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Regional Anesthesia in Postoperative Pain Management: Mechanism, Techniques, and Clinical Considerations – A Review

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ABSTRACT

Regional anesthesia is commonly used after surgery and plays an important role in managing postoperative pain. Even with progress in surgical and anesthetic techniques, many patients still experience noticeable pain following their procedures. This pain may delay early movement, raise the risk of complications, and lead to a longer hospital stay. Regional anesthesia stops pain signals before they reach the central nervous system. Because of this, patients usually feel less pain and need fewer opioids. The effectiveness can vary and depends on the patient's condition, the type of surgery, and the regional technique used. Each method—neuraxial anesthesia, peripheral nerve blocks, and fascial plane blocks—has its own benefits, but their clinical effect may differ between patients. Although complications such as local anesthetic toxicity or nerve injury are rare, they still need to be kept in mind. The purpose of this narrative review is to summarize current knowledge on postoperative pain mechanisms, explain how regional analgesia works, and describe the main techniques of regional anesthesia used in clinical practice, along with their benefits, limitations, and their role in ERAS protocols.

Keywords: postoperative pain, regional anesthesia, nerve blocks, local anesthetics, perioperative care

1. INTRODUCTION

Postoperative pain continues to be an important clinical challenge across surgical specialties, even though perioperative care has improved markedly in recent years. A considerable number of patients still experience moderate to severe pain after surgery, even with advances in perioperative care. Postoperative pain can retard patient mobilization, hinder breathing, and increase the risk of complications such as thromboembolism or prolonged gastrointestinal problems (Eroglu et al., 2014; Chen et al., 2021). Therefore, good postoperative pain control helps patients recover faster and reduces the risk of complications.

The mechanisms that lead to postoperative pain are complex. They include tissue damage, inflammation that makes nerves more sensitive, and changes in how

the central nervous system processes pain signals. Tissue injury causes the release of inflammatory mediators. These substances lower the activation threshold of peripheral pain receptors and make the pain feel stronger. Persistent nociceptive input can also induce central nervous system changes within the spinal cord, resulting in central sensitization, which is increasingly viewed as an important mechanism in the development of persistent postsurgical pain (Chitnis et al., 2020; Chen et al., 2021). A good understanding of these mechanisms helps clinicians select suitable methods of pain treatment and may reduce the risk of long-term pain after surgery.

By blocking pain signals at different levels of the nervous system, regional anesthesia has become an important element of multimodal postoperative pain management. It can help reduce postoperative pain and opioid use across many types of surgical procedures (Eroglu et al., 2014; Chen et al., 2021; Jogie and Jogie, 2023). However, effectiveness of regional anesthesia can change depending on the type of surgery, the patient's individual characteristics, and the technique that is used. The number of new techniques—especially fascial plane blocks—has increased quickly, but the evidence supporting them has not grown at the same pace. Because of this, it is still difficult to clearly determine when these techniques are most effective (Chitnis et al., 2020; Tulgar et al., 2025).

Another issue is that the studies available vary widely in how blocks are performed, how outcomes are defined, and how long patients are followed. The effectiveness of regional anesthesia can also differ simply because it depends on the individual patient anatomy, the clinician experience, and available institutional resources (Chitnis et al., 2020; Paśnicki et al., 2024).

