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# Outcomes of general anesthesia versus regional anesthesia in ambulatory traumatic surgeries: Systematic review

## Resultados de anestesia general versus anestesia regional en cirugía traumática ambulatoria: revisión sistemática

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### ABSTRACT

Ambulatory surgery is on the rise due to its lower costs and quicker recovery, making the choice between general anesthesia (GA) and regional anesthesia (RA) crucial in traumatic procedures. A thorough search of studies published between 2010 and 2024 in PubMed, MEDLINE, Embase, and Google Scholar yielded twelve studies comparing both modalities. Benefits of RA include fewer postoperative pain episodes, shorter hospital stays, and, in some cases, a decreased need for opioids, particularly following ankle and wrist surgeries. However, the complexity of surgery and patient characteristics influence outcomes. While some studies clearly highlight the advantages of RA, others find similar outcomes between GA and RA. Optimizing patient outcomes requires personalized anesthesia strategies, emphasizing the need for further research to determine the best option for different types of ambulatory operations.

**Keywords:** General anesthesia, regional anesthesia, ambulatory, traumatic surgery, outcomes.

### RESUMEN

La cirugía ambulatoria está en aumento debido a sus costos más bajos y a una recuperación más rápida, lo que hace que la elección entre la anestesia general (GA) y la anestesia regional (RA) sea crucial en procedimientos traumáticos. Una exhaustiva búsqueda de estudios publicados entre 2010 y 2024 en PubMed, MEDLINE, Embase y Google Scholar, arrojó doce estudios comparando ambas modalidades. Los beneficios de la RA incluyen menos episodios de dolor posoperatorio, estancias hospitalarias más cortas y, en algunos casos, una disminución en la necesidad de opioides, particularmente después de cirugías de tobillo y muñeca. Sin embargo, la complejidad de la cirugía y las características del paciente influyen en los resultados. Mientras que algunos estudios resaltan claramente las ventajas de la RA, otros encuentran resultados similares entre GA y RA. Optimizar los resultados del paciente requiere estrategias de anestesia personalizadas, enfatizando la necesidad de más investigaciones para determinar la mejor opción para diferentes tipos de operaciones ambulatorias.

**Palabras clave:** Anestesia general, anestesia regional, ambulatorio, cirugía traumática, resultados.

### Introduction

Recent years have seen a rise in the use of ambulatory surgery, also referred to as outpatient or day surgery, because of its possible advantages, which include lower costs, shorter hospital stays, and speedier patient recovery<sup>[1]</sup>. Common instances handled in ambulatory settings include

trauma injuries like fractures that need surgical intervention. The choice of anesthesia in these situations is critical to the treatment and results of the patient. In traumatic procedures, two primary forms of anesthesia are used: general anesthesia (GA) and regional anesthesia (RA). While RA involves numbing a particular part of the body, enabling patients to stay awake and maybe endure fewer systemic adverse effects, GA offers

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total unconsciousness and pain management during the treatment[2]. The difficulty of the procedure, the patient's medical condition, the surgeon's choice, and other criteria are often taken into consideration while choosing an anesthesia type. There is ongoing discussion over the relative efficacy and safety results of GA and RA, despite their common use in ambulatory traumatic procedures. While some research suggests that RA is more likely than GA to result in a quicker recovery, less pain after surgery, and fewer systemic problems, other studies contend that GA may be more appropriate for operations since it offers better intraoperative circumstances and pain management[3],[4].

Many systematic reviews are present on the comparison of general versus regional anesthesia in different fracture surgeries. For example, A meta-analysis was carried out by Roh et al., to assess the relative merits of regional anesthesia and general anesthesia in the postoperative treatment of pain after distal radius fracture surgery[3]. Comparing regional anesthesia to general anesthesia, the findings showed a substantial reduction in postoperative pain ratings after two hours (SMD -2.03; 95% CI -2.88 to -1.17). After 12 hours after surgery, there were no significant variations in pain ratings between the two anesthetic kinds, nevertheless. According to the results, there is a noticeable rise in opioid consumption on the first day after discharge, which may be related to rebound pain, even if regional anesthesia may provide analgesic superiority in the early postoperative period and reduce total opioid usage. To examine the effects of regional anesthesia (RA) with general anesthesia (GA) on postoperative complications in patients having lower extremity amputation (LEA), Mufarrih et al., carried out another systematic review and meta-analysis[5]. In comparison to RA, GA was linked to a greater risk of sepsis and respiratory failure, according to the meta-analyses. But there is no systematic review on ambulatory traumatic surgeries. Therefore, the objective of this systematic study is to evaluate the effects of regional anesthesia (RA) vs general anesthesia (GA) in ambulatory traumatic procedures. Our goal is to assess the effectiveness, safety, recovery times, and financial effects of different anesthetic methods by examining current research on a range of orthopedic operations, such as spine surgery, total joint arthroplasty, and knee arthroscopy. Our goal is to give evidence-based insights to improve patient outcomes and clinician decision-making in ambulatory traumatic procedures by a thorough synthesis of the literature. To compare the effectiveness of GA against RA in ambulatory traumatic procedures, this systematic review will critically analyse and assess the material that is currently accessible.

