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Comparison of regional and general anesthesia in upper extremity fracture surgeries: A narrative review of evidence-based practices

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Abstract: Upper extremity fractures often require surgical fixation. The choice of anesthesia—general anesthesia (GA) or regional anesthesia (RA)—significantly influences perioperative outcomes. While GA remains the standard, RA, particularly peripheral nerve blocks, has gained popularity due to its potential benefits in pain management and recovery. This literature review aims to summarize current evidence comparing RA and GA for upper extremity fracture surgeries, focusing on postoperative pain control, functional recovery, length of hospital stay, patient satisfaction, and cost-effectiveness. A comprehensive search of peer-reviewed journals, clinical guidelines, and systematic reviews was conducted via PubMed, ScienceDirect, Cochrane Library, and Google Scholar for articles published between 2005 and 2024. Studies comparing RA and GA in adult patients undergoing upper extremity fracture fixation were included. Evidence suggests that RA provides superior immediate postoperative pain control and may reduce opioid consumption and hospital stay. Broader adoption requires adequate training and resource allocation. Both techniques demonstrate comparable long-term functional outcomes.

Keywords: *Disability evaluation, Pain measurement, Regional anesthesia, General anesthesia, Upper extremity fractures.*

1. Introduction

Upper extremity fractures are among the most common orthopedic injuries worldwide, especially in elderly populations due to falls and in young adults due to high-energy trauma [1]. The global incidence of humeral and distal radius fractures continues to rise with aging populations [2]. Surgical fixation often requires either general anesthesia (GA) or regional anesthesia (RA).

GA is still predominant in many institutions due to established protocols and familiarity. However, RA—particularly brachial plexus blocks—offers advantages such as targeted analgesia, reduced opioid use, and faster early recovery [3]. Despite these benefits, adoption varies globally due to the need for skilled personnel and equipment. This review explores and consolidates available evidence to guide practitioners in selecting the optimal anesthetic technique for upper extremity fracture fixation.

2. Methods

A comprehensive literature search was conducted in PubMed, Cochrane Library, ScienceDirect, and Google Scholar using keywords: regional anesthesia, general anesthesia, upper extremity fracture, nerve block, and postoperative outcomes. Inclusion criteria: randomized controlled trials, cohort studies, and

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systematic reviews published in English between 2005–2024 comparing RA and GA for adult patients undergoing upper extremity fracture surgery. Studies on pediatric patients, non-comparative reports, and conference abstracts without full texts were excluded [4].

2.1. Rationale of the Study

The increasing number of upper extremity fractures requiring surgical fixation, along with the expanding use of regional anesthesia (RA) techniques, highlights the need for an in-depth exploration of evidence comparing RA and general anesthesia (GA) in this context. Although GA has traditionally been the standard, recent advances in peripheral nerve blocks and ultrasound-guided regional techniques have positioned RA as a promising alternative with potential benefits in perioperative pain control, opioid reduction, and early recovery.

However, there is ongoing debate regarding the most effective and safe anesthetic approach for different patient populations and fracture types. While several studies have examined individual outcomes, a clear synthesis of the evidence is necessary to guide clinical decision-making and optimize patient care.

This narrative review is essential for consolidating current evidence on the comparative effects of RA and GA in upper extremity fracture surgeries. By summarizing available data on pain control, functional recovery, complication rates, patient satisfaction, and cost-effectiveness, this study aims to identify best practices that can improve patient outcomes and inform future research directions. Furthermore, the review discusses practical considerations and challenges in implementing RA widely, including training requirements and resource limitations.

2.2. Objective of the Review

The primary objective of this narrative review is to provide an evidence-based overview of the comparison between regional anesthesia (RA) and general anesthesia (GA) in upper extremity fracture surgeries. By summarizing perioperative outcomes, including pain control, functional recovery, hospital stay, patient satisfaction, complications, and cost-effectiveness, this review aims to inform anesthesiologists, orthopedic surgeons, and perioperative care providers on current best practices for optimizing anesthetic management in upper extremity fracture fixation.