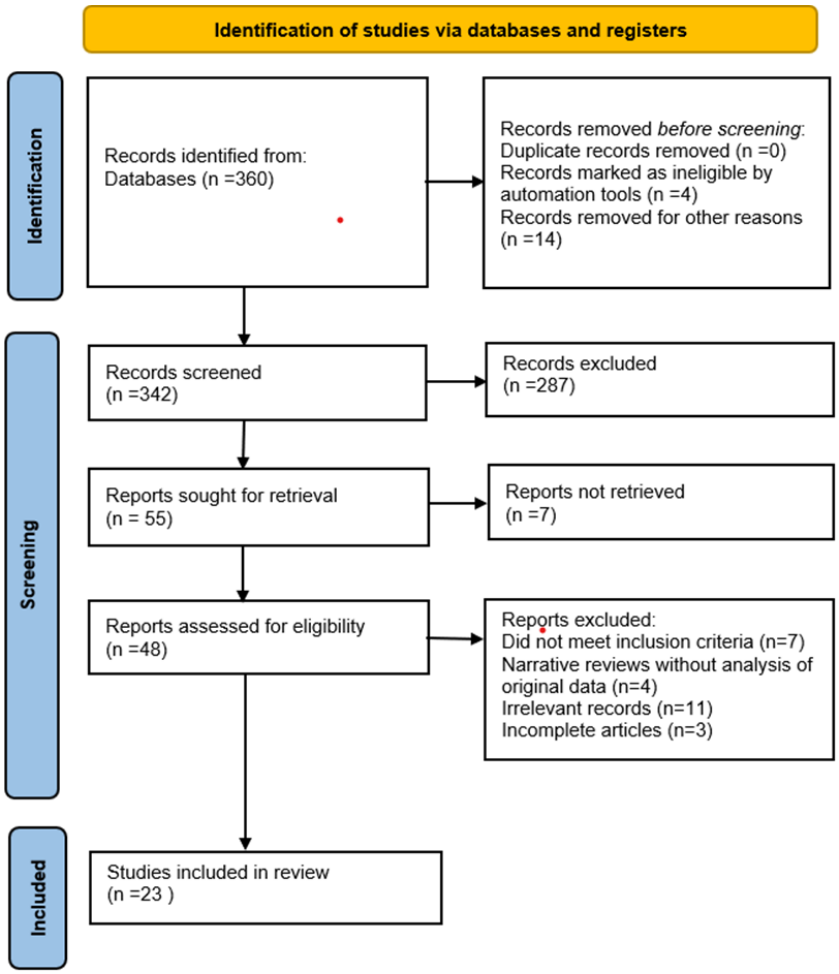

Figure 1. PRISMA chart.

2. REVIEW METHODS

This review was based on studies identified through searches of major scientific databases such as PubMed and PubMed Central. The search concentrated on studies about postoperative pain, different regional anesthesia techniques, peripheral nerve and fascial plane blocks, multimodal pain management, and safety issues, including local anesthetic systemic toxicity. Such selected articles were

analyzed and summarized in this review. In our database search, we used the following keywords: postoperative pain, regional anesthesia, nerve blocks, local anesthetics, perioperative care. This review includes articles published between January 2009 and August 2025. We left out case reports, conference abstracts, non-peer-reviewed papers, and studies that did not focus on postoperative pain or regional anesthesia (Figure 1).

3. RESULTS & DISCUSSION

Pathophysiology of Postoperative Pain

Postoperative pain arises from the interaction of peripheral and central mechanisms activated by surgical tissue damage. The injury triggers the release of inflammatory mediators such as cytokines, prostaglandins, bradykinin, and substance P. These substances make peripheral nociceptors more sensitive and lower their activation threshold. This process, known as peripheral sensitization, increases the responsiveness of sensory fibers and leads to severe pain in the early postoperative period. The magnitude of this response depends on factors such as the extent of surgical trauma, the type of procedure performed, and individual patient characteristics, including baseline inflammatory status and pre-existing pain conditions (Brennan, 2011; Pogatzki-Zahn et al., 2017).

Continuous pain signals from the surgical area can cause changes in the central nervous system. In central sensitization, neurons in the dorsal horn become more excitable. This increases nociceptive signaling and leads to clinical signs such as hyperalgesia and allodynia (Woolf, 2011). These neuroplastic changes may persist beyond the initial phase of tissue healing and are considered an essential mechanism in the progression from acute postoperative pain to persistent postsurgical pain (Woolf, 2011; Richebé et al., 2018).

Early and effective treatment of postoperative pain is very important. It not only improves patient comfort but also helps reduce sensitization in peripheral tissues and in the central nervous system. By limiting ongoing pain signals after surgery, it may also lower the risk of long-term pain problems (Pogatzki-Zahn et al., 2017; Richebé et al., 2018).