## Methodology

### Search strategy

A systematic search of electronic databases, including PubMed, MEDLINE, Embase, and Google Scholar, is being conducted to identify relevant studies published between 2010 and 2024. The search strategy utilizes combinations of keywords related to "general anesthesia," "regional anesthesia," "ambulatory surgery," "traumatic injuries", "fractures", and outcomes. Boolean operators (AND, OR) are used to combine these terms effectively (Figure 1).

### Study selection

Two independent reviewers screened the titles and abstracts of identified articles to assess their eligibility for inclusion. Full-text articles meeting the predefined criteria are retrieved for further evaluation.

### Inclusion criteria

- Studies that compare outcomes of general anesthesia versus regional anesthesia in ambulatory traumatic surgeries.
- Randomized controlled trials, prospective cohort studies, and retrospective cohort studies are included.
- Only studies published in English are considered.

### Exclusion criteria

- Studies not directly comparing general anesthesia with regional anesthesia.
- Case reports, editorials, reviews, and conference abstracts are excluded.
- Studies published in languages other than English are excluded.

### Data extraction

Relevant data are being extracted from the selected studies, including study characteristics (author, year, study design), type of anesthesia, surgical procedures, and outcomes assessed (e.g., pain, recovery time, complications).

### Quality assessment

The quality of included studies is being assessed using appropriate tools such as the RoB 2.0 tool for randomized controlled trials and the Newcastle-Ottawa Scale for cohort studies.

## Results

The characteristics and findings of the studies reviewed are narrated in Table 1. A total of 12 papers were included in the comprehensive review of outcomes after surgery including various methods of anesthesia: 4 randomized controlled trials (RCTs), 1 mixed-method observational research, and 7 cohort studies. Through the analysis of data from large patient groups having surgery under either regional anesthesia (RA) or general anesthesia (GA), the retrospective cohort studies offered insightful information. Numerous surgical techniques were covered by this research, such as lumbar decompression, total knee arthroplasty (TKA), ambulatory hip or knee arthroplasty, distal radius fracture surgery, ulnar nerve decompression, and ankle fracture surgery (Table 2).

The three randomized controlled trials (RCTs) assessed the effects of various anesthetic types on treatments, including volar plating for distal radius fractures, outpatient knee arthroscopy, and maxillofacial surgery. The controlled comparisons between RA and GA provided by these studies helped researchers get a better understanding of the effectiveness and safety of both anesthetic techniques. To evaluate day surgery patients' postoperative recovery experiences and quality, a mixed-method observational research including qualitative and quantitative data was conducted. The studies covered a variety of participant groups having different surgical procedures, and their sample sizes ranged from a few hundred (minimum: 50)

