

CLINICAL PREVENTION STRATEGIES OF REBOUND PAIN PHENOMENON AFTER PERIPHERAL NERVE BLOCK : A NARRATIVE REVIEW

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ABSTRACT

Peripheral nerve block (PNB) is a key technique in perioperative pain management, effectively reducing pain intensity and opioid consumption. However, the phenomenon of *rebound pain*, defined as a significant increase in pain after the resolution of nerve block effects, has emerged as an increasingly recognized clinical challenge. This review aims to evaluate the pathophysiology, risk factors, clinical impact, and prevention strategies of rebound pain. A narrative review approach was employed through literature searches in PubMed, Scopus, and Google Scholar using keywords related to *rebound pain* and *peripheral nerve block*. Included articles comprised clinical studies, systematic reviews, and meta-analyses published within the last five years and relevant to the topic. The literature was critically analyzed and synthesized narratively. Rebound pain typically occurs within 12-24 hours postoperatively and is associated with peripheral and central sensitization, tissue inflammation, and increased neuronal excitability. Risk factors include younger age, orthopedic procedures, use of single-shot blocks, and inadequate multimodal analgesia. Clinical consequences include sleep disturbances, increased opioid consumption, and reduced patient satisfaction. Prevention strategies involve patient education, administration of analgesics prior to block resolution, use of dexamethasone, and continuous nerve block techniques. With an evidence-based approach, the benefits of PNB can be optimized without increasing the risk of rebound pain, thereby improving the quality of perioperative pain management.

Keywords: Peripheral Nerve Block, Rebound Pain, Multimodal Analgesia, Dexamethasone, Postoperative Pain.

INTRODUCTION

Peripheral nerve block (PNB) has become an integral part of modern anesthesiology practice due to its ability to provide effective analgesia with fewer side effects compared to opioids. This technique also plays a crucial role in *enhanced recovery after surgery* (ERAS) protocols aimed at accelerating patient recovery. PNB associated with a 42% decreased risk of chronic

pain after surgery (Chung et al., 2025; Yin et al., 2025). However, the increasing use of PNB has been accompanied by the emergence of the rebound pain phenomenon, defined as a significant increase in pain after the resolution of nerve block effects. This phenomenon typically occurs within 12 to 24 hours postoperatively and is often more intense than pre-block pain. This

presents a clinical challenge as it may reduce the quality of pain management and also increase resource utilization (Loewenstein et al., 2022).

A systematic literature search was conducted using PubMed, Scopus, and Google Scholar with the keywords “rebound pain,” “peripheral nerve block,” “postoperative pain,” and “dexamethasone.” The search strategy was structured using the PICO approach, including perioperative patients, PNB as the intervention, and rebound pain as the outcome. Based on the literature, rebound pain has become a major research focus in recent years, with evolving insights into its pathophysiology and prevention strategies. This review aims to comprehensively evaluate the pathophysiology, risk factors, clinical impact, and prevention strategies of rebound pain following peripheral nerve block based on current evidence.

LITERATURE REVIEW

During nerve block, nociceptive impulses are suppressed; however, inflammatory processes continue, resulting in a significant surge in pain once the block resolves. Another theory proposes that the intrinsic proinflammatory properties of local anesthetics may cause post-PNB hyperalgesia and neuropathic pain (Nobre et al., 2019). Additionally, increased neuronal excitability within the central nervous system contributes to amplified pain perception, explaining why rebound pain is often more intense than baseline pain. Risk factors such as younger age and orthopedic procedures suggest that rebound pain involves both biological and

clinical components (Barry et al., 2021).

RESEARCH METHOD

This review employed a narrative review approach following established narrative review guidelines. Literature searches were conducted in PubMed, Scopus, and Google Scholar using combinations of relevant keywords. Inclusion criteria included articles published within the last five years, consisting of clinical studies, systematic reviews, and meta-analyses relevant to rebound pain following PNB. Exclusion criteria included articles without full-text availability, non-English publications, and studies with low methodological quality. Selected articles were critically analyzed based on study objectives, methodology, population, and main findings. The literature selection process was conducted in stages, including title screening, abstract screening, and full-text evaluation to ensure alignment with the research objectives. The selected studies were then narratively synthesized and presented in summary tables to facilitate comparison across studies.

