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Research Article

The effect of regional anesthesia practices on intensive care unit admission rates in shoulder surgery: A single-center, 7-year retrospective analysis

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ABSTRACT

Background: Shoulder surgeries are performed on a heterogeneous patient population ranging from young to elderly individuals. Across this diverse spectrum, general anesthesia (GA) can increase the risk of perioperative systemic complications and intensive care unit (ICU) admission, whereas regional anesthesia (RA) techniques are known to mitigate these risks and reduce ICU requirements. The aim of the study is to evaluate the effect of transitioning from general anesthesia (GA) to a primary regional anesthesia (RA) model in clinical anesthesia practice on postoperative intensive care unit (ICU) admission rates in patients undergoing shoulder surgery.

Materials and Methods: In this single-center, retrospective study, electronic records of patients who underwent shoulder surgery (arthroscopic or open) at Samsun University Samsun Training and Research Hospital between May 2019 and May 2026 were retrospectively reviewed. Patients were divided into two main groups based on the clinical transition to regional anesthesia: before 2022 (GA Period) and after 2022 (RA Period). Postoperative ICU admission rates of the groups were compared as percentages.

Results: A total of 947 patients were included in the study. In the post-2022 period, when regional techniques were used as the primary method in routine anesthesia practice, postoperative ICU admission rates were found to be statistically significantly lower compared to the GA period (Group RA: 6.41% and Group GA: 15.24%, $p < 0.05$).

Conclusion: This study demonstrates a significant association between the primary regional anesthesia period and lower postoperative ICU admission rates in shoulder surgery. While this correlation points to a potential benefit for hospital resource optimization, further prospective multi-center studies are required to evaluate these retrospective data.

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1. Introduction

Shoulder surgery is performed across a wide age spectrum, ranging from traumatic injuries in the young active population to degenerative diseases in the elderly. The heterogeneous nature of this patient population requires anesthesia management to ensure perioperative

safety for patients with comorbid systemic diseases while incorporating "fast-track" recovery protocols. Particularly in the high-risk patient group, the management of the surgical process is directly associated with the choice of anesthesia technique [1].

General anesthesia (GA), traditionally preferred in shoulder surgery, may lead to the need for intensive care

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unit (ICU) admission due to its systemic effects and the requirement for positive pressure ventilation. These admissions may be intended to manage postoperative complications in elderly patients with severe comorbidities, or they may become necessary due to factors such as hemodynamic instability, respiratory distress, or prolonged recovery developing during the surgical or anesthetic process. Consequently, ICU admissions have significant impacts on hospital resource utilization, increased costs, and patient morbidity [2].

In recent years, regional anesthesia (RA) techniques have expanded the opportunities for awake surgery as the primary anesthesia method in shoulder surgery. The preservation of spontaneous ventilation and minimal systemic drug load provided by RA can enhance perioperative physiological stability, thereby reducing planned or unexpected intensive care requirements in patients [3].

As of 2022, our clinic transitioned from routine general anesthesia practice for shoulder surgeries to a model where regional anesthesia techniques are utilized as the primary anaesthetic method. The aim of this study is to evaluate the impact of this change in anesthesia management on postoperative intensive care unit admission rates based on data from the last 7 years.

2. Materials and Methods

2.1. Study design and ethical approval

This single-center, retrospective cohort study was conducted by reviewing the data of patients who underwent open or arthroscopic shoulder surgery at Samsun University Samsun Training and Research Hospital between May 2019 and May 2026. The study protocol was approved by the local ethics committee (Approval Number: GOKAEK 2026/9/24; Date: May 20, 2026). Due to the retrospective nature of the study, the requirement for obtaining informed consent from the participants was waived by the ethics committee.

2.2. Patient population and grouping

Patients were divided into two groups based on the clinical protocol change implemented in anesthesia management in January 2022 (transition from general anesthesia to regional anesthesia):

- Group GA (General Anesthesia): Patients operated on between May 2019 and January 2022 who received routine general anesthesia.
- Group RA (Regional Anesthesia): Patients operated on between January 2022 and May 2026 for whom regional anesthesia techniques and an awake surgery protocol were applied as the primary method.

2.3. Data collection and primary outcome

Demographic data, such as age and sex, were retrospectively retrieved from the hospital's electronic record system. The primary outcome of this study was the rate of postoperative intensive care unit (ICU) admission. ICU admission was defined as the direct transfer of a patient from the operating theater or the postanesthesia care unit

(PACU) to the tertiary ICU. To comprehensively reflect overall perioperative risk and hospital resource utilization, all postoperative transfers—encompassing both planned admissions for high-risk systemic comorbidities and unplanned/unexpected admissions driven by intraoperative courses—were captured under a single, all-inclusive primary outcome category. The standardized institutional indications for ICU admission included the requirement for mechanical or non-invasive ventilatory support, hemodynamic instability necessitating vasoactive drug infusions, or the necessity for close invasive physiological monitoring due to advanced systemic disease.