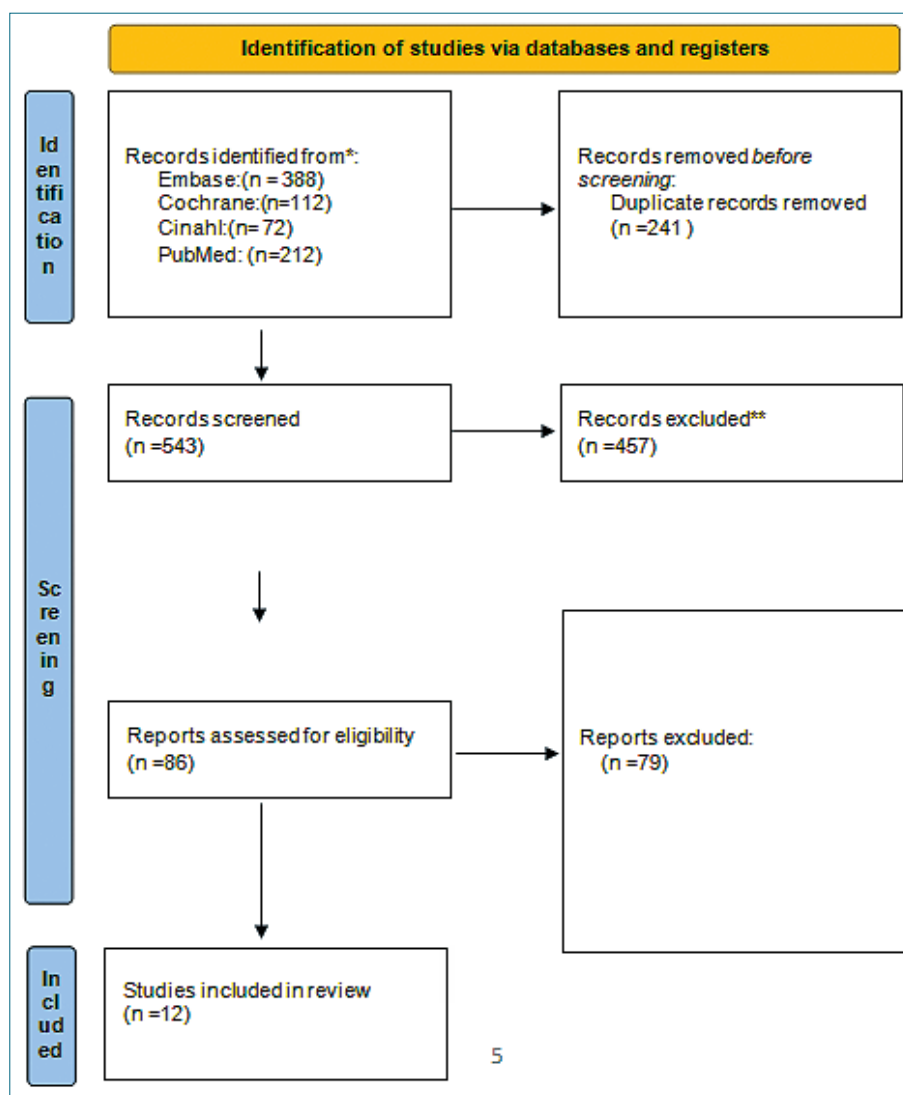


Figure 1. Prima flow diagram.

to several thousands (maximum: 353,970).

Evaluating postoperative outcomes, including surgery time-frames, complications, pain management, recovery times, readmissions, and functional recovery, was the main goal of the 12 trials. Some studies revealed no significant differences between the two anesthesia techniques, while others indicated benefits of RA over GA in some situations, such as less discomfort and shorter hospital stays. All things considered, the research offers significant understanding of the relative safety and efficacy of RA and GA in various surgical situations.

## Discussion

In ambulatory traumatic procedures, the evaluated studies provide insightful information about the relative benefits of general anesthesia (GA) and regional anesthesia (RA). When choosing the best anesthesia method for a patient, it is important to carefully assess the benefits and limits of each tech-

nique. These studies support each other.

Based on the collective data from 12 studies, it can be concluded that, in ambulatory traumatic procedures, regional anesthesia (RA) typically provides better results than general anesthesia (GA). Research shows that RA is useful in a variety of surgical contexts, such as ankle fractures, lumbar decompression, and ulnar nerve decompression. Studies by Womble et al, Lee et al., Carlson Strother et al, and Wahood et al, consistently show this association with shorter hospital length of stay (LOS), comparable safety profiles, and lower rates of postoperative complications[6],[9],[8],[17]. Furthermore, RA is better than GA in terms of postoperative pain management and recovery, especially in maxillofacial and distal radius fracture procedures shown by Rastogi et al., and Nho et al.[12],[13]. These findings are supported by several research. Collectively, these results point to the possibility that RA might be a safer and more successful option than GA for ambulatory traumatic procedures, offering patients improved functional outcomes and pain management.

