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Bloqueo del plano del nervio pectoral (bloqueo PECS) en pacientes con enfermedades cardiovasculares: beneficios en la analgesia regional y el manejo perioperatorio en cardiología y anestesiología

Pectoral nerve plane block (PECS block) in patients with cardiovascular diseases: benefits in regional analgesia and perioperative management in cardiology and anesthesiology

Bloqueio do plano do nervo peitoral (bloqueio PECS) em pacientes com doenças cardiovasculares: benefícios na analgesia regional e no manejo perioperatório em cardiologia e anestesiologia

Carlos David Alvarez Ponce [I]
carlosalvarez2698@gmail.com
https://orcid.org/0009-0002-3797-8005

María Sofía Alpízar Ramírez [II]
msofalp@gmail.com
https://orcid.org/0009-0001-2832-7182

Carol Daniela Arce Sanjur [III]
carolarce99@gmail.com
https://orcid.org/0000-0003-0456-8413

Jorge Luis Badilla Balma [IV]
jorgeluis.badillabalma21@gmail.com
https://orcid.org/0009-0008-1219-5294

Isela Guadalupe Mora Bogantes [V]
iselamora01@gmail.com
https://orcid.org/0009-0006-6877-9948

Correspondencia: carlosalvarez2698@gmail.com

Ciencias de la Salud
Artículo de Investigación

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I. Medical Doctor; Medical Title Homologation at Kaplan Medical; New York, United States
II. Medical Doctor; Costa Rican Social Security Fund; General Physician and Surgeon graduated from the University of Medical Sciences of Costa Rica; San José, Costa Rica
III. General Physician; Costa Rican Social Security Fund; General Physician and Surgeon graduated from the University of Medical Sciences of Costa Rica; San José, Costa Rica
IV. General Physician; Costa Rican Social Security Fund; General Physician and Surgeon, graduated from the University of Medical Sciences of Costa Rica; San José, Costa Rica
V. General Physician; Costa Rican Social Security Fund; General Physician and Surgeon, graduated from the University of Medical Sciences of Costa Rica; San José, Costa Rica

Resumen

El manejo del dolor perioperatorio de los pacientes sometidos a procedimientos cardioquirurgicos es un desafío debido a los riesgos inherentes asociados al uso de opioides, como la depresión respiratoria y la inestabilidad hemodinámica. Por lo tanto, es crucial identificar estrategias analgésicas efectivas que mejoren el bienestar del paciente y reduzcan las complicaciones postoperatorias, minimizando al mismo tiempo la necesidad de medicación sistémica. El bloqueo del nervio pectoral (PECS) se ha establecido como una técnica segura y eficaz para el manejo del dolor en la cirugía cardíaca, ya que su ubicación superficial y su mínimo impacto hemodinámico lo hacen ideal para pacientes con enfermedades cardiovasculares. A diferencia de las técnicas neuroaxiales, el PECS reduce el riesgo de hematomas y complicaciones cardiovasculares, a la vez que es una alternativa más segura a los opioides. Su uso, optimizado con guía ecográfica, no solo mejora el alivio del dolor, sino que también contribuye a una recuperación más rápida, facilitando la extubación temprana y acortando la estancia hospitalaria. Sin embargo, se necesita más investigación a gran escala para consolidar su papel y optimizar su aplicación en esta población de pacientes. Este estudio tiene como objetivo evaluar el impacto del bloqueo del plano del nervio pectoral (bloqueo PECS) como una técnica de analgesia en pacientes con enfermedades cardiovasculares sometidos a procedimientos quirúrgicos.

Palabras claves: Bloqueo PECS, Bloqueo del nervio pectoral, Dolor postoperatorio, Cirugía cardíaca, Enfermedad cardiovascular.

Abstract

The management of perioperative pain in patients undergoing cardiac surgical procedures is a challenge due to the inherent risks associated with opioid use, such as respiratory depression and hemodynamic instability. Therefore, it is crucial to identify effective analgesic strategies that improve patient well-being and reduce postoperative complications while minimizing the need for systemic medication. The pectoral nerve block (PECS) has been established as a safe and effective technique for pain management in cardiac surgery, as its superficial location and minimal hemodynamic impact make it ideal for patients with cardiovascular disease. Unlike neuroaxial techniques, the PECS block reduces the risk of hematomas and cardiovascular complications, while also being a safer alternative to opioids. Its use, optimized with ultrasound guidance, not only

improves pain relief but also contributes to a faster recovery, facilitating early extubation and shortening hospital stays. However, more large-scale research is needed to consolidate its role and optimize its application in this patient population. This study aims to evaluate the impact of the pectoral nerve plane block (PECS block) as an analgesic technique in cardiovascular patients undergoing surgical procedures.