2.3. Eligibility Criteria

This narrative review is based on the literature published between 2005 and 2025. Relevant studies were identified through comprehensive keyword searches using PubMed, Google Scholar, Cochrane Library, and ScienceDirect databases. Keywords searched included: *regional anesthesia*, *general anesthesia*, *nerve block*, *upper extremity fractures*, *perioperative outcomes*, *and pain management*.

To be included in this review, studies must compare regional anesthesia techniques, such as brachial plexus blocks, with general anesthesia for fracture fixation. We will specifically look for research that reports on key perioperative outcomes, including pain scores, opioid consumption, functional recovery, hospital length of stay, complications, patient satisfaction, or cost-effectiveness. Only studies published in English within the last 20 years will be considered to ensure their relevance to contemporary medical practice.

Conversely, studies will be excluded if they evaluate only one anesthetic method without a direct comparison between regional and general anesthesia. Research that does not report on relevant perioperative or functional outcomes will also be excluded. Finally, non-English publications will be excluded due to limitations in access and translation capabilities.

These criteria ensure the inclusion of high-quality, relevant studies providing comprehensive insights into the advantages and limitations of regional versus general anesthesia in upper extremity fracture surgeries.

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2.4. Search Methods

Articles were retrieved from PubMed, Google Scholar, Cochrane Library, and ScienceDirect using structured keyword combinations and Boolean operators. Reference lists of relevant articles were also screened to identify additional eligible studies. The final selection was based on full-text review and relevance to the comparison of RA and GA in adult upper extremity fracture surgeries.

3. Discussion

3.1. Postoperative Pain Control

Effective postoperative pain management is a key factor in patient satisfaction and functional recovery following upper extremity fracture fixation. Multiple studies, including Roh, et al. [5] have demonstrated that patients who received regional anesthesia, particularly brachial plexus blocks, experienced significantly lower pain scores compared to those under general anesthesia during the first 24 hours post-surgery. This benefit is attributed to the targeted nerve blockade, which interrupts pain signal transmission at its origin.

Moreover, Ilfeld [6] highlighted that continuous peripheral nerve blocks can extend analgesia well beyond the intraoperative period, reducing the need for systemic opioids. Reduced opioid use translates to fewer opioid-related side effects such as nausea, constipation, and sedation, which are common contributors to patient discomfort and delayed discharge. Enhanced pain control also supports earlier participation in postoperative physiotherapy, which is critical for maintaining joint mobility and preventing stiffness. These benefits underline why RA is increasingly favored, especially for day-case or short-stay surgeries where rapid recovery is essential.

3.2. Functional Recovery

Functional recovery encompasses the restoration of joint range of motion, muscle strength, and return to pre-injury activities. Smith, et al. [7] found no significant long-term differences in objective functional outcomes, such as grip strength and range of motion, between RA and GA groups at 6 months. However, early-phase recovery may be enhanced in RA patients due to superior pain control.

Abdallah and Brull [8] suggested that patients receiving RA may be more willing and able to perform early active movements, thereby reducing the risk of postoperative stiffness and frozen shoulder in proximal humerus fractures. Earlier mobilization can shorten the timeline for functional independence, which is especially beneficial for elderly patients or those with multiple comorbidities. Furthermore, better pain control has a positive psychological impact, which indirectly supports motivation to engage in prescribed rehabilitation exercises.

3.3. Hospital Stay and Discharge

Several studies, including Gupta, et al. [9] have reported that patients receiving RA tend to have shorter postoperative hospital stays compared to those who undergo surgery under GA. The key reasons include lower incidence of postoperative nausea and vomiting (PONV), reduced drowsiness, and faster mobilization due to better pain control.