Mechanisms of Regional Analgesia

Regional analgesia is an important part of modern postoperative pain management because it works by stopping pain signals before they reach the central nervous system. Local anesthetics work by acting directly on peripheral nerves. They block sodium channels in the nerve membrane, which prevents normal nerve signal transmission. As a result, pain signals from the surgical area are reduced or completely blocked (Becker and Reed, 2012).

Not all nerve fibers are affected equally by local anesthetics. Sensory nerve fibers are usually blocked earlier than motor fibers, so pain relief appears before muscle weakness. The effect of local anesthetics is temporary. As the drug is slowly redistributed and metabolized, normal nerve function slowly returns. Because this mechanism is fully reversible, regional analgesia can provide effective postoperative pain control with a good safety profile and without causing permanent nerve damage (Becker and Reed, 2012).

In clinical practice, regional analgesia works by blocking pain signals near the surgical site, helping patients experience less pain after surgery. According to Eroglu and colleagues, regional anesthesia techniques have been shown to reduce how often patients experience postoperative pain and to lower the amount of opioid analgesics they need after surgery. This also decreases side effects related to opioids like nausea and vomiting, making recovery smoother for many patients. Regional blocks are used in different types of surgery and can be particularly helpful when combined with other pain management methods as part of a multimodal approach to postoperative care (Eroglu et al., 2014).

Neuraxial Techniques of Regional Anesthesia

Neuraxial techniques mainly include spinal and epidural anesthesia. These methods are often used to control pain after surgery. In neuraxial anesthesia, local anesthetic drugs are injected close to the spinal cord. This blocks pain signals at the level of the spinal nerves, so pain from the surgical area does not reach the brain as strongly (Eroglu et al., 2014).

Spinal anesthesia is usually given as a single injection into the subarachnoid space. It works quickly, but the effect lasts only briefly. Because of this, spinal anesthesia is mainly used for shorter operations. Epidural anesthesia is different because a catheter is placed in the epidural space. This allows repeated or continuous administration of local anesthetics. Thanks to this, epidural analgesia can be continued after surgery and adjusted depending on how much pain the patient is experiencing (Eroglu et al., 2014).

Neuraxial anesthesia can help control pain and may also lower the body's stress response to surgery by reducing activation of the sympathetic nervous system (Cusack and Buggy, 2020). At the same time, these techniques can cause side effects. The most common

ones include low blood pressure, weakness in the legs, and problems with urination. For this reason, careful monitoring and proper patient selection are important when neuraxial anesthesia is used (Agarwal and Kishore, 2009).

Peripheral Nerve Blocks

Peripheral nerve blocks are often used after surgery because they target the nerves that send pain signals from a specific area, which can help reduce the need for systemic opioids. In this method, local anesthetic is injected close to a peripheral nerve or nerve plexus, which gives effective pain relief, especially in the early hours after the operation. These techniques are frequently employed in orthopedic procedures such as knee, shoulder, and ankle surgery, but their use extends to many other surgical specialties depending on institutional practice (Niyonkuru et al., 2024; Jogie and Jogie, 2023).

Nerve blocks are usually performed as a single injection or with a catheter placed near the nerve. Single-shot blocks provide effective early postoperative analgesia, but their effect is time-limited, which means that pain may increase once the block wears off. They often give good pain control for several hours after surgery, which is usually the most painful time. When the block effect fades, some patients report sudden worsening of pain, sometimes described as rebound pain. That's why it is important to plan regular analgesics from the beginning (Chung et al., 2025). Continuous nerve block techniques can avoid this problem to some extent, but they are more demanding. They require pumps, trained staff, and patient education, which is not always practical for every patient (Singhal and Taksande, 2024).

Peripheral nerve blocks are well described in knee surgery. The femoral nerve block gives good pain relief, but it can weaken the quadriceps muscle, which is not helpful when early mobilization is needed. For this reason, the adductor canal block has become more popular. It mainly blocks sensory fibers and usually has less effect on muscle strength. Studies available in PubMed Central suggest that pain control is often similar, while patients may mobilize earlier, although results are not always identical between studies (Lim et al., 2019).

