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REVIEW ARTICLE **OPEN ACCESS**

A Comprehensive Review on Rhomboid Intercostal Block as Postoperative Analgesia in Breast Surgery

Sulaman Almesned[1]

[1]*Assistant Professor, Department of Emergency, Intensive Care & Anesthesia, Medical College, Qassim University, Saudi Arabia.*

Abstract:
After the breast surgery, management of pain postoperatively is a critical aspect and it needs new and latest techniques to improve the outcome. This comprehensive literature review evaluates the efficacy and safety of the Rhomboid intercostal block (RIB), which is considered an alternative approach for postoperative regional anesthesia. RIB has been shown to be effective in pain management, reducing opioid consumption, and improving patient satisfaction. However, further research is needed to standardize protocols and assess long-term outcomes. This review highlights the potential of RIB in revolutionizing postoperative care and addressing the challenges associated with opioid dependency and insufficient pain management in the context of breast surgery.

Keywords: Rhomboid intercostal block, Postoperative analgesia, Breast surgery, Regional anesthesia, Opioid dependency, Intravenous analgesia.

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*Address correspondence to this author at the Department of Emergency, Intensive Care & Anesthesia College of Medicine, Qassim University, Saudi Arabia; E-mail: s.almesned@qu.edu.sa

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1. INTRODUCTION

Breast cancer constitutes the most common cancer in the female population across the globe [1]. Surgery is an efficient therapeutic modality for the management of breast cancer, particularly primary malignant neoplasms. Aggressive surgical approaches are implicated in the improvement of patient survival outcomes during the procedure [1, 2]. The surgical procedures can be broadly classified into breast conservative surgery and mastectomy, the latter further involving simple, modified radical, radical, and extensive radical mastectomy [1].

Breast cancer constitutes the most common cancer in females globally. Surgery remains an effective therapeutic modality, particularly for primary malignant neoplasms, with significant postoperative pain being a common outcome. Approximately 60% of patients experience persistent pain post-surgery, with about 40% developing postmastectomy pain syndrome, emphasizing the need for effective pain management strategies [3, 4]. Inadequate postoperative management can lead to delayed discharge, mobilization, psychological distress, sleep disturbances, and cardiac issues [5].

Different regional anesthesia techniques have been utilized in the management of postoperative pain. The administration of regional anesthesia is effective in providing acute postoperative pain control and reducing morphine consumption following breast surgery [6]. Moreover, regional anesthesia is implicated in the reduction of intraoperative morphine requirements in other surgical procedures, prospecting reduced intraoperative morphine administration and a decrease in the incidence of postoperative nausea and vomiting in patients undergoing breast surgery [6]. The techniques include the injection of local anesthetic in the paravertebral, serratus anterior plane, erector spinae plane, and pectoral nerve-2 blocks. Rhomboid intercostal block (RIB) is considered an optimal regional anesthesia approach for postoperative analgesia in patients undergoing breast

surgery due to its effectiveness in providing targeted analgesia with fewer side effects compared to traditional opioid-based methods. It offers reliable pain relief by blocking sensory nerves from T2 to T9, and it reduces the need for opioids, minimizing associated risks like nausea and respiratory depression [7]. In RIB, the anesthetic agent is injected into the upper intercostal plane, located inferior to the rhomboid muscle, imparting analgesia at the T3-T9 levels [6]. RIB is found to have similar effectiveness as other regional anesthesia plane blocks in the thoracic area of the human body [8].

The existing medical literature provides evidence regarding the use of RIB in breast surgery and other procedures and pathologies involving the thoracic wall. However, the evidence is limited to observational and experimental studies with a paucity of comprehensive reviews on the topic. The purpose of this review is to evaluate the effectiveness of RIB for breast surgery and other procedures, provide evidence about the comparable safety and effectiveness of the anesthetic block, and highlight the procedural details of RIB.

2. METHODS

A literature search was conducted in PubMed, Web of Science, and EMBASE (2016-2023), yielding 1330 studies on RIB administration in breast surgery patients. Inclusion criteria: patients ≥ 18 years undergoing breast surgery, with RIB as the intervention and outcomes including safety and effectiveness. Non-English studies and those not meeting the inclusion criteria were excluded. After screening for duplicates and eligibility of the articles by two reviewers independently, 14 studies were included in the literature review Table **1**.

Table 1. Summary of Literature Search and Study Selection Process.

Step	Details
Databases Searched	PubMed, Web of Science, EMBASE
Search Period	2016–2023
Initial Studies Identified	1330
Study Focus	RIB administration in patients undergoing breast surgery
Inclusion Criteria	- Adults (≥18 years) undergoing breast surgery - Intervention: RIB - Comparator: other nerve blocks, placebo, or systemic analgesia - Outcomes: safety, effectiveness, complications
Exclusion Criteria	- Non-English studies - Studies not meeting inclusion criteria
Screening Process	Duplicates removed and eligibility checked independently by two reviewers
Final Studies Included in Review	14