Shorter hospital stays reduce the risk of hospital-acquired infections and contribute to overall cost savings. In high-volume centers or settings with limited bed availability, early discharge optimizes bed turnover and resource allocation. For healthcare systems, this has broader implications for cost-effectiveness and efficiency. Additionally, reduced length of stay aligns with enhanced recovery protocols (ERAS) that aim to streamline perioperative care without compromising patient safety or satisfaction.

3.4. Complication Profile

Despite its advantages, RA is not without potential complications. The most concerning risks include local anesthetic systemic toxicity (LAST), nerve injury, and hematoma formation, especially in

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anticoagulated patients [10]. However, these complications are rare when performed by experienced anesthesiologists using ultrasound guidance and adhering to safe dosage limits.

In contrast, GA is more frequently associated with systemic complications such as PONV, sore throat due to intubation, residual sedation, and cardiorespiratory stress [11]. Patients with significant cardiopulmonary comorbidities may face increased perioperative risks under GA, making RA a safer alternative when feasible. Nonetheless, RA may be technically challenging in certain cases, such as distorted anatomy due to previous surgery or severe trauma. Thorough patient assessment, informed consent, and readiness to convert to GA if RA fails are essential to minimize adverse events.

3.5. Cost-Effectiveness

Economic considerations play an increasingly important role in determining the choice of anesthetic technique. RA has been shown to lower overall treatment costs by decreasing intraoperative drug use, minimizing postoperative opioid consumption, and facilitating shorter hospital stays [12]. These factors collectively reduce direct healthcare costs such as bed occupancy, pharmacy expenses, and nursing care related to opioid side-effect management.

However, the implementation of RA, especially advanced ultrasound-guided blocks, requires investment in equipment, training, and time allocation. Mariano, et al. [13] pointed out that while initial costs for RA training programs and ultrasound devices are higher, long-term savings and improved patient outcomes justify these investments. Additionally, indirect savings include fewer readmissions due to opioid complications or prolonged recovery.

3.6. Patient Satisfaction

Patient satisfaction is a critical outcome metric in modern perioperative care. Liu, et al. [14] found that patients who received RA reported higher satisfaction scores due to reduced pain levels, quicker recovery, and fewer side effects like PONV and residual sedation commonly seen with GA. Surveys also indicate that many patients appreciate remaining awake yet comfortable during surgery, especially when adequately sedated and reassured by the anesthesia team [15].

Furthermore, some patients feel more in control when they can communicate with the surgical team if needed. However, patient preference can vary. While some appreciate being awake, others may experience anxiety about remaining conscious during surgery. Clear preoperative counseling is necessary to align the anesthetic plan with individual patient expectations and comfort levels.

3.6.1. Training and Resources

The successful adoption of RA techniques relies heavily on trained personnel and access to appropriate equipment, particularly ultrasound machines for precise nerve localization [16]. The learning curve for proficiency in RA can be steep, requiring hands-on practice, supervised procedures, and continuous skills updates.

In resource-limited settings, barriers such as lack of trained anesthesiologists, insufficient ultrasound availability, and resistance to change may hinder widespread adoption [17]. To address these challenges, simulation-based training programs and tele-mentoring can be valuable strategies to expand RA capabilities globally. Investing in RA skills also aligns with global initiatives to promote safe anesthesia practices, optimize perioperative outcomes, and improve patient satisfaction.

4. Conclusion

Regional and general anesthesia each have a valuable place in the surgical management of upper extremity fractures. Regional anesthesia often brings clear benefits, especially for pain control in the early recovery phase, which can help patients mobilize sooner and feel more comfortable after surgery. This can also mean a shorter hospital stay in many cases. On the other hand, general anesthesia remains an appropriate and dependable choice, particularly for longer or technically demanding operations, or when patient factors limit the use of nerve blocks.

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In practice, the best results come from matching the anesthesia technique to the patient's overall condition, the type of fracture, and the resources and skills available at the treating hospital. Neither approach is perfect on its own; both rely on careful planning, good technique, and clear communication between the surgical and anesthesia teams.