The use of ultrasound has clearly changed how peripheral nerve blocks are performed. Ultrasound allows direct visualization of anatomical structures, making needle placement easier and more precise. This probably explains why nerve blocks are now used more widely than in the past. Still, they are not completely without risk. Serious complications such as nerve injury or local anesthetic systemic toxicity are uncommon, but they can still occur. Because of this, following basic safety principles, using the right dose, and monitoring the patient remain essential, even when the procedure seems routine (Wahl et al., 2018).

Peripheral nerve blocks play an important role in multimodal postoperative pain management. They can markedly improve patient comfort in the early postoperative period by providing effective, targeted analgesia. However, it is important to plan for continued analgesia when the block loses its effect (Chung et al., 2025; Jogie and Jogie, 2023).

Fascial Plane Blocks

Fascial plane blocks are increasingly used in postoperative pain management. One main reason is that they are usually easier to perform than classic nerve blocks. They are also considered relatively safe. In these techniques, a local anesthetic is not injected directly next to a single nerve. Instead, it is placed into a fascial plane. The drug then spreads in this space and affects nearby sensory nerves. Because the spread of the local anesthetic within fascial planes is variable and different fascial layers have distinct properties, the analgesic effect can differ between patients (Jakobsson et al., 2015; Tulgar et al., 2025).

The transversus abdominis plane (TAP) block is a regional anesthesia technique that is commonly used to reduce postoperative pain after abdominal surgery. In this block, local anesthetic is injected between the internal oblique and transversus abdominis muscles, where the nerves supplying the anterior abdominal wall are located. According to the reviewed studies, this technique can lower postoperative pain scores and reduce the need for opioids, especially during the first one or two days after surgery. The TAP block has been used in different procedures, such as laparoscopic cholecystectomy, cesarean section, and colorectal surgery, with generally favorable effects on pain control (Jakobsson et al., 2015).

The review also shows that results are not always the same in all studies. There are differences in how the block is performed, the anesthetic dose used, and the comparative methods used in different studies. As a result, the analgesic effect may vary between patients and surgical procedures. Some outcomes, like the influence on postoperative nausea and vomiting, are not clearly improved in all studies. For this reason, the authors suggest that the TAP block should be considered as a part of multimodal analgesia rather than a single solution for postoperative pain (Jakobsson et al., 2015).

The quadratus lumborum block (QLB) is a posterior abdominal trunk block in which local anesthetic spreads to the thoracic paravertebral space and thoracolumbar fascia, providing broad sensory coverage. The local anesthetic is injected near the quadratus lumborum muscle. It is thought that the drug may spread deeper, which could explain why the block can be more effective. Clinical studies show that QLB can reduce pain and opioid use after abdominal and obstetric surgery, although the results are not the same in all studies. The exact mechanism is also not fully clear, which makes the block less predictable in daily practice (Mahmoud Fakhry et al., 2024).

Another technique that has gained attention is the erector spinae plane block (ESPB). The ESPB consist in injecting a local anesthetic deep into the erector spinae muscle, close to the transverse processes. It is used in different types of surgery, such as spinal, thoracic, and abdominal procedures. Evidence from randomized trials and systematic reviews shows that this technique can reduce postoperative opioid use. However, its effect on pain scores is not always consistent and is often only modest. This is due to the fact that the analgesic effect is dependent on where the injection is performed and on the type of surgery (Schnabel et al., 2023; Mahmoud Fakhry et al., 2024).

Overall, fascial plane blocks are attractive because they are relatively simple and usually performed under ultrasound guidance. Serious complications are rare. On the other hand, the analgesic effect can sometimes be difficult to predict because the spread of the local anesthetic within fascial planes is variable. Anatomical differences between patients and the properties of fascial tissues may result in inconsistent clinical effects. In addition, fascial plane blocks do not provide a dense sensory block and are often associated with unpredictable dermatomal coverage (Tulgar et al., 2025). For this reason, in real clinical practice, they are mainly used as part of multimodal analgesia, especially when other regional techniques are contraindicated or technically difficult to perform (Jakobsson et al., 2015; Tulgar et al., 2025).