**Table 1. Characteristics and findings of the studies reviewed**

Author	Year	Study type	Population (Number)	Surgery type	Results	Conclusion (summarized)
Tanner N Womble et al.[6]	2021	Retrospective cohort study	9,459 patients undergoing ankle fracture surgery	Open reduction and internal fixation (ORIF) of closed ankle fracture	Inpatient (GAI = 71 min vs. RAI = 79 min, $p = 0.002$ ) and outpatient (GAO = 66 min vs. RAI = 72 min, $p < 0.001$ ), the RA group's surgical times were greater. - Overall, LOS was reduced in the RA group (GA = 1.7 days vs. RA = 1.1 days, $p < 0.001$ ) - Greater rate of pain readmission in the RA group (RAO = 4 [0.3%] vs to GAO = 1 [0.0%], $p = 0.007$ )	Increased surgical time, shorter hospital lengths of stay, and greater readmission rates for rebound pain are all linked to RA. The low rate of readmissions, however, suggests that RA is a secure and efficient treatment for ankle fractures
Ulrica Nilsson et al.[7]	2019	Mixed Method Observational study	401-day surgery patients	General, hand and orthopedic ambulatory surgeries	There were significant variations in the recovery quality between GA and RA from day 1 to day 13 ( $P < .05$ ). - The GA group showed more noticeable psychological problems and weariness. The primary issue was discomfort from the surgery wound	In comparison to RA, GA produced a worse prognosis, including more weariness and psychological problems. Improving patient outcomes throughout recovery requires addressing unforeseen difficulties
Carlson Strother CR et al.[8]	2023	Retrospective cohort study	91 patients undergoing ulnar nerve decompression	Ulnar nerve decompression at cubital tunnel	There was no discernible variation in post-operative problems between the groups receiving general anesthesia ( $n = 8$ ) and regional anesthesia ( $n = 7$ ). - There was no discernible difference in the pre- and post-operative McGowan ratings between the anesthesia groups ( $p = 0.81$ )	There is no difference in the number of post-operative problems between patients under regional anesthesia and those under general anesthesia after in situ ulnar nerve decompression at the cubital tunnel. For patients, regional anesthesia is a dependable and safe alternative
Ryan Lee et al.[9]	2022	Retrospective cohort study	1,191 patients receiving RA matched to 9,250 patients receiving GA	Open reduction and internal fixation (ORIF) for distal radius fractures (DRFs)	The matched-cohort analysis revealed no statistically significant variations in the rates of any complications (all $p \geq 0.083$ ). RA was not linked to a higher risk of any kind of complication, minor or severe complications, unplanned readmissions, unplanned reoperations, or death, according to multivariate regression models (all $p > 0.05$ )	To surgically control DRFs, RA is a viable and safe substitute for GA. In individuals with severe cardiopulmonary risk factors, it could be preferable
Mark C. Kendall et al.[10]	2021	Retrospective cohort study	353,970 patients who underwent TKA procedures	Outpatient total knee arthroplasty (TKA)	Patients receiving GA did not have higher SAE rates at 72 hours after surgery (0.92% vs. 0.66%, $p = 0.369$ ) than patients receiving SA. - There were more minor adverse events in the GA group (2.09% vs. 0.51%, $p < 0.001$ ) than in the SA group. - Postoperative transfusion rate was higher in the GA group	For patients receiving outpatient TKA surgery, the type of anesthetic approach (GA or SA) had no discernible impact on readmissions, failure to rescue, or short-term major adverse events. Clinical advantages might be maximized by SA customised for anaesthetic management
Jennifer Héroux et al.[11]	2023	Prospective observational cohort study	76 patients undergoing wrist surgery	Orthopedic wrist surgery (distal radial fracture)	- According to the QuickDASH and PRWE questionnaires, there was no discernible difference in the functional recovery between the RA and GA groups 12 weeks after surgery ( $p > 0.05$ ). - There were no differences in groups' range of motion, satisfaction, or postoperative discomfort. - The GA group had a stronger right-hand grip	When it comes to wrist surgery, regional anesthesia is not linked to a better functional recovery than general anesthesia. In order to evaluate the impact of anesthesia on recovery, further study is required to take into consideration the dominance of the operated limb

