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Analgesic Techniques for Rib Fractures—A Comprehensive Review Article

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Abstract

Purpose of Review Rib fractures are a common traumatic injury that has been traditionally treated with systemic opioids and non-opioid analgesics. Due to the adverse effects of opioid analgesics, regional anesthesia techniques have become an increasingly promising alternative. This review article aims to explore the efficacy, safety, and constraints of medical management and regional anesthesia techniques in alleviating pain related to rib fractures.

Recent Findings Recently, opioid analgesia, thoracic epidural analgesia (TEA), and paravertebral block (PVB) have been favored options in the pain management of rib fractures. TEA has positive analgesic effects, and many studies vouch for its efficacy; however, it is contraindicated for many patients. PVB is a viable alternative to those with contraindications to TEA and exhibits promising outcomes compared to other regional anesthesia techniques; however, a failure rate of up to 10% and adverse complications challenge its administration in trauma settings. Serratus anterior plane blocks (SAPB) and erector spinae blocks (ESPB) serve as practical alternatives to TEA or PVB with lower incidences of adverse effects while exhibiting similar levels of analgesia. ESPB can be performed by trained emergency physicians, making it a feasible procedure to perform that is low-risk and efficient in pain management. Compared to the other techniques, intercostal nerve block (ICNB) had less analgesic impact and required concurrent intravenous medication to achieve comparable outcomes to the other blocks.

Summary The regional anesthesia techniques showed great success in improving pain scores and expediting recovery in many patients. However, choosing the optimal technique may not be so clear and will depend on the patient's case and the team's preferences. The peripheral nerve blocks have impressive potential in the future and may very well surpass neuraxial techniques; however, further research is needed to prove their efficacy and weaknesses.

Keywords Rib fractures · Regional anesthesia · Opioids · Non-opioid analgesics · Thoracic epidural · Paravertebral block · Erector spinae block · Intercostal block · Serratus plane block · Pectoralis block

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Introduction

Rib fractures are the most common injury to the thorax, often caused by blunt thoracic trauma. Rib fractures occur in approximately 10% of all traumatic injuries with the incidence increasing with age. Rib fractures can cause significant pain that can limit respiratory function and the cough reflex due to pain. A compromise of respiratory function results in atelectasis, leading to significant pulmonary complications, including pneumonia. Adequate pain control is a critical component in the management of rib fractures. Additionally, adequate analgesia in rib fractures aims to decrease morbidity and mortality in rib fractures by decreasing the incidence of associated pulmonary complications and the development of chronic pain and disability [1].

Traditional methods of pain management in rib fractures include medication management using systemic opioids and non-opioid analgesics. Opioid analgesics are known to cause significant adverse effects including sedation, respiratory depression, and hypotension, especially in elderly populations. Therefore, regional anesthesia techniques to manage pain in rib fractures have gained interest. Regional anesthesia techniques such as thoracic epidural analgesia (TEA), paravertebral block (PVB), intercostal nerve block (ICNB), and serratus anterior plane block (SAPB) have shown promising results in providing effective pain relief while minimizing adverse side effects. These techniques can be used alone or in combination with other techniques to achieve multimodal pain control, while minimizing adverse side effects and improving patient pain and satisfaction. In this review article, there will be a discussion regarding efficacy, safety, and limitations of medical management and regional anesthesia techniques for the management of pain associated with rib fractures.

Medical Therapy for Rib Fractures

Medical therapy of rib fractures was historically focused on anti-inflammatories or opioid analgesics. Opioid analgesia provides adequate pain control for patients with rib fractures. While traditionally opiate-based pain medications for rib fractures continue as the cornerstone of medical therapy for rib fractures, issues related to opioids have driven research into alternative analgesics. Significant side effects of opioid use include drowsiness, decreased respiratory effort, atelectasis, and potential for addiction. There is an emphasis on minimizing the use of opioids due to these adverse effects.

