



Regional versus Systemic Analgesia in Otologic Surgery: Evaluating Greater Auricular Nerve Block Against Intravenous Nalbuphine

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Abstract

Effective perioperative analgesia in tympanomastoid surgeries remains a critical component of anesthesia practice, as inadequate pain control may lead to increased sympathetic responses, delayed recovery, and higher opioid consumption. Traditionally, systemic opioids such as Nalbuphine have been used due to their dual agonist–antagonist profile, offering analgesia with a ceiling effect on respiratory depression. However, opioid-related adverse effects, including postoperative nausea and vomiting (PONV), sedation, and delayed discharge, have prompted increased interest in regional anesthesia techniques. The Greater Auricular Nerve block, a superficial cervical plexus block, has emerged as a promising alternative for perioperative analgesia in otologic procedures.

Aim: This review aims to critically evaluate the efficacy, safety, and clinical outcomes of greater auricular nerve block compared with intravenous nalbuphine for intraoperative and postoperative analgesia in patients undergoing tympanomastoid surgeries under general anesthesia, with a focus on opioid-sparing effects and recovery profiles.

Methods Overview: A comprehensive analysis of available literature was performed, including randomized controlled trials, observational studies, and meta-analyses examining regional nerve blocks and systemic opioid use in otologic surgery. Key outcomes assessed include intraoperative hemodynamic stability, postoperative pain scores, duration of analgesia, opioid consumption, incidence of PONV, and recovery characteristics.

Results: Evidence suggests that greater auricular nerve block provides superior localized analgesia, reduces intraoperative anesthetic and opioid requirements, and prolongs postoperative pain relief. In contrast, intravenous nalbuphine offers effective systemic analgesia but is associated with higher incidences of sedation and PONV. Regional block techniques demonstrate a significant opioid-sparing effect, contributing to enhanced recovery and improved patient satisfaction. Additionally, nerve blocks may attenuate surgical stress responses more effectively by interrupting nociceptive transmission at the peripheral level.

Conclusion: Greater auricular nerve block represents a valuable regional anesthesia technique that can outperform intravenous nalbuphine in terms of analgesic quality, opioid reduction, and recovery outcomes in tympanomastoid surgery. Incorporating this block into multimodal analgesic protocols aligns with modern anesthesia practices emphasizing enhanced recovery and minimization of opioid-related adverse effects. Further high-quality randomized trials are warranted to standardize techniques and validate long-term benefits.

Keywords: *Regional, Systemic Analgesia, Otologic Surgery, Greater Auricular Nerve Block, Intravenous Nalbuphine*



Introduction

Tympanomastoid surgeries are among the most frequently performed otologic procedures and are commonly conducted under General anesthesia to ensure immobility, airway control, and optimal surgical conditions. Despite the relatively superficial nature of these procedures, patients often experience significant intraoperative nociceptive stimulation and postoperative pain, particularly due to periosteal manipulation and soft tissue dissection around the auricle and mastoid region. Inadequate analgesia during such procedures can provoke sympathetic responses, including tachycardia and hypertension, and may adversely affect surgical field conditions as well as postoperative recovery. Therefore, optimizing perioperative pain management remains a key objective in anesthesia practice. [1]

Traditionally, systemic opioids have been the cornerstone of intraoperative and postoperative analgesia. Nalbuphine, a mixed κ -opioid receptor agonist and μ -opioid receptor antagonist, has been widely used due to its effective analgesic properties and ceiling effect on respiratory depression. This pharmacological profile makes it an attractive alternative to pure μ -agonists, especially in ambulatory and short-duration surgeries. However, despite these advantages, nalbuphine is still associated with opioid-related adverse effects such as sedation, dizziness, and postoperative nausea and vomiting (PONV), which may delay recovery and discharge. [2]

In recent years, there has been a paradigm shift toward opioid-sparing and multimodal analgesia strategies, particularly within the framework of enhanced recovery after surgery (ERAS) protocols. Regional anesthesia techniques have gained increasing attention as they provide targeted analgesia, reduce systemic drug exposure, and improve overall perioperative outcomes. Among these techniques, the Greater Auricular Nerve block—derived from the superficial cervical plexus—has emerged as a simple, safe, and effective method for providing analgesia in surgeries involving the external ear and surrounding structures. By blocking sensory innervation to the auricle and mastoid region, this technique can significantly attenuate nociceptive input during and after surgery. [3]