Keywords: PECS block, pectoral nerve block, postoperative pain, cardiac surgery, cardiovascular disease

Resumo

O manejo da dor perioperatória em pacientes submetidos a cirurgia cardíaca é desafiador devido aos riscos inerentes ao uso de opioides, como depressão respiratória e instabilidade hemodinâmica. Portanto, é crucial identificar estratégias analgésicas eficazes que melhorem o bem-estar do paciente e reduzam as complicações pós-operatórias, minimizando a necessidade de medicação sistêmica. O bloqueio do nervo peitoral (PECS) consolidou-se como uma técnica segura e eficaz para o manejo da dor em cirurgia cardíaca, visto que sua localização superficial e impacto hemodinâmico mínimo o tornam ideal para pacientes com doença cardiovascular. Diferentemente das técnicas neuroaxiais, o PECS reduz o risco de hematomas e complicações cardiovasculares, sendo também uma alternativa mais segura aos opioides. Seu uso, otimizado com orientação ultrassonográfica, não apenas melhora o alívio da dor, mas também contribui para uma recuperação mais rápida, facilitando a extubação precoce e reduzindo o tempo de internação hospitalar. No entanto, mais pesquisas em larga escala são necessárias para consolidar seu papel e otimizar sua aplicação nessa população de pacientes. Este estudo tem como objetivo avaliar o impacto do bloqueio do plano do nervo peitoral (bloqueio do PECS) como técnica analgésica em pacientes com doença cardiovascular submetidos a procedimentos cirúrgicos.

Palavras-chave: Bloqueio PECS, Bloqueio do nervo peitoral, Dor pós-operatória, Cirurgia cardíaca, Doença cardiovascular.

Introduction

The management of postoperative pain in cardiac and thoracic surgeries is a critical component of patient recovery. Inadequate pain control can lead to respiratory complications, prolonged hospital

stays, and contribute to the development of chronic pain (1). Traditionally, techniques such as neuroaxial blocks and systemic opioid management have been used, but these methods can present significant risks. Neuroaxial blocks, for example, carry the risk of hematoma formation in anticoagulated patients, which is common in cardiac surgery (2, 3). Furthermore, systemic opioids can cause undesirable side effects and long-term dependence.

In response to these challenges, ultrasound-guided fascial plane blocks have emerged as a promising alternative. These techniques, which include the pectoral nerve (PECS), serratus anterior plane (SAP), and erector spinae plane (ESP) blocks, offer effective and localized analgesia with an improved safety profile (1, 2). These blocks work by targeting local anesthetics to the intercostal nerves, which innervate the thoracic wall, and are increasingly being integrated into Enhanced Recovery After Cardiac Surgery (ERACS) protocols to optimize postoperative outcomes.

Studies have explored the specific application of these blocks in clinical practice. Dr. Chanana (3) evaluated the effectiveness of bilateral pectoral blocks for pain management in cardiac surgery patients, confirming that they are a safe and minimally invasive option. Similarly, a descriptive study in the pediatric setting highlighted the use of PECS I and II blocks for post-sternotomy pain relief in children, acknowledging the limited but growing understanding of their application in this population (4). These findings underscore the evolving role of regional anesthesia techniques in cardiovascular surgery, offering a path to improve patient comfort, reduce complications, and accelerate recovery.

Justification

This review is justified by the growing importance of regional anesthesia techniques for postoperative pain management, particularly fascial plane blocks like the pectoral nerve block (PECS). As clinical practice evolves, these techniques have become increasingly common, offering an alternative to traditional methods that may have greater risks and side effects.

The relevance of this review is heightened when considering the application of these blocks in patients with cardiovascular diseases. This patient group presents specific clinical conditions that make them particularly vulnerable to complications associated with traditional anesthesia, such as the side effects of opioids and the bleeding risks of neuroaxial blocks, especially in those receiving anticoagulant therapy. Therefore, it is crucial to study the applicability, efficacy, and safety of

techniques like the PECS block in this population to optimize pain management, reduce the use of systemic analgesics, and improve postoperative outcomes. This review aims to synthesize current evidence to provide a clear view of the role of these blocks in the context of cardiovascular surgery, an area where research continues to expand.

Methodology

A PRISMA-type methodology was used to evaluate the benefits of the PECS block in cardiovascular patients. A comprehensive search of the literature published in the last 10 years, since 2015, was conducted in databases such as Google Scholar, PubMed, and ScienceDirect/Elsevier. Boolean operators and specific keywords such as "PECS block" OR "pectoral nerve block" AND "postoperative pain" AND "cardiac surgery" OR "cardiovascular disease" OR "implantable devices" were used to refine the results. Randomized clinical trials and cohort studies comparing the PECS block with other regional analgesia or local anesthesia techniques in this patient group were included. Finally, the results were synthesized to determine the impact of the block on pain, opioid consumption, patient satisfaction, and perioperative complications.