2.4. Anesthesia management

In Group GA, general anesthesia was induced and maintained following standard institutional protocols, accompanied by endotracheal intubation or a laryngeal mask airway. Patients in this group did not receive routine regional nerve blocks.

In Group RA, surgical procedures were performed under ultrasound-guided regional nerve blocks while maintaining spontaneous ventilation throughout the operation. Prior to the block administration, a standardized sedation and preemptive analgesia protocol consisting of intravenous midazolam (1 mg) and ketamine (0.25 mg/kg) was administered to all patients. The regional anesthesia regimen comprised an ultrasound-guided interscalene brachial plexus block (10 mL) combined with a superficial cervical plexus block (10 mL), and a supraclavicular brachial plexus block (10 mL). A local anesthetic mixture of 0.25% bupivacaine and 0.5% lidocaine was utilized for all regional interventions. Two cases in which a regional block was performed but converted to general anesthesia due to an insufficient block were excluded from the study.

2.5. Statistical analysis

Statistical analysis of the collected data was performed using the SPSS v22.0 software. Descriptive statistics were expressed as frequencies and/or percentages for categorical variables, and as means \pm standard deviations (SD) for continuous variables. The Chi-square test was utilized to compare categorical variables, including demographic distributions and postoperative intensive care unit (ICU) admission rates between the groups. Furthermore, a multivariate binary logistic regression analysis was conducted to adjust for potential confounding factors (age and sex) and to determine the independent association of the anesthesia technique with postoperative ICU admission. Adjusted odds ratios (aOR) and their corresponding 95% confidence intervals (CI) were calculated from the regression model. A p -value < 0.05 was considered statistically significant.

3. Results

The demographic characteristics and clinical outcomes of the 947 patients comprising the study population are summarized in Table 1 as a comparison between the groups.

Table 1. Patient demographics and intensive care unit admission outcomes.

	Group GA (n=105)	Group RA (n=842)	p
Age (Years, Mean ± SD)	55.17±15.90	53.46±16.04	0.302
Sex (Male / Female)	49/56	384/458	0.918
ICU Admission [n (%)]	16(15.24%)	54(6.41%)	0.002

No statistically significant difference was found between the groups regarding age and sex distribution. The mean age was 55.17 ± 15.90 years in Group GA and 53.46 ± 16.04 years in Group RA (p=0.302). The sex distribution (male/female) was found to be 49/56 in Group GA and 384/458 in Group RA (p=0.918).

When the postoperative ICU admission rates, which represent the primary outcome of the study, were ex-

amined, a statistically significant difference was present between the groups (p=0.002). Postoperative ICU admission was observed in 15.24% (n=16) of patients in Group GA, whereas this rate was 6.41% (n=54) in Group RA.

To evaluate the independent predictors of postoperative intensive care requirements, a multivariate binary logistic regression model was constructed (Table 2).

Table 2. Multivariate logistic regression analysis of risk factors for postoperative ICU admission.

Risk Factor	p	Adjusted Odds Ratio (aOR)	95% Confidence Interval (CI)
Anesthesia Technique (GA vs. RA)	0.005	2.504	1.344 – 4.667
Age (Per-year increase)	<0.001	1.073	1.048 – 1.099
Sex (Male vs. Female)	0.356	1.291	0.751 – 2.218

The analysis demonstrated that anesthesia methodology was an independent predictor of ICU admission. After adjusting for age and sex, general anesthesia was significantly associated with higher odds of ICU admission compared to regional anesthesia (aOR = 2.504, 95% CI: 1.344–4.667, p = 0.004). Advanced age was also identified as an independent risk factor (aOR = 1.073, 95% CI: 1.048–1.099, p < 0.001), whereas patient sex showed no statistically significant association with the outcome (aOR = 1.291, 95% CI: 0.751–2.218, p = 0.356).

4. Discussion

In this study, the effects of GA and RA methods on ICU admission rates were retrospectively examined in a patient population undergoing shoulder surgery at Samsun Training and Research Hospital. Our data suggest that the clinical transition to a primary RA model is associated with a lower rate of postoperative ICU admissions. This trend points to a potential advantage in perioperative care management and may offer important benefits regarding the efficient utilization of hospital resources.

Our finding that primary regional anesthesia is associated with a significantly lower rate of postoperative ICU admissions aligns with large-scale database studies in major orthopedic surgery [4]. Previous literature demonstrates that avoiding GA reduces overall perioperative morbidity, shortens hospital length of stay, and minimizes intensive care utilization [4,5]. Additionally, the use of peripheral nerve blocks is recommended within Enhanced Recovery After Surgery (ERAS) pathways for shoulder surgery to help support recovery and hospital resource management [6].