3. RHOMBOID INTERCOSTAL BLOCK

3.1. Background

The RIB is administered in the triangle of auscultation, which is present on the medial aspect of the scapula. The boundaries of the triangle of auscultation are described in the preceding section. The anesthetic agent is administered inferior to the rhomboid muscles, in the upper intercostal muscle plane. Demonstrated by the spread of dye, the local anesthetic spreads both cranially and caudally from the injection site, expanding across the T2-T8 vertebral levels beneath the rhomboid muscle. The local anesthetic first spreads alongside the serratus anterior muscle. This targets the lateral cutaneous branches of the intercostal nerve. The anesthetic agent then spreads medially, blocking the dorsal rami and the thoracic nerve [8]. With RIB, the dermatomal coverage spans from T2 to T9 on the anterior hemithorax and posterior hemithorax just medial to the midline and medial to the spinous processes, respectively [9]. RIB has also been demonstrated to provide both sensory block and symptomatic relief in the lateral and mid-anterior hemithorax, with T2-T9 dermatomal coverage [8].

3.2. Procedure

Following proper preparation of the block site, the scapula of the patient is placed in a vertical direction on the lower medial aspect, represented by the triangle of auscultation. This is followed by the identification of the rhomboid major muscle. The muscle is distinguished inferior to the trapezius muscle, at the corresponding T6 and T7 vertebral levels. To further confirm the location of the RIB, hydrodissection is performed beneath the rhomboid major muscle, on the upper intercostal muscles, using a 20-gauge peripheral nerve block needle of 100 mm. A 22-G catheter is then passed beneath the rhomboid major muscle via an in-plane technique. For postoperative pain treatment, other systemic analgesics like paracetamol, NSAIDs, and sometimes opioids are to be given regularly or as needed, *i.e*, PRN, depending on the pain scores in general[8.10]. Another study reported the administration of ultrasound-guided at the level of T5, into the interfascial plane present between intercostal muscles and the rhomboid major [11].

4. EFFICACY OF RIB IN BREAST SURGERY

4.1. Role of RIB in Pain Management

Nerve block in RIB mediates inhibition of pain stimulation by preventing an increase in the levels of inflammatory markers. An effective nerve block is associated with reduced oxidative stress in the postoperative period. RIB blocks afferent pain stimulation at the surgical site or area of injury, which promotes intravenous analgesia outcomes and leads to more effective improvement in postoperative inflammation [11]. Ultrasound-guided RIB and RIB with subserratus plane block are significantly effective in relieving pain within 24 hours after thoracic surgery and reducing the dosage requirement of pharmaceutical agents [12]. Compared to general anesthesia, RIB is more effective in the management of acute postoperative pain in patients undergoing thoracoscopic surgery and mastectomy [13].

4.2. Duration of Pain Relief

According to a prospective randomized controlled trial, the mean duration of anesthesia in RIB and RIB combined with the subserratus plane block is estimated to be 125.1 ± 38 minutes and 118.6 ± 40.1 minutes, respectively. The longer duration of analgesia with the latter technique is associated with dermatomal coverage of the thorax and upper abdomen [12]. The employment of catheter techniques supports prolonged and more flexible analgesia, overcoming the limitation of finite analgesia duration [14].

4.3. Association of Surgical and Non-surgical Factors

The surgical and non-surgical factors that influence the RIB outcomes in the management of postoperative analgesia are the variation in the anatomy of the thoracic wall, age of the patients, body mass index, the existence of coagulation pathologies, injection site infections, allergy to the local anesthetic used in the nerve block, and psychosocial factors that make the administration of local anesthesia a challenging task [15, 16]. Obesity is considered a threat to the accuracy of ultrasound-guided identification of thoracic segments in RIB and other intercostal nerve blocks. Overlooking anatomic variation in the rhomboid muscle in patients also contributes to poor identification of the muscle [17].

4.4. Rhomboid Intercostal Blocks and Axillary Clearance

Postoperative analgesia with erector spinae plane block in patients subjected to total mastectomy with axillary clearance is considered both safe and has reliable outcomes [18]. The combination of RIB, erector spinae, and parasternal blocks has been demonstrated to provide complete analgesia for patients undergoing breast surgery as well as axillary clearance [19]. The comparative efficacy of RIB and other analgesic techniques is not well-established in terms of perioperative pain management among patients undergoing mastectomy with axillary clearance. The success of these analgesic techniques, however, depends on the involvement of multiple nerves in postoperative pain. These include the long thoracic nerves, the intercostal nerves, the thoracodorsal nerves, and the pectoral nerves. On the contrary, RIB, serratus anterior block, and serratus plane block are considered less effective in the management of axillary pain [11].

5. RIB *VS* OTHER ALTERNATIVE NERVE BLOCKS

There are various clinical trials and comparative studies that have evaluated the safety and efficacy of RIB relative to other procedures for postoperative pain management. In a meta-analysis of four clinical trials, the authors concluded that RIB was more effective in acute pain management following breast surgery compared to intravenous analgesia. Patients in the RIB group demonstrated significantly lower 24-hour opioid intake following surgery. The interfascial plane block does not influence the vagus nerve; hence, it does not contribute to hemodynamic outcomes [13]. In another double-blind clinical trial, the authors demonstrated that RIB and erector spinae plane block were comparable in terms of postoperative tramadol consumption and numerical rating scale scores, indicating effective postoperative pain relief in patients undergoing modified radical mastectomy [20]. In a recent network meta-analysis, the regional anesthesia techniques were related to reduced acute pain and morphine utilization; however, these techniques do not contribute to chronic pain management. While a greater degree of evidence supports RIB as an optimal technique for postoperative analgesia in patients undergoing breast surgery, the strength of evidence is considerably low. Compared to other regional anesthesia approaches, RIB ranked highest in decreasing postoperative nausea and vomiting [6].