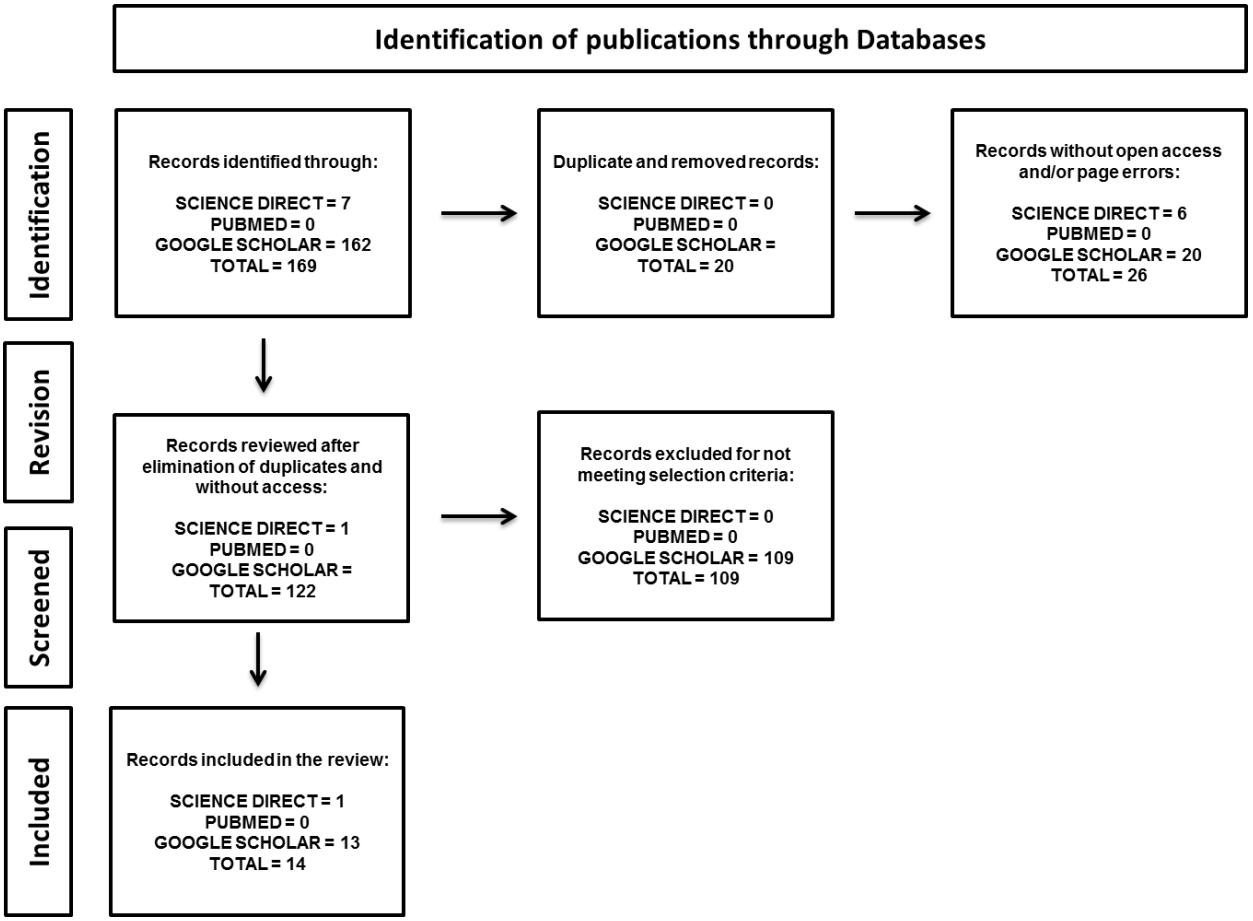
Inclusion criteria:

- Clinical studies and reviews on the PECS block in patients with cardiovascular disease.
- Research published in the last 5–10 years.
- Articles reporting efficacy and safety results for the use of the PECS block.
- Research papers in English and Spanish.

Exclusion criteria:

- Animal or non-human studies.
- Articles without relevant data on the PECS block or not focused on the cardiovascular context.
- Tools such as the Cochrane Risk of Bias Tool were used to evaluate the validity of the included studies.
- Research articles in languages other than English and Spanish.

Figure 1. summarizes the findings of the research conducted. It was determined that 14 studies were included and 109 were excluded.



Results

Fundamentals of the PECS Block

Definition and Technique:

- The PECS (pectoral nerve) block involves delivering a local anesthetic into the fascial layer between the pectoralis major and minor muscles to anesthetize the medial and lateral pectoral nerves (5).
- The PECS1 block anesthetizes the deeper fascial layers but does not provide skin coverage (5).

- Regarding the technique, an ultrasound transducer is used to visualize the supraclavicular nerve (SCN) and then the thoracic branch of the thoracoacromial artery as a landmark, since the nerves cannot be reliably visualized. Approximately 15 cc of local anesthetic is injected into the plane between the pectoralis major and minor muscles (5).