Several clinical studies have explored the role of superficial cervical plexus blocks, including the greater auricular nerve block, in otologic and head-and-neck procedures. These studies suggest improved intraoperative hemodynamic stability, prolonged postoperative analgesia, and reduced opioid consumption when regional techniques are employed. Furthermore, the simplicity of the block and its low complication rate make it particularly appealing in routine anesthesia practice. However, despite these promising findings, the comparative effectiveness of greater auricular nerve block versus systemic opioids such as nalbuphine in tympanomastoid surgery remains insufficiently synthesized in the literature. [3]

A clear research gap exists in directly evaluating regional versus systemic analgesic strategies in otologic surgery, particularly focusing on clinically meaningful outcomes such as pain scores, opioid consumption, recovery profile, and incidence of PONV. Most available studies either assess regional techniques in isolation or compare different systemic agents, without establishing a comprehensive comparison between these two fundamentally different analgesic approaches. Addressing this gap is essential for guiding evidence-based anesthesia practice and optimizing patient-centered care.

Aim of the Review:

This review aims to critically evaluate and compare the efficacy and safety of greater auricular nerve block versus intravenous nalbuphine for intraoperative and postoperative analgesia in tympanomastoid surgeries performed under general anesthesia, with emphasis on analgesic quality, opioid-sparing potential, and recovery outcomes.

Anatomical and Physiological Basis of Analgesia in Otologic Surgery

The sensory innervation of the auricle and mastoid region is a key determinant of pain during tympanomastoid surgeries. The Greater Auricular Nerve, arising from the cervical plexus (C2–C3), supplies the skin over the parotid region, mastoid process, and lower portion of the auricle. Additional contributions from the auriculotemporal and lesser occipital nerves create a complex sensory network



that transmits nociceptive stimuli during surgical manipulation. Even though these procedures are considered relatively superficial, periosteal irritation and soft tissue dissection generate significant pain. A precise understanding of this anatomical distribution is essential for optimizing targeted regional anesthesia strategies and improving perioperative analgesia. [4]

Pain generation in otologic surgery involves both peripheral nociceptor activation and central sensitization. Surgical trauma induces the release of inflammatory mediators such as prostaglandins, bradykinin, and cytokines, which lower nociceptor thresholds and amplify afferent signaling. These impulses are transmitted through A-delta and C fibers to the dorsal horn of the spinal cord, where they may undergo further modulation and amplification. Inadequate analgesia allows persistent nociceptive input, leading to exaggerated autonomic responses such as tachycardia and hypertension, as well as increased anesthetic requirements. Regional anesthesia techniques can attenuate this cascade by interrupting nociceptive transmission at its peripheral origin, thereby reducing central sensitization and improving overall analgesic outcomes. [4,6]

Pharmacological Profile of Intravenous Nalbuphine

Nalbuphine is a synthetic opioid with a distinct pharmacological profile characterized by κ -opioid receptor agonism and μ -opioid receptor antagonism. This dual mechanism provides effective analgesia while limiting the risk of respiratory depression, which is commonly associated with full μ -opioid agonists. The drug has a rapid onset of action when administered intravenously and is frequently used in intraoperative settings to control moderate pain. However, its analgesic efficacy is subject to a ceiling effect, which may limit its usefulness in procedures associated with more intense nociceptive stimuli, such as mastoid bone drilling and deep tissue manipulation. [5,7]

Despite its advantages, nalbuphine is associated with several clinically relevant adverse effects. Activation of κ -receptors has been linked to sedation and dysphoria, which may negatively affect patient comfort and postoperative recovery. Additionally, opioid-related complications such as postoperative nausea and vomiting remain significant concerns, particularly in otologic surgeries where increased middle ear pressure can worsen patient outcomes. These limitations highlight the need for alternative analgesic strategies that can provide effective pain relief while minimizing systemic side effects and facilitating faster recovery. [5,8]

Technique and Clinical Application of Greater Auricular Nerve Block

The Greater Auricular Nerve block is a regional anesthesia technique targeting the superficial branches of the cervical plexus. It is typically performed at the midpoint of the posterior border of the sternocleidomastoid muscle, where the nerve emerges and becomes superficial. The administration of local anesthetic at this location effectively blocks sensory transmission from the auricle and adjacent structures. Due to its superficial nature, the block is technically straightforward and can be performed with a high success rate using either landmark-based or ultrasound-guided approaches. [3,9]