Non-opioid analgesics are most commonly used in the management of patients with rib fractures. Non-steroidal anti-inflammatory drugs (NSAIDs) have fewer side effects than opioids, are inexpensive, and are well-tolerated. Ibuprofen and naproxen are NSAIDs with great effects in reducing pain and inflammation associated with rib fractures. Previous studies have shown that early administration of intravenous NSAIDs, such as ketorolac, is associated with a decreased likelihood of pneumonia and without a notable increase in adverse outcomes in patients with rib fractures [2]. Ketorolac has been feared to have complications of its own including increased incidence of acute kidney injury (AKI) and bleeding, limiting its use. However, a retrospective chart review of one institution discovered that ketorolac use did not increase the incidence of AKI or bleeding in these patients, suggesting ketorolac is a safe and effective analgesic for use in rib fractures [3]. Additionally, early intravenous ibuprofen use has been studied in patients with traumatic rib fractures. The results showed that patients who received ibuprofen required fewer narcotic medications and had a shorter length of hospital stay compared to those who did not receive it. This suggests that the use of early intravenous ibuprofen may be beneficial in managing pain and improving outcomes in patients with traumatic rib fractures [4].

Acetaminophen is another commonly used non-opioid analgesic in the management of pain in rib fractures. Acetaminophen inhibits prostaglandin production in the central nervous system, reducing pain and fever, is well-tolerated, and has a low risk of adverse effects when used in recommended doses. It is available in both oral and intravenous formulations. A single-center, randomized, placebo-controlled, double-blinded study aimed to determine whether oral acetaminophen is as effective as intravenous acetaminophen in treating pain associated with rib fractures in elderly trauma patients > 65 years old. The study found that there was no statistically significant difference between the two groups in terms of pain reduction 24 h after injury, opioid use, hospital mortality rate, ICU length of stay, hospital length of stay, or development of pneumonia. Based on these findings, the authors suggest oral acetaminophen should be preferred over intravenous acetaminophen when treating elderly trauma patients with rib fractures who are tolerating oral intake [5].

Gabapentin blocks the transmission of nerve signals to reduce pain and has been previously studied in the acute management of patients with rib fractures. Evidence regarding the effectiveness of gabapentin in rib fractures is mixed. A double-blind, randomized controlled trial investigated the use of gabapentin for acute pain management in critically ill patients with rib fractures and found that gabapentin did not significantly reduce pain intensity or opioid requirements compared to placebo in these patients. However, gabapentin was associated with a lower incidence of delirium and a shorter duration of mechanical ventilation in this study. The study suggests that gabapentin may have some benefits in critically ill patients with rib fractures, but further research

is needed to fully understand its potential for pain management in this population [6].

Lidocaine infusion has been investigated as an adjunct to narcotics for pain management in trauma patients with rib fractures. A pilot study found that the addition of lidocaine to narcotic medications resulted in a significant reduction in pain scores and opioid requirements in these patients, without significant adverse events reported. The study suggests that lidocaine may be a safe and effective adjunct to narcotics for pain management in trauma patients with rib fractures, but further research is needed to confirm these findings [7]. Additionally, a retrospective chart review aimed to investigate the effectiveness of intravenous lidocaine (IVL) infusion as a component of multimodal analgesia for rib fractures. The results showed that IVL infusion reduced opioid utilization, pain scores, hospital length of stay, and costs, supporting the use of IVL in multimodal pain regimens for rib fractures [8]. Additionally, studies have shown that transdermal lidocaine patch use was associated with a significant decrease in opiate utilization during hospitalization in admitted trauma patients with acute rib fractures [9] and a significant reduction in pain scores with no change in narcotic use [10, 11].

Ketamine infusion has been investigated for pain control in rib fractures. A randomized control trial of elderly patients (age, ≥ 65 years) with three or more rib fractures showed that low-dose ketamine failed to affect pain scores or oral morphine equivalents within the overall cohort. However, a decrease in oral morphine equivalents was observed in those with a high injury severity. Ketamine infusion was also associated with fewer adverse effects than standard pain management. The study suggests that ketamine infusion may be an effective and safe option for pain management in adult patients with multiple rib fractures, but further research is needed to confirm these findings [12].