Uses in Thoracic Surgery and in Cardiology Patients

- PECS blocks were initially developed for thoracic and breast procedures (5).
- They have now shown promise for the implantation of cardiovascular implantable electronic devices (CIEDs) (5).
- In cardiology patients, the block is used as primary periprocedural analgesia for CIED implantation, with the goal of reducing or eliminating the need for intravenous sedation. Antiperovitch et al (5) describe a study that combines the PECS1 and SCN blocks to provide complete coverage of the CIED implantation site**.**

Indications and Benefits of PECS Block in Cardiovascular Patients

In Cardiology:

Ata & Yılmaz (6) note that, in their clinic, the PECS II block is applied as part of a multimodal analgesia approach for managing postoperative pain in patients undergoing open-heart surgery. Specifically, it's used to alleviate pain associated with median sternotomy (the incision in the breastbone) and the insertion of chest tubes. The technique is performed with ultrasound guidance at the end of the surgery.

Benefits and Comparisons:

The findings from the Ata et al. study (6) suggest that the PECS block is a useful tool for pain management, although its effectiveness can vary when compared to other regional block techniques:

Pain Management: The study compares the PECS II block combined with the pectoro-intercostal fascial plane block (PIFB) against the combination of the serratus anterior plane block (SAPB) with PIFB. The study found that while both combinations are effective, the SAPB+PIFB combination provided more effective analgesia in the early postoperative period. Specifically,

Visual Analog Scale (VAS) scores at 6 hours post-extubation were significantly lower in the SAPB+PIFB group compared to the PECS II+PIFB group (6).

Reduced Opioid Use: The authors highlight that the use of fascial blocks, like PECS, along with a larger amount of intraoperatively administered opioids, contributed to a lower need for rescue opioid analgesics postoperatively. This supports the concept of "opioid-sparing" analgesia (6).

Patient Satisfaction: An important finding was the difference in patient satisfaction. Patient satisfaction was considerably higher in the group that received the SAPB+PIFB combination (57% "very satisfied") than in the group that received PECS II+PIFB (20% "very satisfied"). This suggests that the SAPB+PIFB combination was perceived as more effective for pain control by patients (6).

Recovery Parameters: The study evaluated whether there were differences in extubation time, duration of mechanical ventilation, discharge from the cardiac intensive care unit (CICU), and hospital stay. No statistically significant differences were found between the groups (6).

In Internal Medicine:

The PECS II block is indicated for patients undergoing the insertion of a cardiovascular implantable electronic device (CIED). These devices, such as pacemakers and implantable cardioverter-defibrillators (ICDs), treat heart conditions like bradyarrhythmias, ventricular tachyarrhythmias, and advanced systolic heart failure. This type of block is particularly useful in patients at high risk for general anesthesia, as it helps avoid the potential adverse effects associated with it (7).

Benefits of the PECS Block in Cardiovascular Patients

The PECS II block provides effective postoperative analgesia for at least 24 hours after CIED insertion. In a study of 120 patients, 98 (81.7%) reported high levels of satisfaction with the procedure. The block has been shown to significantly reduce postoperative pain scores and the overall need for opioid medication. In fact, only 9 out of 120 patients (7.5%) needed postoperative tramadol for pain relief (7).

Intraoperative Experience

While the PECS II block alone doesn't always completely replace the need for surgical anesthesia, it contributes to a more comfortable intraoperative experience when combined with a supplemental local anesthetic. It helps address challenges such as inadequate pain relief and patient movement that can occur with local anesthesia alone (7).

Comparison with Other Types of Regional or General Analgesia

PECS vs. General Anesthesia

The study by Zhou et al (8) does not directly compare PECS to general anesthesia but rather positions all regional techniques as part of a multimodal analgesia approach that aims to reduce opioid consumption and its adverse effects. General anesthesia is the primary technique for the surgery itself, while regional blocks are used for subsequent pain management.

PECS vs. Other Regional Blocks

- **Thoracic Epidural Anesthesia (TEA):**
    - Efficacy: TEA was the most effective technique. It reduced pain scores at multiple time points (6, 12, 24, and 48 hours) at rest and with coughing, which is a significant advantage over the PECS, whose effectiveness was only noted at 6 hours.
    - Functionality: TEA also shortened extubation time, hospital stay, and the need for rescue analgesia—benefits that were not found for PECS in this study.
    - Side Effects: Unlike PECS, TEA increased the risk of pruritus (itching) (8).
    - Erector Spinae Plane Block (ESPB):
    - Efficacy: Similar to PECS, ESPB also reduced pain scores at 6 hours at rest.
    - Functionality: ESPB showed additional benefits, shortening the ICU stay.
    - Side Effects: ESPB reduced the risk of pruritus, which makes it more favorable than TEA in this aspect (8).
- **Serratus Anterior Plane Block (SAPB):**
    - **Efficacy:** SAPB was superior to controls in reducing the need for rescue analgesia.

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- **Side Effects:** SAPB reduced the risk of postoperative nausea and vomiting (PONV). The study even notes that SAPB reduced the need for rescue analgesia compared to TEA (8).

- **Paravertebral Block (PVB):**
  - **Efficacy:** PVB did not show a significant reduction in pain scores compared to controls.
  - **Functionality:** It shortened the ICU stay.
  - **Side Effects:** PVB reduced the risk of PONV (8).
  - Transversus Thoracis Muscle Plane Block (TTMPB) and Pecto-intercostal Fascial Block (PIFB)
  - **Efficacy:** TTMPB and PIFB reduced pain scores at 6 and 12 hours at rest, suggesting a longer-lasting analgesic efficacy than PECS, which was only significant at 6 hours (8).

