad and caudad for multiple levels
- Easier to perform without side effects of other thoracic blocks such as hematoma, lung injury or nerve injury
- Can be a single shot injection or a catheter left in place for continuous infusion

FIU

benefits

- Lower pain scores compared to paravertebral and intercostal nerve block
- Comparable results to a thoracic epidural
- Reduced opioid consumption post-op by as much as 65%
- Early ambulation
- Better spirometry
- Reduced length of stay in PACU, ICU and overall hospital time

FIU

Contraindications

- Local anesthetic allergy
- Severe spinal deformity
- Refusal

FIU

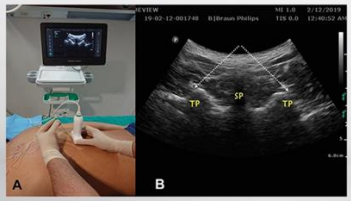
Acceptable surgeries

- VATS
- Thoracotomy
- Sternotomy (open heart)
- Mediastinoscopy
- Breast surgeries

FIU

Practice change

- Educate surgeons and anesthesia providers on the benefits of ESPB
- Offer ESPB to all thoracic cavity surgery patients that meet qualifications
- More judicious use and prescriptions of opioids to for postoperative pain
- Include multimodal pain management for all patients



FIU

Summary

- Easier to perform; less side effects
- Comparable pain control to thoracic epidural
- Reduces the need for postoperative narcotics
- Encourages early ambulation and reduced length of stay
- Postoperative spirometry higher

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Appendix G: Survey Questions

Pretest and Posttest Questionnaire:

Use of Erector Spinae Plane Block to Reduce Postoperative Pain and Opioid Consumption

INTRODUCTION

The primary aim of this QI project is to improve the knowledge of CRNAs pertaining to the use of the erector spinae plane block to reduce postoperative pain and opioid consumption in adults undergoing thoracic cavity surgery.

Please answer the question below to the best of your ability. The questions are either in multiple choice or true/false format and are meant to measure knowledge and perceptions on erector spinae plane blocks in postoperative pain reduction.

PERSONAL INFORMATION

1. **Gender:** Male Female Other_____
2. **Age:** _____
3. **Ethnicity:**

   Hispanic Caucasian African American Asian Other_____
4. **Position/Title:** _____
5. **Level of Education:** Associates Bachelors Masters Other _____
6. How many years have you been an anesthesia provider?

   Over 10 5-10 years 2-5 years 1-2 years

QUESTIONNAIRE

1. **Which of the following is NOT a risk factor for opioid addiction:**
    a. poverty
    b. heavy smoking
    c. female gender
    d. high socioeconomic status
2. **The number of drug related overdose deaths each year is approximately:**
    a. 30,000
    b. 70,000
    c. 125,000
    d. 1 million
3. **The economic impact of opioid addiction surpasses _____ per year.**
    a. $86 million
    b. $324 million
    c. $5 billion
    d. $79 billion
4. **The erector spinae plane (ESP) block is placed in what region of the body?**
    a. Cervical spine
    b. Thoracic spine
    c. Lumbar spine
    d. Intercostal
5. **The ESP block works by (select all that apply)**
    a. Sensory block

b. Motor block

c. Volume block

d. Continuous infusion

6. The ESP block controls _____ pain (select all that apply)

a. somatic

b. visceral

c. neurogenic

7. The ESP block reduces postoperative pain _____ the thoracic epidural:

a. Better than

b. The same as

c. Less than

8. The ESP block can reduce opioid consumption by as much as

a. 15%

b. 30%

c. 50%

d. 65%

9. Benefits of the ESP block include (select all that apply)

a. Easy to perform

b. Less side effects

c. Circumferential spread

d. Reduced ICU length of stay

e. Improved spirometry

f. Superior pain control compared to the thoracic epidural

10. Which surgery is NOT a good candidate for an ESP block?

a. Whipple

b. VATS

c. Open heart

d. Mastectomy

11. How likely are you to use alternative methods of pain management to reduce opioid consumption?

a. Very likely

b. Somewhat likely

c. Somewhat unlikely

d. Very unlikely

12. How likely are you to recommend the erector spinae plane block for postoperative pain management?

a. Very likely

b. Somewhat likely

c. Somewhat unlikely

d. Very unlikely

Appendix H: Pair T-test

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	postfinal	6.8571	7	1.34519	.50843
	prefinal	3.7143	7	1.49603	.56544