Overall, medical therapy for rib fractures has shifted away from the traditional approach of opioid analgesia for pain management due to adverse effects associated with opioids. Non-opioid analgesics such as NSAIDs, acetaminophen, gabapentin, lidocaine, and ketamine have been investigated as alternative options for pain management in rib fractures. These studies have shown that non-opioid medical therapy may provide effective pain relief with fewer adverse effects. Further research is needed to fully understand the role of non-opioid analgesics in rib fractures. It is clear that there are numerous options for medical therapy available to provide analgesia in the management of patients with rib fractures.

Thoracic Epidural

Thoracic epidural analgesia (TEA) can produce a myriad of physiological effects. Notably, the use of TEA can cause hypotension, propagated by bowel preparation and hypovolemia after fasting. TEA can also dilate coronary vessels, leading to a reduction in heart rate and improved cardiac function due to a reduction of preload and afterload, optimizing myocardial oxygen delivery. Epidural analgesia can also block adrenal catecholamine release, restoring the muscle synthesis and breakdown balance that is often disturbed due to pain and surgery. This restoration can reduce increases in plasma glucose. TEA can also reduce the duration of postoperative ileus [13].

The current literature on thoracic epidurals shows conflicting studies regarding their overall benefits. In a retrospective study by Kim et al. analyzing the results of surgical reduction and fixation of ribs under thoracic epidural anesthesia and analgesia in patients who had no more than 3 consecutive rib fractures, TEA showed potential positive effects on the cardiopulmonary functions in the perioperative period with an earlier return of gastrointestinal function and early ambulation without severe postoperative complications. This led to a shortened hospital stay and lowered overall costs [14]. Hashemzadeh et al.'s study comparing thoracic epidural block and intercostal nerve block showed statistically significant improvement in ventilatory function tests during the 1st, 2nd, and 3rd days after the thoracic epidural ($P < 0.004$), with lower pain scores [15]. A prospective study by Bulger et al. compared epidural analgesia and IV opioids for the management of chest wall pain after rib fractures. After adjusting for differences in direct pulmonary injury, there was a greater risk of pneumonia in the opioid group compared to the epidural group ($P = 0.05$) and a 2.0-fold increase in the number of ventilator days when stratified for the presence of pulmonary contusion ($P < 0.001$) [16]. In a systematic review and meta-analysis conducted by Peep et al. that compared epidurals to other pain management interventions such as IV analgesia, paravertebral blocks, and intercostal blocks, it was suggested that epidural analgesia offered significantly better pain relief in comparison to other pain management modalities [17•]. Both Gage et al. and Flagel et al.'s studies looked at epidural analgesia in the setting of trauma and demonstrated a reduction in mortality. Gage et al. showed a decreased odds of death in patients with three or more rib fractures, while Flagel et al. saw a reduction in mortality at 2, 4, and 6–8 rib fractures [18, 19]. Additionally, in another retrospective study that looked at patients with one or more rib fractures admitted to a level II trauma center, patients who received epidural analgesia had a lower mortality rate (0.5% vs 1.9%) despite greater injury severity [20]. One feared side-effect is the neurologic complications that may occur during the placement of a TEA. However, in a retrospective study by Reiner et al., it was found that no permanent neurological sequelae were reported in the 185 patients analyzed [21].

Despite the evidence supporting the positive benefits of TEA, some studies show the alternative. Duch et al. conducted a systematic review with meta-analysis and trial sequential analysis on randomized controlled trials in patients receiving continuous epidural analgesia (CEA). A total of six trials were included. In their meta-analysis, they found that there was no statistically significant difference in mortality ($P=0.09$) or pneumonia ($P=0.13$) between CEA and other analgesic interventions [22]. McKendy et al.'s study of 1360 patients at a level one trauma center with greater than or equal to one rib fracture showed that patients who had received epidural analgesia experienced more respiratory complications (19% versus 10%, $P=0.009$) and a longer hospital stay ($P=0.026$) [23].