Reduction in Conversion to Open Surgery, Lower Need for General Anesthesia

- **Conversion Rate:** A study by White et al (9) states that emergency conversion to full sternotomy occurs in 2-3% of cases of minimally invasive cardiac surgery (MICS).
- **Reasons for Conversion:** The most frequent reasons for this conversion are excessive bleeding, poor exposure of the mitral valve, adhesions, and iatrogenic aortic dissection (9).
- **Conclusion on PECS Blocks:** The study does not mention that the application of regional blocks, including PECS, influences these intraoperative causes or reduces the conversion rate (9).
- Peripheral nerve blocks can help create safe and effective perioperative conditions. However, the study does not claim that PECS blocks, or any regional block alone, eliminates the need for general anesthesia for the surgical procedure itself (9).

Perioperative Management with PECS Block in Cardiothoracic Surgery

- **Reduced Need for General Anesthesia:** Szamborski et al (10) mention that the PECS block can be used as a supplement to general anesthesia or even as a primary local anesthesia technique, suggesting its potential to reduce the reliance on general anesthesia in certain procedures.

Reduced Opioid Use and Improved Postoperative Pain Control:

Szamborski et al (10) confirm that these interfascial plane blocks reduce the doses of intravenous medications, including opioids, for postoperative pain management.

Jiang et al (11) mention that patients who received regional blocks, such as the PECS I, required 51.1% less opioids intraoperatively and 46.9% less overall compared to those who received no regional block. The reduction in opioid consumption contributes to better recovery, decreases side effects such as nausea, urinary retention, and sedation, and aligns with efforts to combat the opioid epidemic.

Jiang et al (11) highlight that the PECS block is very safe due to its superficial nature, the absence of large neurovascular structures in the area, and its high compressibility in case of a hematoma. Furthermore, it can be performed with the patient in a supine position, which does not disrupt the workflow of the operating room.

Impact on Postoperative Recovery:

Ata & Yılmaz (6) emphasize that inadequate postoperative pain management is associated with a higher risk of pulmonary complications and a prolonged stay in the intensive care unit (ICU). Therefore, the effective use of the PECS block for pain management can mitigate these consequences.

Szamborski et al (10) mention that one of the main advantages of fascial plane blocks is their ability to decrease the harmful effects of anesthesia on respiratory function, which is directly related to the prevention of pulmonary complications.

Accelerated Recovery and "Fast-tracking": The study by Kumar et al cited by Jiang et al (11), which compared the PECS block with no block in patients undergoing CABG or valve surgery,

found that the group with the PECS block was extubated significantly earlier ($p<0.0001$). This early extubation is a fundamental pillar of "fast-tracking," an approach that seeks to reduce hospitalization times and complications associated with prolonged ventilation.

Clinical Evidence

Review of Studies Comparing the PECS Block with Traditional Techniques in Cardiothoracic Surgery

A study by Elhaddad et al (12) compared the pectoral nerve (PECS) block with standard analgesic treatment in children undergoing transvenous subpectoral pacemaker insertion. Here are the results of that comparison:

- **Pain Score:** The mean pain score was significantly lower in the PECS group compared to the control group.
- **Opioid Consumption:** The cumulative doses of fentanyl and atracurium, as well as the cumulative dose of postoperative morphine, were significantly lower in the PECS group.
- **Time to First Analgesic Rescue:** The time until the first request for rescue analgesic was significantly longer in the PECS group (mean of 7 hours) than in the control group (2 hours).
- **Duration of Surgery:** The mean surgery time was significantly longer in the PECS group.
- **Hemodynamic Parameters:** The PECS group had a superior hemodynamic profile. The mean arterial pressure and heart rate were significantly higher in the control group than in the PECS group at multiple time points after the incision.
- **Complications:** No statistically significant differences were found in the incidence of complications, such as nausea, vomiting, pneumothorax, or infection, between both groups.

Another study by Janc et al (13) evaluated the effectiveness of a modified version of the Type II pectoral nerve block (PECS II) compared to infiltration anesthesia for vascular access port implantation. The study, a retrospective observational trial, was conducted on 114 patients. All patients received the modified PECS II block in addition to cutaneous infiltration anesthesia at the incision line.

The results of the study were as follows:

- **Intraoperative Pain:** The median pain intensity during vascular port implantation was 0. There was a significant difference in pain intensity between the specialist group and the resident group at the second and third measurement points.
- **Patient Satisfaction:** The mean value on the QoR-15 scale was 132 points, suggesting a high level of patient satisfaction.
- **Surgeon Comfort:** The results showed that the modified PECS II block provides optimal comfort for both the patient and the operator, even in prolonged procedures or in obese patients.
- **Complications:** There were no postoperative complications 7 days after hospital discharge, and no patient needed paracetamol after discharge.