Looking ahead, developing more consistent training in regional anesthesia, improving access to equipment, and sharing experience across centers can help more patients benefit from its advantages. Continued study and local adaptation will support safe, effective care and help hospitals make the best use of both techniques to serve their patients well.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Copyright:

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Table 1.
Characteristics of the Included Studies.

Author	Year	Study Design	Anesthesia (n)	Age (mean SD)	Sample Size	Gender	Fracture type	Outcome
Alimohammadi, et al. [18]	2014	RCT	General (n=30)	38.1 (19.4)	60	M: 21 (70%) F: 9 (30%)	Upper extremity fractures	VAS upper extremity, medicine used
			Regional (n=30)	38.1 (16.9)		M: 20 (66.7%) F: 10 (33.3%)		
Galos, et al. [19]	2016	RCT	General (N=18)	54.9 (16.7)	36	M: 6 F: 12	Distal radius fractures	VAS upper extremity, DASH Score, medicine used, time of recovery
			Regional (N=18)	54.4 (14.8)		M: 9 F: 9		
Egol, et al. [20]	2012	Retrospective cohort	General (n=122)	53.5 (15.7)	187	M: 55 (45%) F: 67 (55%)	Distal radius fractures	VAS upper extremity, DASH Score
			Regional (n=65)	55.3 (15.6)		M: 18 (28%) F: 47 (72%)		
Egol, et al. [21]	2014	Retrospective cohort	General (n=47)	60 (15.6)	92	M: 13 (27.7%) F: 34 (72.3%)	Proximal humeral fractures	DASH Score, medicine used
			Regional (n=45)	61 (13.3)		M: 11 (24.4%) F: 34 (75.6%)		
Glover, et al. [22]	2015	Retrospective cohort	General (n=194)	5.0 ± 2.2	230	not specified (M+F = 194)	Type II and type III supracondylar fractures	VAS upper extremity, medicine used, time of recovery
			Regional (n=36)	5.2 ± 1.9		not specified (M+F = 36)		
Lee, et al. [23]	2022	Retrospective cohort	General (n=87)	38.5 (13.3)	168	M: 69 (79.3%) F: 18 (20.6%)	Clavicle fractures	VAS upper extremity, medicine used
			Regional (n=81)	36.2 (11.9)		M: 71 (87.7%) F: 10 (12.3%)		
Héroux, et al. [24]	2024	Prospective cohort	General (n=32)	58.6 (13.8)	76	M: 10 (31%) F: 22 (69%)	Wrist fractures	VAS upper extremity, DASH Score, medicine used
			Regional (n=44)	59.9 (18.2)		M: 4 (9%) F: 40 (91%)		
Li, et al. [25]	2023	Prospective cohort	General (n=51)	5.26 (1.42)	106	M: 28 (54.90%) F: 23 (45.10%)	Lateral condyle fracture of humerus	VAS upper extremity, medicine used, time of recovery
			Regional (n=55)	5.30 (1.41)		M: 29 (52.73%) F: 26 (47.27%)		

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Nho, et al. [26]	2022	RCT	General (n=36)	71.2 ± 14.5	72	not specified (M+F = 36)	Distal radius fractures	VAS upper extremity, medicine used, time of recovery
			Regional (n=36)	69.5 ± 15.8		not specified (M+F = 36)		
Rundgren, et al. [27]	2019	RCT	General (n=44)	55 (29-74)	88	M: 10 (23%) F: 34 (77%)	Distal radius fractures	VAS upper extremity, medicine used, time of recovery
			Regional (n=44)	55 (21-74)		M: 11 (25%) F: 33 (75%)		
Wong, et al. [28]	2020	RCT	General (n=26)	58.9 ± 12.8	52	M: 7 (26.9%) F: 19 (73.1%)	Distal radius fractures	VAS upper extremity, DASH Score, medicine used
			Regional (n=26)	59.2 ± 8.5		M: 8 (30.8%) F: 18 (69.2%)		

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