The use of TEA is commonly contraindicated in patients with coagulopathies, spinal cord injuries, or epidural hematomas and in associated injuries such as traumatic brain injury or hemodynamic instability [24]. While the incidence rate of hematomas due to TEA has previously been unclear, a recent single-center database analysis has shown that the incidence ranged between 1:2700 and 1:4761, with rates increasing in patients with renal dysfunction or who are on anticoagulants [25]. The risk of infection secondary to TEA is a necessary consideration as well. One study conducted in Germany reported an incidence of one abscess in 10,000 patients who had received TEA [26]. The use of TEA may also depend heavily on the skill level of the clinician and require adequate knowledge of anatomy and placement compared to other regional anesthetic techniques for rib fracture.

Paravertebral Block

Paravertebral block (PVB) is a method of injecting anesthetic in proximity to where the spinal nerves exit the intervertebral foramina to produce an ipsilateral somatosensory and sympathetic nerve blockade. This block should be placed at the dermatome of interest due to variable anesthetic spread. PVB has a failure rate of up to 10% with additional complications such as vascular puncture, hypotension, pleural puncture, and aberrant spread of local anesthetic [27]. PVB using large volumes of local anesthetic also has epidural spread leading to similar hemodynamic effects of a standard epidural block. PVB can be placed in either multiple injection sites, a large volume single injection, or through a continuous peripheral nerve catheter. If multiple single levels are desired, 3–5 mL of anesthetic is injected per site per dermatome. A single large volume injection of local anesthetic 15–20 mL will provide approximately 5 levels of coverage. Therefore, thoracic paravertebral blocks (TPVB) certainly have utility in providing analgesia in rib fractures. Yeying et al. compared the pain relief effect and pulmonary function preservation of TPVB and intravenous patient-controlled analgesia (IVPCA) in 90 patients with multiple rib fractures. TPVB group had significantly lower VAS pain scores than the IVPCA group during rest and coughing as well as an improvement in spirometer values, highlighting TPVB's beneficial effects for pain control [28]. Turhan et al. compared the pain control of thoracic paravertebral block (TPVB), erector spinae plane block (ESPB), and intercostal nerve block (ICNB) in patients undergoing thoracoscopic lung resection. They found that the group of patients who received TPVB reported significantly lower static (at rest) and dynamic (at cough) pain scores on a visual analog scale for the first 24 h than the groups treated with ESPB or ICNB. TPVB appears to achieve better pain control compared with ESPB and ICNB in thoracoscopic surgery [29]. Similarly, Chen et al. performed a randomized control trial comparing the efficacy of multiple injection paravertebral block with ESPB and other analgesic methods after thoracoscopic surgery. This study demonstrated a superior analgesic effect of ultrasound-guided multiple injection paravertebral block in comparison to ICNB and single-injection ESPB [30]. This study also reported that ICNB or ESPB combined with patient-controlled intravenous analgesia can be a safe and effective alternative to PVB if PVB is contraindicated or has failed [30]. Lastly, a study by Bhalla et al. demonstrated that both the PVB and SAPB were effective in reducing pain scores in 39 critically ill patients with rib fractures [31•].

Although epidural and paravertebral blocks are an established approach for pain control, their utility can be challenging in trauma settings. Thus, the other methods with fewer contraindications may be recommended in these cases.

Erector Spinae Block

Ultrasound-guided erector spinae plane block (ESPB) is achieved by injecting 20–30 mL of local anesthetic (LA), such as 0.5% ropivacaine, into the erector spinae plane to target the thoracic and abdominal spinal nerves. Local anesthetic tends to also spread anterior and cephalocaudal which allows for additional analgesia of the chest wall [32]. While few large-scale controlled trials are currently available, many case reports and retrospective reviews report ESPB as their method choice due to ease of performance and high efficacy [33, 34].