The study by Zhou et al (8) is a meta-analysis comparing various regional anesthesia techniques for postoperative analgesia in adult cardiac surgery, which would include the PECS block. Here are the most relevant results:

Pain Scores and Morphine Consumption

- **PECS (Pectoral Nerve Block):** Reduced pain scores at rest at 6 hours compared to controls.
- **TEA (Thoracic Epidural Analgesia):** Reduced pain scores at rest and with coughing at multiple time points (6, 12, 24, 48 hours) and also reduced the need for rescue analgesia.
- **TTMPB (Transversus Thoracis Muscle Plane Block) and ESPB (Erector Spinae Plane Block):** Also reduced pain scores at rest at 6 hours.
- **Morphine Consumption:** None of the regional anesthesia techniques proved to be superior to controls in reducing cumulative morphine consumption at 24 or 48 hours.

Functional and Safety Outcomes

Length of Stay: TEA shortened tracheal extubation time and hospital length of stay. ESPB and PVB (Paravertebral Block) shortened the stay in the intensive care unit (ICU).

Risk of Complications:

- **Postoperative Nausea and Vomiting (PONV):** SAPB (Serratus Anterior Plane Block) and PVB reduced the risk.
- **Pruritus:** ESPB reduced the risk of pruritus, while TEA increased it.
- **Mortality:** There were no differences in mortality between the regional anesthesia techniques and controls.

Studies on the Efficacy of PECS Block in Reducing Postoperative Pain and Improving Patient Satisfaction

Butiulca et al (14) describe the technique of combining pectoral and serratus plane blocks for the implantation of implantable cardiac devices. The article focuses on describing the technique and highlighting its advantages. The authors state that the PECS I and PECS II blocks, when combined, provide appropriate analgesia and sedation for the procedure. Their goal is to demonstrate that the technique is safe and effective, which is crucial for patient stability.

The study by Janc et al (13) concluded that the modified PECS II block is an effective local anesthesia technique for the implantation of vascular access ports. Its use not only reduces postoperative pain and the need for additional analgesics but also improves overall patient satisfaction. The article suggests that this technique could be a valuable alternative to local anesthesia alone in this type of procedure.

A study by Ata & Yılmaz (6) that compared the PECS II block with the serratus anterior plane block (SAPB) yielded the following results:

Key Results on the PECS Block:

- The study compared two groups of patients: Group 1 (n=20) received a PECS II block and a pecto-intercostal fascial block (PIFB), while Group 2 (n=26) received an SAPB and a PIFB.
- The time to the first need for a rescue analgesic was longer in Group 2 (SAPB+PIFB) compared to Group 1 (PECS II+PIFB), although this difference was not statistically significant.

- The Visual Analog Scale (VAS) scores for pain, both at rest and with movement, at 6 hours post-extubation, were significantly lower in Group 2 (SAPB+PIFB) than in Group 1 (PECS II+PIFB).

Study Conclusion:

- The study concluded that VAS scores at 6 hours were lower in the group that received SAPB+PIFB compared to the group that received PECS II+PIFB.
- The authors suggest that these block combinations could be an alternative for pain relief in cardiac surgery, but prospective, randomized studies with a larger number of patients are needed.

Another study by Zafar et al (7) concluded that the PECS II block, when combined with supplemental local anesthesia, provided effective postoperative analgesia for patients undergoing the insertion of cardiovascular implantable electronic devices (CIEDs). Although it did not completely replace surgical anesthesia in most cases, the PECS II block contributed significantly to a smoother intraoperative experience for patients. The study considers the technique to be feasible and effective for this type of procedure. A total of 98 patients (81.7%) reported high levels of satisfaction with the procedure.

Complications

General anesthesia carries risks of hemodynamic instability, as well as respiratory and neurological complications. Lidocaine infiltration can cause systemic toxicity with severe cardiovascular and neurological manifestations, such as seizures. The paravertebral block presents significant risks, including pneumothorax, lung injury, vascular puncture, and hematoma. In contrast, the use of PECS blocks is presented as a safer alternative with a lower risk of these complications, and it is emphasized that ultrasound guidance enhances procedural safety by allowing the visualization of vital structures (14).

The pecto-intercostal fascial (PIF) block has raised doubts because it primarily targets pain from a median sternotomy, meaning it may not be effective for pain associated with chest drainage tubes and graft sites. The retrospective study by Chanana (3) compared the effectiveness of two block combinations and found that the SAPB+PIFB combination resulted in significantly lower pain

scores (VAS) at 6 hours post-extubation compared to the PECS II+PIFB combination. This difference suggests that the SAPB+PIFB combination may be more effective for analgesia in the early postoperative period.

Inadequate postoperative pain management can lead to adverse cardiac consequences, such as "increased oxygen consumption, arrhythmia, tachycardia, etc." Therefore, the application of blocks for adequate analgesia is important to prevent these complications. The document notes that fascial plane blocks have become popular as an alternative to central blocks because they can reduce or eliminate the risks of spinal hematoma and hemodynamic changes caused by sympathectomy in patients with limited cardiac reserve (3).

