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ORIGINAL RESEARCH REGIONAL ANESTHESIA

Effects of the interscalene block on opioid use and hospital stay in shoulder surgery

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ABSTRACT

Background & objective: Regional anesthesia techniques have increasingly been used around the globe, either as a stand-alone technique or as a part of balanced anesthesia. This study aimed to evaluate the effect of interscalene block (ISB) on postoperative hospital length of stay (LOS), opioid consumption, and inflammatory markers in patients undergoing elective shoulder surgery under general anesthesia (GA). The goal was to determine whether this regional anesthesia technique contributes to improved postoperative outcomes under GA.

Methodology: This single-center, retrospective study included 276 patients who underwent elective shoulder surgery between January 2018 and December 2022 under general anesthesia. Patients were divided into two groups based on whether they received an interscalene block or not. Exclusion criteria included patients younger than 18 years, and older than 80 years, ASA class IV or higher, emergency surgery, missing laboratory data, and use of other regional anesthesia methods. Data on opioid consumption, hospital stay, and inflammatory markers, including white blood cells (WBC) and C-reactive protein (CRP), were compared using Mann-Whitney U, chi-square, and Friedman tests. $P < 0.05$ was considered statistically significant.

Results: Postoperative opioid use was significantly lower in the block group, with 60.7% requiring no opioids versus 0.8% in the non-block group ($P < 0.05$). The median hospital length of stay was significantly shorter in the ISB group (22.0 hours) compared to the non-ISB group (29.3 hours, $P = 0.01$). Median postoperative WBC levels at 24 hours were significantly lower in the ISB group compared to the non-ISB group ($8.50 \times 10^3/\mu L$ vs. $9.50 \times 10^3/\mu L$, $P < 0.05$). Similarly, CRP levels at 6 and 24 hours showed statistically significant differences between groups; however, the direction of these differences varied and should be interpreted with caution.

Conclusion: Interscalene block reduces postoperative opioid consumption, shortens hospital stay, and mitigates systemic inflammation in shoulder surgery performed under general anesthesia. It may be a valuable component of multimodal analgesia strategies in this patient population.

Abbreviations: ALT: Alanine transaminase, ASP: Aspartic acid, AST: Aspartate transferase; CRP: C-reactive protein; ISB: interscalene block, LoS: Length of stay, PCA: Patient-controlled analgesia, WBC: white blood cells

Keywords: Interscalene block; Inflammatory Markers; Length of Stay; Opioids; Nerve Block; Pain; Pain, Patient-controlled analgesia; Postoperative; Regional Anesthesia; Shoulder Surgery

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1. INTRODUCTION

Postoperative pain is defined as acute pain that begins simultaneously with the surgical incision and gradually diminishes with tissue regeneration. The characteristics of this pain can vary depending on surgical technique, anesthesia method, the size of the surgical wound, and the patient's physiological, psychological, and social conditions.[1]

Shoulder surgery is a procedure that typically results in significant postoperative pain. Effective pain management is crucial for reducing complications associated with immobilization, shortening hospital stays, and thereby lowering healthcare costs.

The interscalene block has recently emerged as a regional anesthesia technique widely used for pain control and reducing opioid consumption in patients undergoing shoulder surgery. It is considered the gold standard for analgesia in this patient population and has been shown to provide effective pain relief for up to 24 hours postoperatively. Additionally, the interscalene block is known to exert a suppressive effect on the release of inflammatory mediators.[2,3] Given its potential benefits, including reducing the inflammatory response and controlling postoperative pain, this technique holds significant clinical importance.

Although previous studies have examined the postoperative analgesic efficacy of interscalene block (ISB), evidence regarding its effect on hospital length of stay (LOS) and opioid consumption remains limited. In this retrospective study, we primarily aimed to investigate the impact of ISB on hospital length of stay and postoperative opioid consumption in patients undergoing elective shoulder surgery. Inflammatory markers such as C-reactive protein (CRP) and white blood cell (WBC) counts were evaluated as secondary outcomes.

METHODOLOGY

This study was conducted after obtaining approval from the ethics committee (IMU Göztepe Training and Research Hospital Clinical Research Ethics Committee, Decision No: 2023/0003). The study was designed as a randomized, single-blind, retrospective, and single-center study. Patients who underwent shoulder surgery in the Department of Orthopedics and Traumatology at Istanbul Göztepe Süleyman Yalçın City Hospital between January 2018 and December 2022 were retrospectively reviewed through the hospital information management system records.

A formal power analysis was not performed for this retrospective study due to the nature of data collection from existing hospital records. Instead, all eligible patients who met the inclusion criteria within the study period (January 2018 to December 2022) were included to maximize sample size and statistical power.