The introduction of ultrasound guidance has significantly enhanced the safety and precision of this technique. Real-time visualization allows accurate identification of anatomical structures, ensuring proper deposition of local anesthetic while minimizing the risk of vascular puncture or nerve injury. Clinically, the greater auricular nerve block provides focused analgesia that directly corresponds to the surgical field in tympanomastoid procedures. This targeted approach reduces intraoperative nociceptive input and decreases the reliance on systemic analgesics, contributing to improved perioperative management. [3,9]

Intraoperative Hemodynamic Stability

Maintaining hemodynamic stability during otologic surgery is essential for ensuring optimal surgical conditions, including a relatively bloodless field. Inadequate analgesia leads to sympathetic activation, resulting in tachycardia and hypertension, which can compromise surgical precision. Systemic opioids such as Nalbuphine are commonly used to blunt this response; however, they may require repeated administration to maintain adequate effect, potentially increasing the risk of adverse reactions. [1,7]

In contrast, regional techniques such as the greater auricular nerve block provide preemptive analgesia by preventing nociceptive transmission before surgical incision. This results in more stable



intraoperative hemodynamics and reduces the need for supplemental opioids and anesthetic agents. By attenuating the surgical stress response at its origin, regional blocks contribute to improved operative conditions and may enhance overall patient safety. [3,10]

Postoperative Pain Control and Duration of Analgesia

Postoperative pain control is a critical determinant of recovery quality and patient satisfaction. Intravenous administration of Nalbuphine provides moderate analgesia but is limited by its relatively short duration of action, often necessitating repeated dosing or the addition of other analgesics. This approach can lead to cumulative side effects and variability in pain control, particularly in the early postoperative period when pain intensity is highest. [5,7]

In contrast, the greater auricular nerve block offers prolonged and site-specific analgesia, depending on the pharmacokinetics of the local anesthetic used. By directly inhibiting sensory transmission from the surgical area, it provides superior pain relief in the immediate postoperative phase. This extended duration reduces the need for rescue analgesics and supports smoother recovery, particularly in ambulatory surgical settings where rapid discharge is desirable. [3,10]

Opioid-Sparing Effects and Multimodal Analgesia

A central goal in contemporary anesthesia practice is the reduction of perioperative opioid consumption through multimodal analgesia. The use of regional techniques such as the Greater Auricular Nerve block plays a pivotal role in achieving this objective by providing targeted analgesia at the site of surgical injury. By blocking peripheral nociceptive input, this technique reduces the requirement for systemic opioids during both intraoperative and postoperative periods. This opioid-sparing effect not only minimizes drug-related adverse events but also aligns with enhanced recovery protocols aimed at improving patient outcomes and accelerating discharge. [3,10]

In contrast, reliance on systemic opioids such as Nalbuphine, even with its favorable safety profile, does not fully eliminate opioid-related complications. While nalbuphine reduces the risk of respiratory depression due to its ceiling effect, it still contributes to cumulative opioid exposure. This is particularly relevant in procedures where repeated dosing is required to maintain adequate analgesia. Consequently, integrating regional blocks into analgesic regimens represents a more effective strategy for reducing opioid burden while maintaining high-quality pain control. [5,8]

Postoperative Nausea and Vomiting (PONV)

Postoperative nausea and vomiting remain among the most common and distressing complications following otologic surgery. The etiology of PONV in these procedures is multifactorial, involving vestibular stimulation, surgical manipulation of the middle ear, and the use of systemic opioids. Nalbuphine, despite its partial antagonist properties, is still associated with a notable incidence of PONV, which can compromise patient comfort and delay recovery. [1,11]

Regional anesthesia techniques such as the greater auricular nerve block contribute to a reduction in PONV primarily through their opioid-sparing effect. By minimizing the need for systemic analgesics, these techniques decrease the activation of central emetic pathways. Additionally, improved pain control itself has been associated with a lower incidence of nausea and vomiting, further enhancing patient satisfaction. This makes regional analgesia particularly advantageous in otologic surgeries, where prevention of PONV is a critical component of postoperative care. [3,11]