Despite being a relatively novel technique, the ESPB has great potential for use in the emergency department for the acute management of rib fractures. A retrospective analysis of 15 patients receiving ESPB blocks in the ED showed the procedure's capacity to have a quick onset, with an average time to perform the procedure being 16.3 min. It also demonstrated the capacity of its use by non-anesthesiologists, as the blocks were performed by trained emergency physicians.

Additionally, both pain scores and respiratory function were improved: results show a > 50% decrease in pain scores at the 30-min mark and a 72% decrease over a 48-h period. The peak expiratory flow rate was also significantly improved (49% increase, $P < 0.001$) [35•]. Another case report showed the benefits of ESPB as a method of analgesia prior to hospital transport. The block was effective in lowering pain to a 1/10 for two patients when morphine proved ineffective, allowing transportation to the receiving hospitals [36].

Multiple retrospective reviews of ESPB vouch for its efficacy and safety, often favoring a continuous block over a single injection. A retrospective cohort study of 79 patients receiving single dose (23%) or continuous (77%) ESPB for rib fracture showed a significant reduction in pain scores, noting a 39% decrease over the first 3 h. Incentive spirometry volumes also improved by an average of 591 mL ($P < 0.01$). There were no complications noted, and mean arterial pressure remained constant. Of note, opioid use reduction was not significant, and the patients receiving a single injection instead of the continuous treatment did not have a clinically relevant improvement in spirometry volumes [37].

A larger retrospective cohort study, analyzing 224 patients who received 244 ESPB catheters for rib fracture, supported the claim that ESPB has a very low incidence of adverse events. No complications, such as hypertension, pneumothorax, hypoxia, or local anesthetic system toxicity (LAST), were observed during admission. However, late complications included 2 erythematous catheter sites and 2 small hematomas, none of which required intervention. Of all the catheters placed, 7.7% were removed due to catheter failure. Since more than 25% of the patients analyzed had contraindications to TEA and PVB, the lack of significant complications with ESPB catheter placement during admission noted here is even more impressive [38]. Contraindication to epidural analgesia is often connected to risk of bleeding. In a retrospective review of 25 patients on anticoagulants receiving ESPB for multiple rib fractures, 80% did not have any missed doses of prescribed anticoagulant medication. No bleeding complications or neurological deficits were reported. This makes ESPB an excellent alternative to epidural analgesia or other contraindicated techniques [39]. Lastly, the timing of ESPB block placement was found to significantly impact safety and efficacy outcomes. One cohort study analyzing 199 patients who received an erector spinae block catheter for multiple rib fractures looked into the effect of timing on its efficacy. From the cases studied, 14% of patients received ESPB within 24 h of admission, 47% received ESPB within 48 h of admission, and 37% of patients received a block after 48 h (which is considered "late"). While the study does not show the efficacy of ESPB when compared to other analgesic procedures, it is a great demonstration of the need for early intervention. Late blocks were significantly associated with the development of respiratory complications ($P = 0.005$). Additionally, those in the late block had a 5.52% rate of respiratory failure, compared to a 0% rate for those who got early and prompt intervention [40].

Overall, erector spinae block is an excellent low-risk approach to analgesia for rib fractures. Despite a lack of large-scale evidence from controlled trials, retrospective reviews and case reports largely support the consensus that ESPB is easy to perform, is safe for a larger population of patients than other techniques, and is efficient in its treatment of pain which results in significantly improved respiratory outcomes.

Intercostal Nerve Block

An intercostal nerve block (ICNB) is performed by injecting 3–5 mL of local anesthetic into the intercostal space of each targeted level. While both the landmark technique and ultrasound can be used, ultrasound may decrease the risk of adverse effects such as pneumothorax and intravascular injection [41].