RESEARCH RESULT

The literature review indicates that rebound pain is a consistently reported phenomenon in patients undergoing PNB, particularly in orthopedic procedures. Most studies report that rebound pain occurs within 12-24 hours after block resolution, with high pain intensity and significant impact on patient sleep quality.

Studies suggest that the mechanisms underlying rebound pain involve neural sensitization and tissue inflammation. Additionally, multimodal analgesia and

dexamethasone have been shown to reduce the incidence of rebound pain. Continuous nerve block techniques demonstrate superior

outcomes in pain control compared to single-shot blocks, particularly in maintaining analgesic stability.

Table 1. Characteristics and Findings of Studies

No	Author (Year)	Country	Study Design	Research Focus	Key Finding
1	Yin et al. (2025)	China	Narrative review	Pathophysiology of rebound pain	Peripheral and central sensitization play key roles
2	Admassie et al. (2024)	Ethiopia	Systematic review	Prevention of rebound pain	Multimodal analgesia to reduce incidence of rebound pain
3	Lavand et al. (2020)	Belgium	Review	Prevention of rebound pain	Patient education to reduce incidence of rebound pain
4	Singh et al. (2024)	India	Meta-analysis	Prophylaxis dexamethasone	Reduces pain intensity and opioid use
5	Ilfeld (2021)	USA	Review	Continuous peripheral nerve block	Provides stable analgesia and reduce pain fluctuation
6	Li et al. (2024)	China	Randomized controlled trial	Perineural dexamethasone	Prolongs analgesia and reduce postoperative pain
7	Makkar et al. (2025)	India	Meta-analysis	IV vs perineural dexamethasone	No significant differences in effectivity, IV is better in safety
8	Tan et al. (2022)	Korea	Meta-analysis	IV vs perineural dexamethasone	Perineural found to be superior in analgesia duration, IV shows higher postoperative glucose levels
9	Fallon et al. (2025)	Ireland	Review	Risk factor, pathophysiology and prevention	RP risk factors, neuroinflammation as hypothesized mechanism, dexamethasone suggested as RP prevention

DISCUSSION

Rebound pain is a complex phenomenon that is not solely caused by the disappearance of local anesthetic effects but also involves mechanisms of peripheral and central sensitization. In all cases, it is a transient phenomenon, and the timing of onset is consistent with the offset of sensory blockade, which typically coincides with night time

pain and negatively affects sleep quality (Nobre et al., 2019). The pain is commonly described as burning sensation, most commonly lasting from 2 to 6 hours (Muñoz-leyva et al., 2020). The pain also characteristically severe (NRS \geq 7) within 24 h of block administration (Fallon & Ramly, 2025).

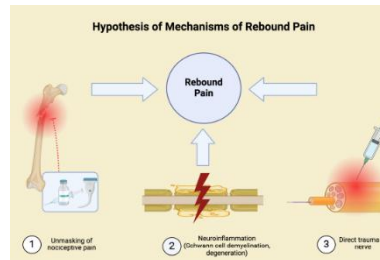


Figure 1. The current hypotheses on the mechanisms of rebound pain (Fallon et al. (2025))

Younger individuals shows higher incidence of rebound pain, possibly because of faster local anesthetic metabolism (Wang et al., 2025). From a management perspective, multimodal analgesia is the primary strategy as it targets multiple pain pathways simultaneously. Multimodal anaesthesia typically involves opioids, NSAIDs, paracetamol, and gabapentin, in conjunction with use of local anaesthetics. Low-dose ketamine were reported to show antihyperalgesic effect, but did not affect rebound pain intensity compared with dexamethasone (Yao et al., 2025). Administering an analgesic medication 1-2 h before the resolution of PNB may help reduce the occurrence of rebound pain. Combination of IV Parecoxib 40 mg and oral Tramadol 100 mg perioperatively also provides effective analgesic bridging and suppressing rebound pain incidence (Admassie et al., 2020; Chen et al., 2025).