A total of 301 patients who underwent shoulder surgery were initially identified. The inclusion criteria were: age between 18 and 80 years, ASA physical status I–III, elective (non-emergency) surgery, availability of both preoperative and postoperative laboratory parameters before discharge, and use of either general anesthesia or general anesthesia combined with interscalene block. Patients were excluded if they did not meet these criteria—specifically, 8 were outside the age range, 5 were classified as ASA IV or higher, 2 underwent emergency surgery, 5 had missing laboratory data, and 4 received a type of regional anesthesia other than the interscalene block. Ultimately, 276 patients who met all inclusion criteria were included in the study.

After recording the demographic data of the patients, such as age and gender, information regarding block administration, postoperative opioid consumption, hospital length of stay, and preoperative and postoperative laboratory parameters before discharge (hemoglobin, hematocrit, platelet count, white blood cell count, calcium, sodium, chloride, potassium, glucose, albumin, AST, Alanine transaminase (ALT), urea, creatinine, and CRP) were noted.

Postoperative opioid use was categorized into three levels: no use, 100 mg, and 200 mg of tramadol. These were administered as-needed (PRN) based on clinical judgment, rather than via fixed PCA protocols. The totals reflect the cumulative dose received within the first 24 hours postoperatively.

The patients were divided into two groups based on whether they received an interscalene block. Group 1 consisted of patients who received the block, while Group 2 consisted of those who did not. The relationships of these groups with the specified parameters were statistically analyzed.

All data were recorded and analyzed using SPSS (Statistical Package for the Social Sciences) for Windows, version 22. Assumptions required for the application of statistical tests (parametric/non-parametric tests) were initially tested. The Kolmogorov-Smirnov test was used to assess the normality of data distribution, while skewness and kurtosis values were also examined for other normality assumptions.

The Mann-Whitney U test was applied to compare two independent groups, specifically Group 1 (with an

Table 1: Relationship between groups and postoperative opioid use

Opioid Use	Group 1 (With Block)	Group 2 (Without Block)	Statistical Test	P-value
None	91 (60.7%)	1 (0.8%)	$X^2 = 110.46$; P = 0.01	**0.01***
Opioid Used (Any Dose)	59 (39.3%)	125 (99.2%)	$X^2 = 129.35$; P = 0.01	**0.01***
100 mg	20 (68.97%)	9 (31.03%)		
200 mg	39 (25.16%)	116 (74.84%)		

Data presented as n (%); P < 0.05 considered as significant

Table 2: Comparison of Postoperative Length of Stay Between Groups

Variable	Group 1 (With Block)	Group 2 (Without Block)	Z	P
Postoperative Length of Stay (hours)	21.50 (19.00–23.00)	23.00 (21.00–32.00)	-5.08	**0.01***

z: Man Whıtney- U test; Data presented as Median (IQR); P < 0.05 considered as significant

interscalene block) and Group 2 (without a block), in terms of variables such as hospital stay, postoperative WBC, and CRP levels. The Kruskal-Wallis H test was

used to compare more than two independent groups where applicable, such as different doses of opioid consumption (none, 100 mg, and 200 mg). Bonferroni post hoc testing was applied when significant differences were detected to determine the source of these differences, thereby adjusting for multiple comparisons as required. The chi-square test was used to compare categorical variables between groups, such as the proportion of patients requiring different levels of opioid analgesics in Group 1 versus Group 2. The Wilcoxon signed-rank test, used for comparing two related (dependent) groups, was applied in preoperative versus postoperative comparisons within the same patient group. The Friedman test was used for comparing more than two related (dependent) measurements, such as serial WBC or CRP levels taken at different postoperative time intervals (preoperative, 6-hour, and 24-hour values). These results are reported in Table 4 of the output file. A $P < 0.05$ was considered statistically significant.

3. RESULTS

A total of 276 patients were retrospectively included in the study. Of the study sample, 59.1% (n=163) were female, with a mean age of 55.45 ± 13.21 years.

Interscalene block was performed in 54.3% (n=150) of the patients, and 56.2% (n=155) received 200 mg of opioid (tramadol) as analgesia during the postoperative period, while 10.5% (n=29) received 100 mg of opioid (tramadol).

In Group 1, 60.7% (n=91) of patients did not require opioid analgesics, whereas 39.3% (n=59) of Group 2 required opioid analgesics ($X^2=110.46$; $P < 0.05$).