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	postfinal & prefinal	7	.887	.008

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	postfinal - prefinal	3.14286	.69007	.26082	2.50465	3.78106	12.050	6	.000

Appendix I: Citi Training Certificate Supervisor

CITI PROGRAM

Completion Date 11-Jan-2020
Expiration Date 10-Jan-2023
Record ID 26732475

This is to certify that:

Vicente Gonzalez

Has completed the following CITI Program course:

Basic/Refresher Course - Human Subjects Research (Curriculum Group)
Biomedical Human Research Course (Course Learner Group)
3 - Refresher Course (Stage)

Under requirements set by:

Florida International University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wc050e7ed-97f6-47cb-bb4b-2a96763480ce-26732475

Appendix J: Citi Training Certificate Investigator

Completion Date 10-Oct-2020
Expiration Date 10-Oct-2023
Record ID 38905353

This is to certify that:

Ashley Kelley

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Basic/Refresher Course - Human Subjects Research
(Curriculum Group)
Biomedical Human Research Course
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Florida International University

Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wb376f637-349b-4915-9f06-7d1939b6f8ba-38905353

Appendix K: Educational Module Consent Form

FLORIDA INTERNATIONAL UNIVERSITY

CONSENT TO PARTICIPATE IN A QUALITY IMPROVEMENT PROJECT
Use of Erector Spinae Plane Block to Control Postoperative Pain and Reduce Opioid Consumption in Adult Patients Undergoing Thoracic surgery: An Educational Module

PURPOSE OF THE PROJECT

You are being asked to be in a educational module. The goal of this project is to increase anesthesia providers knowledge in the use of erector spinae plane blocks in reducing postoperative pain and opioid consumption in adult patients undergoing thoracic cavity surgeries.

DURATION OF THE PROJECT
Your participation will require about 20 minutes of your time.

PROCEDURES
If you agree to be in the project, we will ask you to do the following things:

RISKS AND/OR DISCOMFORTS
There are no foreseeable risks with you for participating in this project.

BENEFITS
The following benefits may be associated with your participation in this project: An increase in cholesterol management knowledge, which will help you to better assess medication adherence and guidelines implementations to reduce the risk of cardiovascular events. The overall objective of the program is to increase the quality of healthcare delivery, improving the health indicator of our patients, and increase patient engagement.

ALTERNATIVES
There are no known alternatives available to you other than not taking part in this project. However, if you like to receive the educational material given to the participants in this project, it will be provided to you at no cost.

CONFIDENTIALITY
The records of this project will be kept private and will be protected to the fullest extent provided by law. If, in any sort of report, we might publish, we will not include any information that will make it possible to identify you as a participant. Records will be stored securely, and only the project team will have access to the records.

COMPENSATION & COSTS
There is no cost or payment to you for receiving the health education and/or participating in this project.

RIGHT TO DECLINE OR WITHDRAW
Your participation in this project is voluntary. You are free to participate in the project or withdraw your consent at any time during the project. Your withdrawal or lack of participation will not affect any benefits to which you are otherwise entitled. The investigator reserves the right to remove you without your consent at such time that they feel it is in the best interest.

RESEARCHER CONTACT INFORMATION
If you have any questions about the purpose, procedures, or any other issues relating to this research project, you may contact Ashley Kelley at 954-243-6410 akell061@fiu.edu or Dr. Vince Gonzalez at 305-348-0062, gonzalv@fiu.edu

IRB CONTACT INFORMATION
If you would like to talk with someone about your rights of being a subject in this project or about ethical issues with this project, you may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu

PARTICIPANT AGREEMENT
I consent by participating in the survey. I have read the information in this consent form and agree to participate in this project.

Appendix L: PRISMA Flow Diagram