There is a theoretical risk of systemic local anesthetic toxicity due to rapid absorption, which could have cardiac consequences. At the same time, these blocks are considered a safer alternative to neuroaxial techniques because they avoid the risks of spinal hematoma and hemodynamic changes from sympathectomy, which is especially important in patients with limited cardiac reserve (11). Zhou et al (8) also emphasize that inadequate postoperative pain management can lead to cardiovascular complications such as increased oxygen consumption, arrhythmia, and tachycardia.

Szamborski et al (10) mention doubts about the efficacy of the pecto-intercostal fascial (PIF) block for non-sternotomy-related pain (such as that from chest drains), suggesting a limitation in its coverage. In this same text, two block combinations are compared, and it is noted that the SAPB+PIFB combination results in significantly lower pain scores at 6 hours post-extubation than the PECS II+PIFB combination, which indicates that not all blocks are equally effective. There is also the possibility of systemic local anesthetic toxicity due to rapid absorption in the highly vascularized fascial planes. This is a risk that could have adverse cardiac effects.Comparación de la seguridad del PECS block frente a otras técnicas regionales o la analgesia general

1. **PECS Block vs. Neuroaxial Analgesia (Thoracic Epidural Anesthesia - TEA):**

    - **Hematoma Risk:** The PECS block offers a clear safety advantage over TEA, as it can "reduce or even eliminate" the risks of neuroaxial hematoma. TEA, being a deep block, carries a significant risk of spinal hematoma formation, especially in anticoagulated patients, which is a major concern in cardiac surgery (2).

- **Hemodynamic Stability:** PECS blocks do not cause significant hemodynamic changes because they avoid sympathectomy, a common side effect of neuroaxial techniques that can lead to hemodynamic compromise and hypotension. This is particularly disadvantageous for patients with limited cardiac reserve (2).
- **Complexity and Learning Curve:** TEA requires considerable expertise, whereas PECS blocks are simpler and have a faster learning curve (2).
- **Pruritus:** A recent meta-analysis found that TEA increased the risk of pruritus compared to controls (2).

2. **PECS Block vs. Paravertebral Block (PVB):**

- **Hematoma Risk:** Although PVB has a significantly lower risk of spinal hematoma than TEA, ASRA guidelines recommend the same anticoagulation precautions. PECS, being superficial and compressible, is inherently safer in the presence of anticoagulation (2).
- **Pneumothorax Risk:** PVB carries a risk of pleural puncture and pneumothorax, a distinct concern that is much lower with the PECS block due to its superficial location (2).
- **Hemodynamic Stability:** PVB offers more hemodynamic stability than TEA and is associated with a lower incidence of nausea/vomiting and urinary retention (2).
- **Required Expertise:** Bilateral paravertebral blocks require significant expertise and dedicated follow-up from the acute pain team (2).

3. **PECS Block vs. Erector Spinae Plane Block (ESPB):**

- **Overall Safety:** Both ESPB and PECS are fascial plane blocks with a favorable safety profile, especially in anticoagulated and hemodynamically compromised patients. Serious adverse effects are rare with ESPB, as the needle insertion site is distant from the pleura, major blood vessels, and the neuroaxial region (2).
- **Learning Curve:** Both are considered safe with a rapid learning curve (2).
- **Pneumothorax:** Only one case of pneumothorax has been reported with ESPB (2).

4. **PECS Block vs. Serratus Anterior Plane Block (SAPB):**
    - **Overall Safety:** Both are considered very safe and can be performed in the supine position. SAPB is an extension of PECS II (2).
    - **Analgesic Efficacy:** One study suggested that SAPB might have less analgesic efficacy compared to PVB in minimally invasive coronary artery bypass grafting. However, another study found that SAPB combined with PIFB showed significantly lower pain scores compared to PECS II + PIFB, and was associated with a longer time to first rescue analgesic and a shorter extubation time.
    - **Specific Complications:** Potential complications of SAPB include vascular puncture, hematoma, pneumothorax, and winged scapula (rare) (2).
5. **PECS Block vs. Pecto-Intercostal Fascial Block (PIFB) and Transversus Thoracis Muscle Plane Block (TTPB):**
    - **Safety and Proximity to Vital Structures:** Although PIFB is considered safe and TTPB has a very low incidence of complications, the vascularity of the PIFB plane and the proximity of TTPB to vital structures like the internal mammary artery (IMA) and the pleura can increase the risk of systemic local anesthetic toxicity (LAST) and vascular injury compared to PECS blocks, which are more superficial (2).
    - **Technical Difficulty:** The difficulty in visualizing the transversus thoracis muscle with ultrasound and the closeness of the pleura and IMA to the infiltration site make TTPB challenging (2).
6. **PECS Block vs. Intercostal Nerve Blocks (ICNB):**
    - **Risks**: ICNBs carry risks of pneumothorax and LAST due to the direct proximity of the needle to the pleura and intercostal vessels. These risks are greater than with PECS blocks, which are more superficial and have a wider safety margin (2).
    - **Efficacy**: ICNBs are used less frequently in cardiac surgery due to their limited efficacy compared to fascial plane blocks. A pediatric study found that ICNBs had

higher postoperative fentanyl requirements and a shorter duration of analgesia compared to SAPB and PECS II (2).