The use of dexamethasone has demonstrated consistent

effectiveness across multiple studies. Both IV (0.05 - 0.12 mg/kg) and Perineural (4 - 8 mg) dexamethasone have been shown to be equally efficacious in prolonging the duration and analgesic effects of peripheral nerve blocks (Singh et al., 2024; Touil et al., 2023). When administered perineurally, dexamethasone causes vasoconstriction to decrease the absorption of local analgesics or inhibit potassium channel-mediated discharge of nociceptive C-fibers, and also reduce the level of C-Reactive Protein (CRP) after surgery (Lee et al., 2023; Li et al., 2024). The use of perineural dexamethasone as an adjunct to PNB showed lower incidence of rebound pain, and also showing reduced 24-hour opioid consumption (Sein et al., 2022). A meta-analysis on dexamethasone use when administered with PNB found that perineural dexamethasone was superior to intravenous dexamethasone in duration of analgesia as the primary outcome, no significant differences

found in PONV incidence and patient's satisfaction, but intravenous dexamethasone group shows significantly higher postoperative glucose levels (Sein et al., 2022).

But some patients receiving intraoperative dexamethasone still exhibited rebound pain after peripheral nerve blocks. Three significant risk factors are high anxiety scores (APAIS), high catastrophising score (PCS), and nocturnal awakening pain (Touil et al., 2025). Furthermore, continuous nerve block techniques offer advantages in maintaining analgesic stability and preventing pain fluctuations, but more time consuming, technically challenging, displacement risk, and costly (Ilfeld, 2011; Yoo et al., 2025). Patient's education is also important to either prevent or minimize its occurrence of rebound pain. Some authors suggested that patients should be advised to compare rebound pain intensity to their preoperative pain rather than to the 'almost zero pain score' when PNB was working (Lavand, 2018). However, several limitations exist in the current literature, including variability in study design, heterogeneity of patient populations, and differences in the operational definition of rebound pain. Most studies focus on orthopedic populations, limiting generalizability to other types of surgery. Therefore, further research with standardized definitions and more homogeneous study designs is required to strengthen existing evidence.

CONCLUSION

Rebound pain is an increasingly recognized clinical phenomenon in modern anesthetic practice, particularly with the

growing use of peripheral nerve block (PNB) in perioperative pain management. This phenomenon does not merely reflect the return of pain after block resolution but represents a complex interaction between peripheral and central sensitization, tissue inflammatory responses, and altered pain modulation within the central nervous system. Based on current literature, rebound pain typically occurs within 12-24 hours postoperatively, with pain intensity that may exceed baseline levels, leading to significant clinical consequences such as sleep disturbances, increased opioid consumption, and reduced patient satisfaction. Risk factors include patient characteristics, type of surgery, and anesthetic techniques, particularly the use of single-shot blocks without adequate analgesic support. Effective prevention strategies require an integrated approach, including patient education, administration of analgesics prior to block resolution (bridging analgesia), multimodal analgesia, and the use of adjuvants such as dexamethasone. Additionally, continuous peripheral nerve block techniques show potential in providing more stable pain control and reducing postoperative pain fluctuations.

Nevertheless, knowledge gaps remain and should be addressed in future research. Standardization of the definition of rebound pain is essential to improve consistency across studies. Further well-designed clinical trials are needed to evaluate the effectiveness of prevention strategies, including comparisons of nerve block techniques and optimization of adjuvant use. Individualized approaches based on patient characteristics, including biological and psychological factors, should

also be explored. Additionally, the development of predictive biomarkers and integration of technology in pain monitoring and management may significantly improve patient care outcomes. With a multidisciplinary and evidence-based approach, future research is expected to produce more effective and targeted strategies to prevent rebound pain and improve overall clinical outcomes.

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