Amit Rastogi et al.[12]	2014	Randomized controlled trial	50 patients aged 15-50 scheduled for maxillofacial surgery	Maxillofacial surgery (mandibular fracture or TMJ ankylosis)	Compared to group II (general anesthesia), patients in group I (regional block with sedation) had less postoperative pain (VAS score) and were pain-free for a longer period of time. - Group I had fewer bouts of postoperative nausea and vomiting and needed smaller doses of rescue analgesia. - Group I's earlier PACU discharge	When compared to general anesthesia, regional block with sedation is a safe substitute for maxillofacial surgery that offers benefits for postoperative pain management and recovery
Jae-Hwi Nho et al.[13]	2021	Randomized controlled trial	72 patients undergoing volar plating for distal radius fracture (DRF)	Volar plating for distal radius fracture	Compared to patients under general anesthesia, those under brachial plexus block (BPB) anesthesia had reduced postoperative pain (VAS score). - Early postoperative pain scores were lower when BPB anesthesia was used. Superior pain control with BPB anesthesia in contrast to general anesthesia	Patients with distal radius fractures respond better to brachial plexus block (BPB) anesthesia than general anesthesia for the treatment of acute pain after volar plating
Rundgren et al.[14]	2019	Randomized controlled trial	88 patients undergoing day surgery for displaced distal radial fracture (DRF)	Day surgery for displaced distal radial fracture with volar-plate fixation	Between the general anesthesia (GA) and regional anesthesia (RA) groups, different patterns of postoperative pain and opioid intake were noted. - Both acute postoperative pain and painkiller usage were greater in the GA group. - After discharge, the RA group had increased discomfort. - After six months, there were no appreciable variations in the long-term results	In distal radial fracture surgery, anesthesia technique has a substantial impact on both early postoperative pain and opioid use; nevertheless, long-term results between general anesthesia and regional anesthesia groups are comparable
Volker Gebhardt et al.[15]	2018	Randomized controlled trial	50 patients aged 18-80 undergoing outpatient knee arthroscopy	Outpatient knee arthroscopy	Compared to general anesthesia, spinal anesthesia with 1% chloroprocaine resulted in a much earlier discharge and less expenses. Pain started much sooner in the group under general anesthesia. - Following general anesthesia, patients had significantly greater discomfort	A good alternative for an outpatient knee arthroscopy is spinal anesthesia with 1% chloroprocaine, which reduces patient pain and allows for an earlier release
Edward Yap et al.[16]	2022	Retrospective cohort study	11,523 patients undergoing ambulatory hip or knee arthroplasty	Ambulatory hip or knee arthroplasty	There were no significant problems that distinguished general anesthesia (GA) from neuraxial anesthesia (NA). The NA group had less pain, a decreased need for opioids, and a decrease in postoperative nausea and vomiting (PONV). - The NA group's median stay in the recovery room was shorter	Despite shorter recovery room stays, neuraxial anesthesia improves outcomes that predict readiness for release in ambulatory hip or knee arthroplasty, with less pain, less opioids, and a decreased incidence of PONV
Waseem Wahood et al.[17]	2019	Retrospective cohort study	60,222 patients undergoing lumbar decompression (LD)	Lumbar decompression (LD)	For LD, there were no significant variations in readmission, complications, or duration of stay between the general and non-general anesthesia groups. - For LD, non-general anesthesia produced results that were comparable to those of general anesthesia	In lumbar decompression surgery, non-general anesthesia performs comparably to general anesthesia, indicating that it is a safe substitute that yields similar results

**Table 2. Quality assessment of RCTs**

Study	Risk of bias domains					Overall
	D1	D2	D3	D4	D5	
Amit Rastogi et al.	-	+	+	+	+	+
Jae-Hwi Nho et al.	+	+	+	+	+	+
Rundgren et al.	+	+	+	+	-	+
Volker Gebhardt et al.	-	+	+	+	+	+

Domains:  
D1: Bias arising from the randomization process.  
D2: Bias due to deviations from intended intervention.  
D3: Bias due to missing outcome data.  
D4: Bias in measurement of the outcome.  
D5: Bias in selection of the reported result.