Some studies have identified ICNB to be a valuable resource in managing analgesia for rib fractures. A retrospective study of 54 patients showed that despite the group receiving an intercostal block having significantly greater baseline pain, the pain after administration was significantly lower. It is noted that additional methods are recommended for long-term pain control due to the short-acting nature of intercostal blocks [42].

ICNB is often compared to thoracic epidurals. One retrospective study of 116 patients compared intercostal blocks using liposomal bupivacaine to an epidural catheter for the treatment of traumatic rib fracture. Compared to those receiving the epidural, patients receiving the intercostal block had a significantly lower length of stay (both in the hospital overall and in the ICU), had a lower incidence of intubation ($P = 0.015$), and had no complications. The epidural group had a 26% rate of complications [43]. However, these findings are in contradiction with the majority of other available literature. For example, a randomized, double-blind trial compared epidural and intercostal blocks in patients with 3–4 broken ribs following chest cage blunt trauma. The group receiving an epidural was shown to have significantly lower pain scores at all time points ranging from 15 min to 24 h ($P < 0.01$) [44]. Another prospective study evaluating pain and ventilation parameters in rib fracture patients showed that for most variables — pain scores, inpatient length of stay, tidal volume, and minute expiratory capacity — results were significantly better for the thoracic epidural group over the ICNB group [15]. Lastly, one case study showed a successful administration of the ultrasound-guided intercostal block by emergency physicians, rather

than a trained anesthesiologist, with no adverse effects. The study used 40 mL of 0.25% bupivacaine at T5, and five patients reported a decrease in pain with the exception of one patient [45].

Overall, ICNB can be considered as a suitable analgesic option in rib fracture patients who may have contraindications to an epidural.

Serratus Anterior/PECS II Block

Both fascial plane blocks, the pectoralis (PECS) II, and the serratus anterior plane blocks (SAPBs) have shown results in the treatment of pain associated with anterior rib fracture. The PECS II block serves as a follow-up for the PECS I injection between the pectoralis minor and the pectoralis major. It is accomplished by a local anesthetic injection in the fascial plane between the pectoralis minor and serratus anterior muscles, usually with ultrasound guidance [46]. A randomized controlled trial of 20 patients assessed bilateral PECS II to be an effective treatment for pain following cardiac surgery with midline sternotomy. Pain scores, at rest and while coughing, and peak inspiratory volume were significantly improved. Additionally, ventilator support time ($P < 0.0001$) and rescue analgesia doses needed was decreased for patients receiving PECS [47]. While studies investigating PECS II implementation for rib fracture are limited, its use for mastectomy pain has been investigated. Pain scores immediately after administration were similar to that of patients receiving SAPB. Chronic pain was significantly decreased [48].

The SAPB targets the cutaneous branches of the intercostal nerve [49] and can be performed in a supine position, with multiple successful cases confirming its feasibility [50]. SAPB has been widely reported on, including case reports, randomized trials, and meta-analyses. Overall, it has a low incidence of adverse effects such as nausea, local anesthetic poisoning, or hypertension. The risk of pneumothorax is also extremely low, but not zero [51]. The occurrence of respiratory adverse events is difficult to attach to the block itself due to the nature of rib fractures. In a retrospective review of 34 patients, a SAPB catheter with 0.2% ropivacaine at 12 mL/h was effective in reducing pain and improving respiratory function due to significantly increased incentive spirometry volumes, decreased respiratory rate, and increase oxygen saturation. Twenty-five of the patients experienced adverse events such as pneumothorax, but this was likely due to the high degree of chest damage (median number of fractures was 7) [52].