Recovery Profile and Discharge Characteristics

Rapid and smooth recovery is a key objective in modern anesthesia, especially in procedures commonly performed on an outpatient basis such as tympanomastoid surgery. Systemic opioids like Nalbuphine may contribute to delayed emergence, sedation, and prolonged stay in the post-anesthesia care unit. These effects can hinder early mobilization and delay discharge, impacting both patient throughput and healthcare resource utilization. [1,7]

The use of the greater auricular nerve block has been associated with improved recovery profiles due to its targeted analgesic effect and minimal systemic involvement. Patients receiving regional blocks often demonstrate reduced sedation, earlier return of cognitive function, and decreased need for additional analgesics. This facilitates faster transition through the recovery phase and supports same-day discharge,



which is particularly beneficial in high-volume surgical settings. [3,10]

Safety and Complications

Safety considerations are paramount when selecting an analgesic technique. Nalbuphine is generally considered safe, with a lower risk of respiratory depression compared to full opioid agonists. However, it is not without adverse effects, including sedation, dizziness, and potential dysphoria, which may affect patient experience and recovery. Careful dosing and monitoring remain essential when using systemic opioids. [5,7]

The greater auricular nerve block is a relatively safe procedure with a low complication rate, particularly when performed under ultrasound guidance. Potential risks include local anesthetic systemic toxicity, hematoma formation, and inadvertent nerve injury, although these are rare. The superficial location of the nerve and the simplicity of the technique contribute to its favorable safety profile. When performed by experienced clinicians, this block offers a high benefit-to-risk ratio in otologic surgery. [3,9]

Future Perspectives and Clinical Implications

The evolving landscape of perioperative medicine increasingly emphasizes individualized and opioid-sparing analgesic strategies. The integration of regional techniques such as the greater auricular nerve block into routine practice reflects this shift toward precision anesthesia. Future investigations should focus on optimizing block techniques, evaluating long-acting local anesthetics and adjuvants, and generating high-quality randomized controlled trials comparing regional and systemic approaches in otologic surgery. [3,10]

From a clinical standpoint, the choice between regional and systemic analgesia should be guided by patient-specific factors, surgical characteristics, and practitioner expertise. While Nalbuphine remains a useful component of multimodal analgesia, its role may be more appropriate as an adjunct rather than a primary modality when effective regional techniques are available. Expanding the use of nerve blocks in tympanomastoid surgery has the potential to improve analgesic outcomes, reduce complications, and enhance overall patient recovery. [1,10]

Comparative Clinical Evidence and Current Literature

The comparative evaluation between regional techniques such as the Greater Auricular Nerve block and systemic opioids like Nalbuphine has been explored in multiple clinical contexts, although direct head-to-head trials in tympanomastoid surgery remain limited. Available randomized studies on superficial cervical plexus blocks in ear surgeries consistently demonstrate lower intraoperative opioid requirements, improved pain scores, and prolonged analgesia compared with systemic opioid-based regimens. These findings support the growing preference for regional anesthesia as a cornerstone of perioperative analgesia in otologic procedures. [12,13]

Several investigations evaluating regional blocks in head and neck surgery have shown significant reductions in visual analog scale (VAS) pain scores during the early postoperative period. These studies also report delayed time to first rescue analgesic request, indicating superior duration of analgesia. In contrast, opioid-based strategies, including nalbuphine administration, tend to provide shorter analgesic windows and require supplemental dosing. This difference becomes particularly relevant in ambulatory surgery, where sustained analgesia without repeated intervention is highly desirable. [12,14]

Impact on Surgical Field and Operating Conditions

Optimal surgical field conditions are critical in tympanomastoid procedures, where precision is essential. Hemodynamic fluctuations can increase bleeding and compromise visualization under the microscope. Regional blocks, including the Greater Auricular Nerve block, contribute to improved operating conditions by attenuating sympathetic responses and stabilizing blood pressure. This reduction in bleeding enhances surgical accuracy and may shorten operative time. [10,13]

In contrast, systemic opioids such as Nalbuphine provide indirect control of hemodynamic responses and may not fully suppress nociceptive stimuli, especially during intense surgical manipulation. This may necessitate higher anesthetic concentrations or additional agents, potentially increasing the risk of delayed recovery. Thus, regional anesthesia offers a more direct and physiologically effective approach to optimizing intraoperative conditions. [1,7]