Judgement  
- Some concerns  
+ Low

Study	Representativeness of the exposed cohort (1)	Selection of the non-exposed cohort (1)	Ascertainment of exposure (1)	Demonstration that outcome of interest was not present at start of study (1)	Comparability of cohorts on the basis of the design or analysis (2)	Assessment of outcome (1)	Was follow-up long enough for outcomes to occur (1)	Adequacy of follow up of cohorts (1)	Representativeness of the exposed cohort (1)
Tanner N Womble et al.	1	1	1		2	1	1	1	1
Carlson Strother CR et al.	1	1	1	1	2	1	1	1	1
Ryan Lee et al.	1	1	1		2	1	1	1	1
Mark C. Kendall et al.	1		1		1	1	1	1	1
Jennifer Héroux et al.	1		1		1	1	1	1	1
Edward Yap et al.	1	1	1		2	1	1	1	1
Waseem Wahood et al.	1	1	1	1	2	1	1	1	1

Even as RA has several benefits, the data also shows that, in certain surgical procedures, there are no appreciable differences between GA and RA, or even possible benefits. Research by Nilsson et al., Kendall et al, and Gebhardt et al. indicates that decisions on RA vs GA may not have a major effect on how well patients recover after procedures including day surgery, outpatient total knee arthroplasty (TKA), and knee arthroscopy[7],[10],[15]. Further evidence of similar results between the two anesthetic methods comes from Héroux et al., who found no discernible difference in functional recovery between the RA and GA groups after wrist surgery[11]. According to Yap et al., there were variations in pain management and postoperative nausea and vomiting (PONV), but overall, GA and neuraxial anesthesia (NA) produced comparable major complication rates in ambulatory hip or knee arthroplasty [16].

Different recovery patterns for GA and RA have been seen in several investigations, which is a consistent result. Patients having surgery under GA had worse recovery outcomes than

those under RA, according to Ulrica Nilsson et al. [7]. These patients also reported higher levels of weariness and psychiatric problems. For outpatient knee arthroscopy, Volker Gebhardt et al., discovered that spinal anesthesia with 1% chlorprocaine led to a much quicker discharge and cheaper expenditures than GA[15]. When selecting an anesthesia approach for ambulatory operations, our results emphasize the need to take the patient's comfort and recovery time into account.

But patients' unique surgical needs and preferences should also be taken into account when deciding between GA and RA. Jennifer Héroux et al., for example, showed no appreciable difference in functional recovery between the RA and GA groups after wrist surgery for distal radial fractures [11]. It is possible that the kind of anesthesia used during an operation won't have a major effect on the functional results in the long run.

The research is conflicting on safety and complication rates. Studies like Waseem Wahood et al, [17] and Carlson Strother CR et al,[8] observed no statistically significant difference in

post-operative complications between the GA and RA groups, but Tanner N. Womble et al, found that the RA group had greater readmission rates for pain[6]. The disparity highlights the need for more investigation to get a deeper comprehension of the elements influencing post-operative problems and readmissions in ambulatory traumatic procedures.

Additionally, the results imply that when selecting the anesthesia approach, certain patient characteristics and preferences should be considered. In patients having surgery for distal radius fractures, for instance, Ryan Lee et al, discovered that RA may be recommended over GA since it was not linked to an increased risk of complications. The patients had high cardiac risk factors [9].

The variability of included studies with regard to anesthesia methods, surgical procedures, and outcome measures is one of the systematic review's limitations since it may restrict how broadly the results can be applied. Furthermore, certain studies' quality and design-such as those of retrospective cohort studies-may add bias and compromise the validity of the findings. Prospective viewpoints have to concentrate on carrying out meticulously planned randomised controlled trials with uniform procedures to contrast GA and RA in particular ambulatory trauma operations. Furthermore, studies examining characteristics unique to each patient, such comorbidities and preferences, may be able to better customise anesthetic techniques. In ambulatory traumatic operations, integrating cutting-edge technology like perioperative monitoring tools and enhanced recovery after surgery (ERAS) protocols may further optimize anesthesia management and improve patient recovery.

## Conclusion

Finally, a thorough comparison of the results of general anesthesia (GA) vs regional anesthesia (RA) in ambulatory traumatic procedures is provided by this systematic review. Based on a comprehensive analysis of twelve trials covering a range of orthopedic operations and surgical methods, we have determined that both GA and RA are reasonable choices for anesthesia in ambulatory settings, with unique benefits and drawbacks. While some research revealed advantages of RA, such as decreased opioid use, shorter hospital stays, and less pain after surgery, other studies found similar results with GA and RA. The intricacy of the surgery, the patient's features, and the postoperative recovery objectives all influence the choice of anesthesia. In order to improve clinical decision-making and patient outcomes in ambulatory settings, further research is required to clarify the best anesthesia strategy for certain ambulatory traumatic procedures.

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