In Group 2, 31.03% (n=9) of patients received 100 mg of opioids, while 74.84% (n=116) received 200 mg postoperatively. Among patients who did not use opioids, 98.91% (n=91) were in Group 1 ($X^2=129.35$; $p<0.05$). The mean postoperative length of stay was shorter in Group 1 (22.03 ± 5.05 hours) compared to Group 2 (29.28 ± 15.55 hours) ($P < 0.05$).

The median WBC levels at 24 hours postoperatively were lower in Group 1 (Median: $8.50 \times 10^3/\mu L$) compared to Group 2 (Median: $9.50 \times 10^3/\mu L$) ($z = -2.09$; $P < 0.05$). Similarly, median CRP levels at 6 hours postoperatively were lower in Group 1 (Median: 0.14 mg/L) compared to Group 2 (Median: 1.76 mg/L) ($z = -9.10$; $P < 0.05$). At 24 hours, CRP levels remained lower in Group 1 (Median: 1.47 mg/L). Although Table 4 presents descriptive statistics as mean ± standard deviation for standardization, the non-normal distribution of WBC and CRP values confirmed by the Kolmogorov-Smirnov test necessitated statistical comparison using median and interquartile range. Accordingly, results are reported using medians in this section to align with the applied statistical methodology.

Table 3: Intergroup comparison of WBC and CRP levels over time

Parameter	Group 1 (With Block)	Group 2 (Without Block)	Mann-Whitney U Test	P-value
Pre-op WBC (10^3/uL)	7.89 ± 2.19 7.60 [6.30–8.90]	7.30 ± 1.61 7.08 [6.22–8.23]	z = -1.26	0.21
WBC at 6h (10^3/uL)	10.15 ± 3.24 9.45 [7.70–12.00]	10.82 ± 3.10 10.50 [8.30–12.70]	z = -1.55	0.12
WBC at 24h (10^3/uL)	9.93 ± 2.19 9.50 [8.50–10.90]	9.22 ± 2.11 8.50 [7.70–10.30]	z = -1.44	0.15
Friedman Test (WBC)	X^2 = 133.04; p = 0.01 Diff: 1<2,3 & 3<2	X^2 = 20.10; p = 0.01 Diff: 1<2,3		
Pre-op CRP (mg/L)	3.26 ± 6.60 1.51 [0.41–4.10]	0.14 ± 0.73 0.01 [0.01–0.01]	z = -11.93	**0.01***
CRP at 6h (mg/L)	0.44 ± 0.97 0.14 [0.10–0.44]	3.32 ± 6.25 1.76 [0.60–3.77]	z = -9.10	**0.01***
CRP at 24h (mg/L)	8.63 ± 13.44 3.08 [0.99–7.48]	2.17 ± 2.24 1.47 [0.97–2.65]	z = -2.78	**0.01***
Friedman Test (CRP)	X^2 = 211.81; p = 0.01 Diff: 1<2,3 & 2<3	X^2 = 55.64; p = 0.01 Diff: 1,2<3		

Data presented as Mean ± SD / Median [IQR]; P < 0.05 considered as significant

4. DISCUSSION

Pain is a common postoperative issue following shoulder surgery. Regional anesthesia techniques can modulate or inhibit the nociceptive response, thereby altering the stress response. It has been demonstrated that regional anesthesia in patients undergoing shoulder surgery can reduce opioid consumption and postoperative pain intensity while improving patient satisfaction.[4] Effective pain management can also influence the length of hospital stays. The interscalene block is the most commonly used regional anesthesia method in this patient population and has been shown to regulate the immune response triggered by the surgical procedure.[5] The drugs used in regional anesthesia possess anti-inflammatory properties at the site of inflammation.[6] These anti-inflammatory effects may prevent prolonged hospital stays associated with potential complications.

Shin et al. (2010) compared patients undergoing shoulder surgery who received general anesthesia, general anesthesia combined with supraclavicular block, or interscalene block.[7] They observed statistically significant reductions in VAS scores over time in patients receiving general anesthesia and general anesthesia combined with supraclavicular block, but no significant differences in the interscalene block group. However, the interscalene block group had lower pain scores and shorter hospital stays compared to other groups, with fewer side effects. Similarly, Ovesen et al. (2014) investigated the postoperative 4th and 24th-hour VAS scores of 91 patients undergoing shoulder surgery who divided into interscalene block, supraclavicular block, subacromial bursa block, and general anesthesia groups.[8] Patients in the interscalene block group had significantly lower VAS scores compared to the other three groups. Dhir et al. compared suprascapular block and interscalene block within the first 6 hours postoperatively and found that both reduced postoperative pain, but interscalene block provided more effective analgesia and reduced opioid consumption.[9]