Regional Anesthesia within ERAS Programs

Enhanced Recovery After Surgery (ERAS) programs aim to speed up recovery by reducing the body's stress response to surgery and encouraging earlier movement after the operation. Good pain control is an essential part of these protocols. Regional anesthesia supports ERAS goals by providing targeted pain relief, which helps reduce the amount of opioids patients need. Minimizing opioid requirements also helps reduce their side effects, which might otherwise slow the patient's recovery (Chitnis et al., 2020; Chen et al., 2021).

Several studies show that the use of regional anesthesia within ERAS programs is associated with earlier mobilization and better patient comfort (Eroglu et al., 2014; Chitnis et al., 2020). Neuraxial and peripheral nerve blocks allow patients to breathe more easily, move sooner, and participate in physiotherapy, which are central elements of ERAS protocols (Eroglu et al., 2014). In this setting, regional anesthesia is usually combined with non-opioid systemic analgesics as part of a multimodal approach rather than used alone (Eroglu et al., 2014; Chitnis et al., 2020).

Another benefit of regional anesthesia in ERAS programs is that it helps reduce opioid-related side effects, such as nausea, bowel problems, and excessive sedation. This reduction in opioid related side effects supports faster recovery and facilitates earlier return to normal postoperative function. However, the type of block should be carefully selected based on the surgery and the patient, as excessive motor blockade can make early mobilization more difficult (Chen et al., 2021).

Overall, regional anesthesia can be used effectively in ERAS programs when it is applied in a thoughtful way. Success depends on proper selection of the technique, close cooperation between anesthesiologists and surgeons, and combining regional techniques with other parts of multimodal perioperative care (Chitnis et al., 2020; Chen et al., 2021).

Safety and Complications

Regional anesthesia is usually considered a safe method of postoperative pain control. However, like most medical procedures, it is not completely risk-free. Serious complications are rare but can occur, especially when the technique is difficult or when monitoring is inadequate. Be aware of possible complications allows for more accurate monitoring, which improves the overall safety of regional anesthesia (Eroglu et al., 2014; Chitnis et al., 2020; Paśnicki et al., 2024).

Most complications related to regional anesthesia appear to be mild and include mainly incomplete or failed block, small hematomas, local infection, or transient neurological symptoms such as numbness or weakness. These problems usually resolve without specific treatment, and available studies suggest that transient neurological symptoms occur in only a small proportion of patients. Permanent nerve injury is described as uncommon (Paśnicki et al., 2024).

A more serious complication is local anesthetic systemic toxicity (LAST), which occurs when excessive amount of local anesthetic gets into the bloodstream. Early symptoms include a metallic taste, numbness around the lips, impairment of hearing and vision, and confusion or agitation. This condition can progress rapidly and lead to seizures—the most common symptom—cardiac arrhythmia, and even severe cardiovascular depression. Although LAST is considered rare, it is a potentially life-threatening adverse event that requires immediate diagnosis and treatment (El-Boghdadly et al., 2018; Antel and Ingelmo, 2022).

Nerve injury is a possible but rare complication of regional anesthesia (Agarwal and Kishore, 2009; Eroglu et al., 2014; Chitnis et al., 2020; Tulgar et al., 2025). Using ultrasound guidance makes the procedure safer and reduces the risk of nerve injury, but it cannot remove this risk completely (Agarwal and Kishore, 2009; Eroglu et al., 2014; Tulgar et al., 2025).

Neuraxial techniques, such as spinal and epidural anesthesia, have their own specific risks. Low blood pressure and slow heart rate may occur due to sympathetic blockade, especially in older patients (Agarwal and Kishore, 2009; Chitnis et al., 2020). Another known complication is post-dural puncture headache, which can appear after spinal anesthesia or accidental dural puncture and may last several days if not treated properly (Agarwal and Kishore, 2009).

The safety of regional anesthesia depends on the use of accurate, well-established techniques and ultrasound guidance, which improve precision and reduce the risk of complications. Correct administration of regional anesthesia with attention to risk factors associated with the patient and the procedure allows for effective postoperative pain relief and maintains an overall good safety profile within multimodal pain management (Eroglu et al., 2014; Paśnicki et al., 2024).