Although traditional approaches prioritize GA administration for airway control and surgical comfort in shoulder surgery, the systemic effects and positive pressure ventilation (PPV) requirement of this method bring along certain challenges in clinical management. As widely documented in the literature, the use of PPV and high-dose systemic agents prolongs the postoperative recovery period and predisposes patients to hemodynamic instability and respiratory complications, particularly in the vulnerable patient group with advanced age and cardiopulmonary comorbidities [7]. This situation can constitute the major reason for admitting patients to the ICU due to the need for close monitoring and/or mechanical ventilation support during the postoperative period.

Several physiological mechanisms may explain the lower ICU requirement in the RA cohort. First, the preservation of spontaneous ventilation and avoidance of endotracheal intubation can reduce the risk of postoperative respiratory complications, such as atelectasis and ventilator-associated lung injury, particularly in patients with underlying chronic obstructive pulmonary disease or obstructive sleep apnea [8,9]. Second, this observation could potentially be driven by a lower requirement for postoperative systemic opioids due to the prolonged analgesic efficacy of peripheral nerve blocks, although opioid consumption was not directly quantified in our cohort. Consequently, a subsequent reduction in potential opioid-induced adverse events—such as respiratory depression, profound sedation, or severe postoperative nausea and vomiting—might have minimized common clinical triggers for ICU admission [10,11].

Furthermore, regional anesthesia techniques effectively blunt the neuroendocrine stress response triggered by surgical trauma [12]. Compared to general anesthesia, which may cause intraoperative hypotension

due to systemic vasodilation, peripheral nerve blocks can provide more stable hemodynamic profiles [5]. Consequently, maintaining a more stable hemodynamic course with peripheral blocks might help minimize perioperative cardiovascular stress, potentially lowering the necessity for continuous physiological monitoring in an intensive care setting during the immediate postoperative window.

The RA techniques evaluated in our study allow patients to undergo shoulder surgery while awake, without receiving general anesthesia. Continuous preservation of spontaneous ventilation through peripheral nerve blocks and maintaining a minimal systemic drug load play a fundamental role in maintaining perioperative physiological homeostasis. The significantly lower ICU admission rates found in the RA group in our study can be evaluated as a direct reflection of these operative advantages into clinical practice.

In our cohort, the conversion rate from regional to general anesthesia was remarkably low at 0.24% (n=2). Both cases were managed under general anesthesia without intraoperative complications or subsequent postoperative ICU requirements. This low conversion rate indicates that the exclusion of these cases does not mathematically or clinically alter the primary outcomes of the study.

Our study has certain limitations. One of these limitations is that the two periods examined in our study were not equal in duration. However, to minimize potential biases that this situation might cause, intensive care admission rates (percentages) were used as the basis in our analyses instead of absolute numbers of patients. Second, due to insufficient records in the hospital's electronic system, patients' ASA physical status scores and detailed comorbidity data could not be accessed, which limited the full homogenization of the baseline risk profiles of the groups.

Another limitation is a prominent five-fold difference in monthly case volume was present between the two study periods (Group GA: 3.28 cases/month vs. Group RA: 16.19 cases/month), primarily driven by the global reduction in elective procedures during the COVID-19 pandemic [13,14]. Methodologically, this temporal disparity introduces a period-related selection bias. The restricted ICU bed capacity during the pandemic era may have led to a higher clinical threshold for postoperative ICU admissions, potentially selecting a relatively more stable patient profile for surgery during the GA period. Although this selection bias could have underestimated the true baseline ICU admission requirements in the general anesthesia cohort, the primary regional anesthesia period was still associated with a statistically lower rate of admissions. Nevertheless, this historical variation warrants a cautious interpretation, as standard, non-pandemic clinical settings might present different baseline risk distributions.

5. Conclusions

Our findings suggest that utilizing regional anesthesia methods as the primary approach in shoulder surgery is associated with lower postoperative ICU admission rates

and more efficient hospital resource utilization. Within the framework of modern ERAS protocols, regional techniques appear to offer a valuable strategy for enhancing perioperative patient safety. However, given the single-center retrospective nature of this study, further prospective, multi-center randomized controlled trials are needed to confirm these findings and firmly establish these protocols as a routine clinical standard.

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Conflict of Interest

The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this manuscript.

Data Availability

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author upon reasonable request.

AI Assistance

No AI-based tools were used in the preparation of this manuscript.

Ethics Approval and Consent to Participate

This single-center, retrospective cohort study was conducted by reviewing the data of patients who underwent open or arthroscopic shoulder surgery at Samsun University Samsun Training and Research Hospital between May 2019 and May 2026. The study protocol was approved by the local ethics committee (Approval Number: GOKAEK 2026/9/24; Date: May 20, 2026). Due to the retrospective nature of the study, the requirement for obtaining informed consent from the participants was waived by the ethics committee.

Author Contributions

The author declares sole responsibility for all aspects of the study, including conceptualization, methodology, formal analysis, investigation, data curation, visualization, writing of the original draft, and writing, review, and editing of the manuscript.

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