7. **PECS Block vs. General Analgesia (Opioid-based):**

- **Adverse Effects:** General analgesia, traditionally opioid-based, is associated with numerous dose-dependent side effects, such as respiratory depression, postoperative nausea and vomiting (PONV), pruritus, constipation, and opioid-induced hyperalgesia (2).
- **Impact on Recovery:** These adverse effects can prolong intubation and ICU stay. The PECS block, as part of a multimodal and opioid-sparing analgesia strategy, significantly reduces these adverse effects, leading to a smoother and safer patient recovery (2).
- **Hemodynamic Stability:** Uncontrolled pain under general analgesia can lead to sympathetic stimulation and hemodynamic instability, while PECS contributes to maintaining stability (2).

Table 1. *Main studies on the PECS block in cardiovascular patients.*

Author(s) and Year	Study Title	Study Type	Key Results
Ata and Yılmaz (2023)	"Retrospective Evaluation of Fascial Plane Blocks in Cardiac Surgery With Median Sternotomy in a Tertiary Hospital"	Retrospective Study	Compared the PECS II block with the serratus anterior plane block (SAPB) in cardiac surgery patients. Found that pain scores were significantly lower with the SAPB+PIFB block than with PECS II+PIFB at 6 hours post-extubation.
Zafar et al. (2024)	"Pectoral Nerve Block II for Cardiac Implantable Electronic Devices"	Prospective Feasibility Study	The PECS II block, along with supplemental local anesthesia, provided effective postoperative analgesia. 65% of patients needed supplemental local anesthesia. 81.7% of patients reported high satisfaction.

Elhaddad et al. (2023)	"Pectoral nerve blocks for transvenous subpectoral pacemaker insertion in children: a randomized controlled study"	Randomized Controlled Study	The pectoral block in children for transvenous subpectoral pacemaker insertion reduced pain scores and opioid consumption.
Janc et al. (2021)	"Evaluation of the Effectiveness of Modified Pectoral Nerve Blocks Type II (PECS II) for Vascular Access Port Implantation Using Cephalic Vein Venesection"	Efficacy Evaluation Study	The modified PECS II block significantly reduced postoperative pain and analgesic consumption in patients with vascular access port implants. It was considered a safe and effective technique that improved patient satisfaction.
Devarajan et al. (2021)	"Regional Analgesia for Cardiac Surgery. Part 2: Peripheral Regional Analgesia for Cardiac Surgery"	Review Article	Mentions that fascial plane blocks, like PECS, are alternatives to neuroaxial and paravertebral blocks with lower risk. States that studies suggest these blocks reduce opioid requirements and improve patient satisfaction.

¿The PECS block is an effective option for patients with cardiovascular diseases?

- **Postoperative Pain Management:** Several studies, including one by Janc et al (13), show that the PECS II block significantly reduces pain and the need for analgesics after vascular access port implantation. Zafar et al (7) also found that the PECS II block, with additional local anesthesia, provides effective postoperative analgesia.
- **Improved Patient Satisfaction:** Studies by Janc et al and Zafar et al (7, 13) report high levels of satisfaction among patients who received the PECS block.
- **Alternative to General Anesthesia:** The PECS block is considered a safer alternative to general anesthesia for high-risk patients, as it avoids complications associated with general anesthesia, such as hemodynamic instability and respiratory or neurological problems.
- **Safety:** The PECS block is a low-risk technique compared to more invasive blocks (like the paravertebral block), as it reduces the incidence of serious complications such as pneumothorax and vascular puncture.

The evidence suggests that the PECS block is a valuable and safe technique for analgesia in cardiovascular patients, especially for procedures like the implantation of cardiovascular electronic devices.

Conclusion

The pectoral nerve block (PECS) has been established as a safe and effective regional anesthesia technique for pain management in cardiac surgery. Its superior safety profile, characterized by a superficial location, compressibility in the presence of anticoagulation, and minimal hemodynamic alteration, makes it a particularly advantageous option for cardiac patients. Compared to deeper neuroaxial and paravertebral techniques, the PECS block significantly reduces the risks of hematoma and cardiovascular compromise, while offering a safer alternative to general analgesia by mitigating opioid-related adverse effects.

While the current evidence is promising, much of it comes from studies with small sample sizes and retrospective designs. The widespread adoption of ultrasound guidance has drastically improved the safety of all regional blocks, making techniques like the PECS more accessible and reliable. The integration of the PECS block into multimodal analgesia strategies not only optimizes pain relief but also contributes to enhanced recovery after cardiac surgery (ERACS), facilitating early extubation and shortening hospital stays. Future research should focus on large-scale randomized controlled trials and the evaluation of long-term outcomes to further consolidate its role and optimize its application in the complex population of cardiac patients.

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