Challenges and Limitations

Regional anesthesia is widely used, but in everyday clinical practice, it can be challenging due to variability in block performance and success rates. The clinical effectiveness of a given block often varies among patients, reflecting differences in surgical procedures, individual anatomy, and the clinician experience and technique (Eroglu et al., 2014; Chitnis et al., 2020).

Another significant limitation is that regional anesthesia is highly dependent on the operator. Nerve blocks require specific training and regular practice. In hospitals with limited experience, regional techniques may be used less often. Access to ultrasound equipment and trained staff can also be a limiting factor (Chitnis et al., 2020).

Single injections block peripheral nerves and give effective pain relief, but the effect lasts only as long as the local anesthetic. Continuous catheter techniques can prolong this effect because the medication is administered over a longer period, helping to maintain more stable postoperative pain control. Even though these techniques are more complex than single injections and require appropriate training and experience to perform safely (Eroglu et al., 2014; Paśnicki et al., 2024).

Patient-related factors also play an important role. Regional anesthesia may not be suitable for individuals with coagulation disorders, those taking anticoagulant medication, or when there is a local infection at the planned injection site. In addition, peripheral nerve blocks may occasionally lead to transient neurological symptoms (TNS). TNS can be very painful, but it is temporary. In most cases, the symptoms resolve without intervention within a few days, usually by the fifth day after surgery, and they do not cause permanent nerve damage (Agarwal and Kishore, 2009).

A challenge in clinical practice is the limited consistency of the evidence base across different surgical procedures. Available studies differ widely in how patients are selected, how outcomes are measured, how long patients are followed, and which block techniques are used. This creates a lot of variation in the evidence. For many newer techniques, especially fascial plane blocks, the amount of solid, high-quality research is still limited. Most studies are small and involve different types of patients, which makes it hard to compare results and create clear, procedure-specific recommendations (Chitnis et al., 2020; Chen et al., 2021).

Regional anesthesia is widely used in perioperative pain management and forms an important component of multimodal analgesia. Nevertheless, the evidence supporting many regional techniques remains heterogeneous, and further well-designed studies are needed to define their effectiveness better and guide clinical practice (Eroglu et al., 2014; Chitnis et al., 2020). The safety of regional anesthesia also depends on factors related to the patient. Anatomical differences and existing medical conditions can increase the risk of nerve problems or other complications (Agarwal and Kishore, 2009; Paśnicki et al., 2024). Safe and successful performance of regional anesthesia relies on appropriate technical skills and the use of modern imaging and monitoring methods, including ultrasound guidance (Chitnis et al., 2020; Tulgar et al., 2025), nerve stimulation, and injection pressure monitoring (Paśnicki et al., 2024).

Future Directions

Future directions in regional anesthesia increasingly focus on making these techniques more individualized, safer, and easier to use in everyday clinical practice. Recent studies suggest that the choice of a regional anesthesia technique should not be based only on the type of surgery, but also on patient-related factors, surgical details, and local clinical conditions. Special attention should be given to the following factors: the patient's preoperative pain level, pain sensitivity, psychological aspects, and the risk of long-term postoperative pain. This approach represents a gradual shift toward more personalized postoperative pain management, in which analgesic strategies are tailored to each patient rather than applied uniformly (Chitnis et al., 2020).

Fascial plane blocks are now among the fastest-developing techniques in regional anesthesia. Their growing use comes from several practical advantages. These include the fact that they are relatively easy to perform, have a good safety profile, and can be used in many different surgical procedures (Niyonkuru et al., 2024; Tulgar et al., 2025). These blocks can be used as a primary regional technique in selected surgeries or, more commonly, as part of a multimodal postoperative pain management (Tulgar et al., 2025). At the same time, their actual effectiveness and optimal clinical role depend on the type of procedure, the specific block used, and the manner in which it is performed, which is reflected in the variability of study outcomes (Niyonkuru et al., 2024; Tulgar et al., 2025).