Many studies have shown SAPB's equivalence, or even superiority, to the alternatives. A double-blind randomized trial compared continuous deep serratus anterior plane block to paravertebral block in thoracic surgery. SAPB was equally successful in lowering opioid use as PVB and had no differences with respect to hemodynamics and length of stay in the hospital. Notably, postoperative pain scores and day 1 walking distance were significantly improved for SAPB [53]. When compared to PCA with tramadol, a randomized controlled trial of 60 patients with rib fracture pain showed that a 30 mL of 0.25% bupivacaine SAPB administered in the supine position had improved pain control, higher oxygen saturation ($P < 0.05$), and decreased total opioid consumption ($P = 0.02$). No complications were observed for patients receiving the block, while 30% of the control group reported nausea and vomiting [54]. Another 10 patient case corroborated this data, reporting decreased pain and no complications themselves [55].

Overall, PECS II and SAPB could be useful additions to the rib fracture pain management arsenal. However, further research is needed to determine its efficacy when compared with other techniques, such as the ESPB or thoracic epidural.

Discussion

This review of rib fracture analgesia provides a comprehensive record of the risks and benefits of medical therapy and numerous regional anesthesia techniques, as well their impact on patient outcomes. The treatment of pain due to rib fracture is immensely important to promote proper breathing and coughing in order to bring about a faster recovery. The majority of applications for all methods covered result in improved pain scores, shorter lengths of stay, and overall faster recovery. The choice of treatment, however, may not be easy to pinpoint and can depend greatly on the patient population and clinician skill to have the best possible outcomes.

In recent years, opioid analgesia, TEA, and PVB have been popular choices for rib fracture pain management. While opioid analgesia and TEA have been the most investigated and frequently used approaches, they carry higher risks than alternatives. Opioids, bringing about numerous complications, add unnecessary problems both in the short and long term. TEA, while effective in pain treatment, is contraindicated for a large subset of the population, namely, those who take anticoagulants. Additionally, the skillset required to perform a successful epidural block limits its applications in an emergency setting. PVB, a good alternative for those having some contraindications to TEA, has promising outcomes but a relatively high failure rate (10%) compared to alternatives in addition to complications of pleural puncture and hypotension.

The SAPB or ESPB are excellent blocks as an alternative to TEA or PVB. Providing largely non-inferior

analgesia to TEA, they are associated with lower side effects and have fewer contraindications. Having already shown great outcomes when performed by emergency physicians, ESPB, in particular, is an excellent tool to implement in non-specialty training due to its ease of performance and outcomes. Due to the poor impacts of late analgesic intervention on recovery outcomes, it is crucial that the choice of treatment can be performed promptly. Providing effective alternatives like ESPB as an option to emergency departments may improve early intervention rate and, therefore, recovery. ESPB also does not have the same limitations as SAPB, which is best used for anterior fractures. A bilateral ESPB can be effective in treating all fracture locations, anterior, posterior, and lateral, and is a well-regarded approach to analgesia for rib fracture.

While we believe that these more distal peripheral nerve blocks may eventually supercede neuraxial techniques, we cannot disregard successful techniques and omit them from current application. Literature comparing them often has contradictions and lacks an overall conclusion based on controlled trials. ICNB is the only consistently inferior analgesia, requiring simultaneous IV medication to show the same results as other blocks. It is also worth noting that while performing a nerve block reduced opioid and IV medication usage, they were not completely omitted. As such, a multimodal approach using a nerve block for primary analgesia and medical therapy to supplement as needed is the best protocol to guarantee successful pain management. Worthwhile suggestions include the use of oral acetaminophen, NSAIDs, or IV lidocaine, as discussed earlier.

Further research is needed to compare nerve block efficacy and side effects. We acknowledge the bias in current publications, largely publishing successes over poor outcomes, and the low count of controlled trial conclusions on the topic making recommendations difficult to make. Given the currently available knowledge, final decisions for treatment will be largely dependent on the team's preferences, patient comorbidities, and location and extent of trauma.

Compliance with Ethical Standards

Conflict of Interest Dr. Koushik has served as a one-time consultant for AcelRX pharmaceuticals medical. Dr. Shaparin reports research and personal funding with Heron Therapeutics, Averitas Pharma, and AcelRX pharmaceuticals medical. The remaining authors have no conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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