In our study, 31.03% of patients without a block required 100 mg of opioids, and 74.84% required 200 mg of opioids in the postoperative period. Additionally, 98.91% of patients who did not require opioid use had undergone block application. The absence of opioid use in 60.7% of patients with a block suggests that the interscalene block reduces the need for postoperative analgesia. Similar findings in the literature support the notion that patients undergoing block or regional anesthesia experience less postoperative pain and thus require fewer analgesics.[6,10-12]

Surgical procedures trigger a hypermetabolic response, which induces inflammation and a stress response. Pro-inflammatory cytokines not only initiate local

inflammation at the site of injury but also trigger systemic responses such as tachycardia, tachypnea, leukocytosis, and pyrexia. Tissue damage also stimulates a neuroendocrine stress response, leading to the synthesis of acute-phase proteins in the liver and the activation of the sympathetic nervous system.[13-15] While this inflammatory and catabolic process is necessary for wound healing in the postoperative period, an exaggerated response can lead to complications and prolonged hospital stays.

In our study, although inflammation parameters (WBC and CRP levels) increased over time in both groups, statistical analysis showed only modest and inconsistent differences between the block and non-block groups. The CRP values at certain time points were not consistently lower in the block group, indicating that the effect of the interscalene block on inflammation may be limited or variable. Kolamanecho et al. (2018) examined CRP changes on postoperative days 1, 2, and 3 in 65 patients undergoing total hip arthroplasty who received either regional or general anesthesia.[16] While preoperative CRP levels did not differ significantly between the two groups, postoperative CRP changes were less pronounced in the regional anesthesia group. Although this study aligns with our findings, our results suggest that even in the early postoperative period, CRP increases may be less pronounced in patients receiving blocks.

Mejía-Terrazas et al. compared CRP, white blood cell counts, and erythrocyte sedimentation rates in patients undergoing arthroscopic shoulder surgery under general anesthesia versus interscalene block-based regional anesthesia.[17] They found that increases in these parameters were less pronounced and more moderate in the interscalene block group, consistent with our study findings.

While our findings generally support a moderating effect of interscalene block on inflammatory markers, it is noteworthy that the 6-hour CRP levels were higher in the ISB group compared to the non-block group. However, by 24 hours postoperatively, CRP levels were lower in the ISB group. This may suggest a delayed but more stable anti-inflammatory effect of the interscalene block. The early CRP elevation could be influenced by higher preoperative baseline values or individual inflammatory responses, and thus, should be interpreted cautiously. Further prospective studies are needed to clarify this time-dependent response.

Cole et al. (2018) conducted a cohort study of 3,199 patients divided into three groups: sedation, general anesthesia, and regional anesthesia, and found that postoperative hospital stays were significantly shorter in the regional anesthesia group.[18] In a meta-analysis by Dong et al. (2016) comparing adductor canal and femoral nerve blocks across ,both methods were evaluated in terms of pain (VAS), postoperative opioid consumption, quadriceps and adductor muscle strength, hospital stays, and complications.[19] The meta-analysis concluded that opioid requirements, hospital stays, postoperative complications, and muscle strength were comparable between the two techniques.

Hussain et al. (2017) conducted a meta-analysis of 708 patients undergoing shoulder surgery and compared the effects of interscalene and suprascapular blocks.[20] Both block types reduced postoperative pain and intensive care unit stays, but interscalene blocks were found to result in lower pain scores and shorter postoperative stays.

In our study, patients who received blocks had shorter postoperative hospital stays compared to those who did not. We believe this is due in part to the reduced need for analgesics and possibly mild modulation of inflammatory responses, although the clinical significance of this effect remains to be clarified.

5. LIMITATIONS

Our study had some limitations. The first was a small sample size, which limited the ability to observe the effects of laboratory parameters. The second was the unequal distribution of patients between the block and non-block groups. Additionally, as a retrospective study, we could not evaluate postoperative pain using visual analog scale (VAS) scores, nor could we access records of NSAIDs administered for postoperative analgesia.

6. CONCLUSION

The interscalene block can reduce opioid consumption and shorten hospital stay by better postoperative pain management. Additionally, its potential anti-inflammatory effects may help prevent adverse postoperative outcomes.

7. Data availability

The numerical data generated during this research are available from the authors.

8. Conflict of interest

All authors declare that there was no conflict of interest.

9. Ethical approval

Ethical approval of this study was obtained from İstanbul Medeniyet University Ethics Committee

10. Funding

The study utilized the hospital resources only, and no external or industry funding was involved.

11. Authors' contribution

AY: Concept, design of the study, data interpretation, manuscript writing and editing
SK: Literature search, data collection, manuscript editing
HK: Statistical analysis, critical review of manuscript
SY: Concept, data analysis, supervision, final approval of the manuscript

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