Safety is also an important topic in future research on regional anesthesia. New approaches, like triple monitoring, combine ultrasound guidance, nerve stimulation, and injection-pressure monitoring to help make peripheral nerve blocks safer and more consistent in everyday practice. These techniques are especially useful for less experienced clinicians, because each monitoring tool helps compensate for the limitations of the others. This helps detect potentially harmful needle–nerve contact at an early stage, even when it is not clearly visible on ultrasound (Paśnicki et al., 2024).

At the same time, many authors point out that the available evidence is still limited for some regional techniques. There is a clear need for more high-quality randomized studies that compare different blocks for the same surgical procedures, explain their mechanisms more clearly, and help create practical clinical guidelines. This need is especially evident in regional anesthesia, where the existing evidence base remains limited and current studies show considerable variability in their findings (Niyonkuru et al., 2024; Jogie and Jogie, 2023).

Finally, future clinical practice is expected to continue treating regional anesthesia as part of a broader multimodal analgesic strategy rather than as a single solution. Combining regional blocks with systemic analgesics has been shown to reduce opioid use and improve overall pain control after surgery. This approach works well with ERAS programs and helps provide care that is more focused on the patient and supports recovery over the long term (Eroglu et al., 2014; Jakobsson et al., 2015). The study summaries are mentioned in Table 1.

Table 1. Summary of Key Findings from the Reviewed Literature on Regional Anesthesia in Postoperative Pain Management.

Topic Area	Key Findings	Clinical Implications
Pathophysiology of postoperative pain	Surgical tissue injury triggers release of cytokines, prostaglandins, bradykinin, and substance P; peripheral and central sensitization contribute to early and persistent postoperative pain.	Understanding mechanisms helps guide targeted analgesic strategies and may reduce risk of chronic postsurgical pain.
Mechanism of regional analgesia	Local anesthetics block sodium channels and interrupt nociceptive transmission; sensory fibers are blocked earlier than motor fibers; effects are reversible.	Provides effective analgesia with fewer systemic side effects; supports multimodal pain management.
Neuraxial techniques	Spinal anesthesia offers rapid onset but limited duration; epidural anesthesia allows continuous dosing; both reduce sympathetic activation	Effective for major surgery but require monitoring for hypotension, urinary retention, and motor block.

Peripheral nerve blocks	Provide targeted analgesia; single-shot blocks offer strong early pain relief but may cause rebound pain; continuous catheters prolong analgesia.	Useful in orthopedic and other surgeries; ultrasound improves accuracy; motor weakness may limit mobilization depending on block type
Fascial plane blocks	Easier to perform; analgesic spread is variable; TAP, QLB, and ESPB reduce opioid use but show inconsistent effects on pain scores.	Best used as part of multimodal analgesia; effectiveness depends on injection site, anatomy, and procedure type.
Regional anesthesia in ERAS	Supports early mobilization, reduces opioid use, and improves patient comfort; aligns with multimodal analgesia principles.	Technique selection must avoid excessive motor block to maintain ERAS goals
Safety and complications	Most complications are mild; serious events such as LAST or nerve injury are rare; ultrasound improves safety but does not eliminate risk.	Proper technique, monitoring, and awareness of patient-specific risk factors are essential.
Challenges and limitations	Evidence is heterogeneous; operator skill and anatomical variability affect success; limited high-quality data for newer blocks.	More standardized, procedure-specific research is needed to guide clinical practice.
Future directions	Emphasis on personalized analgesia, improved safety monitoring (e.g., triple monitoring), and better comparative studies.	Tailored block selection and enhanced safety tools may improve outcomes and consistency.

4. CONCLUSION

Regional anesthesia is a useful method for postoperative pain relief, but its effectiveness can vary depending on the patient and the type of procedure. Blocking pain signals before they reach the central nervous system helps reduce pain and opioid consumption. Each form of regional anesthesia has its advantages and can provide effective pain relief, but its effectiveness depends on the patient, the type of procedure, and the quality of the blockade. Although regional anesthesia is generally safe, proper technique and monitoring are essential. Serious complications are rare, but events such as local anesthetic toxicity or transient neurological symptoms can occur and should be recognized early.

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Authors' Contributions

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Conflict of interest
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Data and materials availability
All data associated with this study will be available based on reasonable request to the corresponding author.

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