6. RIB AND PATIENT CONTROLLED ANALGESIA

Patient-controlled analgesia combined with continuous rhomboid intercostal and subserratus blocks is a safe and simple pain control method [14]. However, morphine is less effective than nerve blocks in breast surgery [21]. Patient-controlled analgesia is also combined with a continuous rhomboid intercostal plane block with a subserratus plane block for pain control in thoracic surgeries [14].

Continuous rhomboid intercostal block (CRIB) can be administered alongside patient-controlled analgesia. According to a prospective randomized controlled trial, patient-controlled analgesia with CRIB is associated with a significant reduction in postoperative pain compared to patients administered intravenous patient-controlled analgesia with sufentanil following the surgery. The global Quality of Recovery (QoR-40) scores are also significantly higher with CRIB compared to intravenous patient-controlled analgesia following video-assisted thoracoscopic surgery [22]. Notably, fentanyl consumption from patient-controlled analgesia devices and the requirement for rescue analgesia with meperidine are significantly lower in patients administered RIB for thoracoscopic surgery [23]. Another study suggests that intravenous patient-controlled analgesia with continued rhomboid intercostal and subserratus block is associated with significantly higher patient satisfaction, sparing tramadol consumption, and reduced postoperative pain compared to the administration of patient-controlled analgesia alone [14].

7. RIB FOR OTHER SURGICAL PROCEDURES

The clinical and surgical applications of RIB in thoracic and abdominal wall analgesia span beyond postoperative pain management in patients undergoing breast surgery. A case report has described the utilization of RIB in a patient with multiple rib fractures and anterior and posterior hemithorax [9]. Ultrasound-guided RIB is also implicated in postoperative analgesia for patients undergoing cardiac surgery. These patients also benefit from reduced opioid consumption and improved pain scores following the procedure [24].

8. INDICATIONS AND CONTRAINDICATIONS OF RIB

The indications for intercostal nerve blocks include the provision of analgesia in individuals with rib fractures and in postoperative pain management in patients undergoing thoracic and upper abdominal surgeries. These surgical procedures may include gastrostomy, mastectomy, thoracotomy, and thoracostomy [25, 26]. Intercostal nerve blocks, including RIB, are contraindicated in patients with coagulation disorders, local infection, a lack of expertise of the healthcare professional, and a lack of resuscitation equipment [26]. Moreover, patients who refuse surgical anesthesia and those who are allergic to local anesthetics are not subjected to RIB [12].

9. COMPLICATIONS OF RIB

The potential complications of intercostal nerve block for thoracic and upper abdominal surgeries include delayed pneumothorax, hematoma, development of toxicity to local anesthesia, and the onset of spinal anesthesia; however, this is a rare event [26]. Other adverse effects of RIB include hypotension, bleeding, infection at the site of catheter insertion, and injury to the internal organ [25].

10. FUTURE DIRECTIONS

The use of RIB in postoperative analgesia and anesthesia for breast surgery holds great promise, warranting further exploration in multi-center clinical trials with larger study populations. There is a need for the establishment of standardized techniques and protocols for RIB in patients undergoing breast surgery. The development of universal guidelines in healthcare settings may provide useful information about the optimal injection site, trajectory of the needle, and dosage of the anesthetic regimen. A comprehensive assessment of the safety profile, including any rare complications, will contribute to establishing the risk-benefit ratio. Moreover, conducting further randomized controlled trials with longer follow-up comparing RIB with existing analgesic techniques will provide more robust evidence regarding its efficacy. Comparative studies can help clarify the advantages and limitations of RIB in comparison to other regional anesthesia methods or systemic analgesia. Given that patient-related factors such as age and comorbidities influence postoperative pain outcomes, the researchers and healthcare professionals can further explore the influence of these factors on response to RIB. This can also contribute to the development of tailored and personalized techniques for more effective pain management. There is an imminent need for the commencement of training modules and educational programs for healthcare professionals to gain proficiency in RIB and its successful implementation in clinical practice.

CONCLUSION

This review has highlighted the promising potential of RIB in improving pain management outcomes for patients undergoing breast surgery. The scientific evidence provided by clinical trials and systematic reviews suggests that RIB can effectively provide analgesia, mitigate the consumption of opioids, and promote patient satisfaction. However, further research is needed to establish standardized protocols, optimal dosage, and long-term efficacy. More clinical trials with longer follow-ups are needed. Despite the current limitations, the findings underscore the importance of exploring alternative techniques like RIB to address the challenges associated with postoperative pain in breast surgery.

AUTHOR'S CONTRIBUTION

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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The authors declared no conflict of interest, financial or otherwise.

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