Patient Satisfaction and Quality of Recovery

Patient-centered outcomes, including satisfaction and quality of recovery, are increasingly recognized as essential endpoints in anesthesia research. Effective pain control with minimal side effects significantly enhances the overall patient experience. Regional anesthesia techniques have been associated with higher satisfaction scores due to superior analgesia, reduced nausea, and faster recovery. The use of the Greater Auricular Nerve block aligns well with these goals by providing consistent and prolonged pain relief. [14,15]

Conversely, systemic opioids such as Nalbuphine, while effective, may negatively impact patient experience due to sedation and opioid-related adverse effects. Even mild side effects can influence patient perception of care, particularly in elective procedures. Therefore, minimizing opioid use through regional techniques can significantly improve quality-of-recovery scores and patient-reported outcomes. [8,15]

Cost-Effectiveness and Resource Utilization

Healthcare systems increasingly emphasize cost-effective interventions that improve outcomes without increasing resource burden. The greater auricular nerve block is a low-cost technique that requires minimal additional equipment, particularly when performed using landmark-based methods. Even with ultrasound guidance, the cost is offset by reductions in drug consumption, shorter recovery times, and decreased incidence of complications such as PONV. [9,10]

In contrast, reliance on systemic opioids like Nalbuphine may increase indirect costs related to prolonged PACU stay, need for antiemetics, and management of side effects. When viewed from a broader healthcare perspective, regional anesthesia techniques offer a more efficient and economically favorable approach to perioperative pain management in otologic surgery. [10]

Limitations of Current Evidence

Despite the growing body of literature supporting regional anesthesia, several limitations remain. Many studies evaluating the Greater Auricular Nerve block are limited by small sample sizes, heterogeneity in technique, and variability in outcome measures. Additionally, direct comparisons with specific opioids such as Nalbuphine are relatively scarce, highlighting the need for more focused research in this area. [12]

Another limitation is the lack of long-term outcome data, particularly regarding chronic pain development and functional recovery. Standardization of study protocols, including consistent use of pain scoring systems and recovery metrics, would enhance the comparability of results and strengthen the evidence base. Addressing these gaps is essential for establishing definitive clinical guidelines. [13,15]

Future Directions in Research and Practice

Future research should prioritize well-designed randomized controlled trials directly comparing greater auricular nerve block with systemic opioids in tympanomastoid surgery. The incorporation of ultrasound guidance, standardized dosing protocols, and multimodal analgesia frameworks will further refine clinical practice. Additionally, exploring adjuncts such as dexamethasone or clonidine to prolong block duration may enhance the effectiveness of regional techniques. [3,9]

From a practical standpoint, increasing clinician familiarity with cervical plexus blocks and integrating them into routine anesthetic protocols can significantly improve patient outcomes. As the field continues to evolve toward opioid-sparing strategies, the role of regional anesthesia is expected to expand further, potentially becoming the standard of care in suitable otologic procedures. [10]

Conclusion

The comparison between regional and systemic analgesia in otologic surgery demonstrates that the Greater Auricular Nerve block offers significant advantages over intravenous Nalbuphine in terms of analgesic efficacy, opioid-sparing effects, and recovery outcomes. By providing targeted and prolonged pain relief, the nerve block reduces intraoperative anesthetic requirements, minimizes postoperative opioid consumption, and decreases the incidence of adverse effects such as PONV and sedation. These



benefits translate into improved patient satisfaction and more efficient perioperative care.

While nalbuphine remains a valuable component of multimodal analgesia due to its safety profile and ease of use, its limitations highlight the need for adjunctive or alternative strategies. The integration of regional anesthesia techniques into routine practice represents a significant advancement in perioperative pain management for tympanomastoid surgery. Future research should focus on high-quality comparative trials, optimization of block techniques, and exploration of adjuvants to further enhance analgesic outcomes.

In conclusion, the greater auricular nerve block should be strongly considered as a primary analgesic modality in tympanomastoid procedures under general anesthesia, with systemic opioids reserved as adjuncts within a multimodal framework. This approach aligns with current trends toward opioid minimization and enhanced recovery, ultimately improving both clinical outcomes and patient experience.

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