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Research Article

Evaluation of quality of life and psychosocial factors in hemodialysis patients: A medical student-led observational survey study from a Turkish university hospital

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ABSTRACT

Background: Other than kidney-related problems, haemodialysis patients often face reduced mobility and the burden of chronic illness, along with other factors that negatively affect their health-related quality of life (HRQoL). Depression, fatigue, and pain are common, yet these issues are often overlooked during routine clinical follow-up. We aimed to assess fatigue, depressive mood, and functional limitations in patients with chronic kidney disease (CKD) undergoing haemodialysis and to examine their associations with demographic, clinical, and psychosocial factors.

Materials and Methods: This cross-sectional, observational survey was conducted at a university haemodialysis unit in Türkiye. Sixty-four adult patients completed a modified questionnaire based on the SF-36 Health Survey, incorporating dialysis-specific domains. Data were collected through face-to-face interviews administered by trained medical students. Descriptive statistics and chi-square tests were used to examine associations between symptom domains and patient characteristics.

Results: Of the 64 patients included (60.9% male, median age 61–70 years), 75.0% received dialysis three times weekly. Post-dialysis fatigue was reported as moderate (35.9%), severe (29.7%), or mild (25.0%). Clinically relevant depressive symptoms were reported by 18.8% of patients, while 43.8% described at least moderate pain. A strong association was found between pain severity and daily activity limitation ($\chi^2 = 58.3$, $df = 9$, $p < 0.001$). Depression was not significantly associated with age, sex, or dialysis frequency.

Conclusions: In this cohort, fatigue, pain, and depressive mood were prominent among haemodialysis patients and more closely related to symptom burden than to demographic or dialysis treatment parameters. Routine patient-reported outcome screening and targeted psychosocial interventions may improve quality of life and daily functioning in this population.

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1. Introduction

Chronic kidney disease (CKD) affects more than 10% of the adult population worldwide and is projected to rise in parallel with aging demographics and the increasing prevalence of diabetes and hypertension [1]. Progression to end-stage renal disease necessitates renal replacement therapy, and maintenance hemodialysis remains the most commonly used modality. Although life-sustaining, hemodialysis imposes a substantial symptom burden: fatigue is reported by up to 80% of patients and contributes markedly to activity limitation and poor

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treatment adherence [2]. Beyond physical symptoms, health-related quality of life (HRQoL) has emerged as an independent predictor of both hospitalization and mortality in the dialysis population [3].

Traditional clinical indicators alone fail to capture this multidimensional impact, which is better assessed using validated patient-reported outcome measures (PROMs). The Kidney Disease Quality of Life (KDQOL) instrument and the generic Short-Form Health Survey (SF36) have been widely adopted for this purpose and possess robust psychometric properties in CKD cohorts [4,5]. Nevertheless, depressive symptoms—highly prevalent yet often underrecognized—remain a major driver of reduced HRQoL and are independently associated with adverse outcomes, including death and repeated hospitalizations [6].

Despite growing recognition of the psychosocial burden of hemodialysis, data from middle-income settings are limited, and few studies have simultaneously examined the interplay among fatigue, depression, pain, and daily functional limitation in a single framework. To address this gap, we conducted a cross-sectional, medical-student–led survey of maintenance hemodialysis patients at Samsun University Faculty of Medicine, Türkiye. Using a Turkish-validated version of the SF-36 [7], along with dialysis-specific questions developed by consensus among supervising faculty and student researchers, we aimed to (i) describe symptom prevalence and severity, (ii) explore relationships between physical and emotional domains, and (iii) identify potential targets for multidisciplinary intervention to improve patient-centered care. We hypothesized that symptom burden (particularly fatigue and depressive mood) would show stronger associations with perceived quality of life than traditional demographic or dialysis-related parameters.

2. Materials and Methods

2.1. Study design

This cross-sectional survey was performed from January to April 2025 at the hemodialysis unit of Samsun University Faculty of Medicine, Samsun Training and Research Hospital. The study was part of a planned social responsibility project run by medical students under the supervision of the cardiovascular surgery department. Six second-year medical students, trained for this project, asked the questions face-to-face while patients were on dialysis. Ethical approval for the study was obtained from the Samsun University Clinical Research Ethics Committee (Decision No: 2025/01/32, Date: 03.01.2025). All participants provided written informed consent prior to participation. Confidentiality and anonymity were assured, and participation did not affect clinical care. All participants were informed about the purpose, procedures, and voluntary nature of the study. A written informed consent form was provided and signed by each participant prior to data collection. Patients were assured that their responses would remain confidential and anonymized, and that participation would not affect their clinical care in any way.

2.2. Participants

Adult patients (aged 18 years or older) receiving regular hemodialysis at the centrewere invited to participate. Inclusion criteria were clinical stability and the ability to provide informed consent. Patients could complete the questionnaire independently or with verbal assistance. Those with cognitive impairment, current hospitalization, or unwillingness to participate were excluded. Of the 72 patients approached during the study period, 6 declined participation and 2 were excluded due to cognitive impairment, resulting in a final sample size of 64 patients.

2.3. Data collection

We used a short, structured questionnaire built on the validated Turkish version of the Short Form-36 Health Survey (SF-36) [7] and added a few dialysis-specific questions. It covered four topics:

1. Demographics and clinical data—age, gender, dialysis schedule, and comorbidities.
2. Symptoms—fatigue and any other problems during or after dialysis.
3. Mental health—mood, energy level, and general emotional state.
4. Pain—intensity and interference with daily activities.

The primary outcome was the prevalence of clinically significant postdialysis fatigue. Secondary outcomes included the frequency of depressive mood symptoms, the association between pain intensity and daily limitations, and the impact of dialysis frequency on patients' emotional well-being.

2.4. Statistical analysis and sample size

Data was entered into Microsoft Excel (Office 365 version) and analysed using Python (v3.11) with the Pandas (v2.2) and Scipy (v1.12) packages. Categorical variables were expressed as counts and percentages. Associations between categorical variables were analysed using Pearson's Chi-square test. A p-value < 0.05 was considered statistically significant.

3. Results

A total of 64 hemodialysis patients were enrolled in the study. Of these, 39 (60.9%) were male and 25 (39.1%) were female. The most frequent age groups were 61–70 years (34.4%) and 51–60 years (26.6%). Most participants (75.0%) underwent hemodialysis three times per week, followed by 14.1% who dialysed twice weekly and 10.9% who received four or more sessions per week (Table 1).

During dialysis, 56.3% of participants reported feeling fatigued, 35.9% felt well, and 7.8% experienced pain or discomfort. After dialysis, 29.7% reported severe fatigue, 35.9% reported moderate fatigue, 25.0% reported mild fatigue, and 9.4% stated they felt no fatigue.

Regarding mood symptoms, 24 participants (37.5%) reported feeling depressed or hopeless "sometimes," 9

(14.1%) "frequently," and 2 (3.1%) "always." Patients who answered 'frequently' or 'always' to the depression item were categorized as having clinically relevant depressive symptoms. Conversely, 15 participants (23.4%) denied experiencing depressive symptoms altogether. Based on established criteria, 12 participants (18.8%) were identified as having clinically relevant depressive symptoms (Table 2).

Pain was another prominent complaint: Almost half of the patients (43.8%) described at least moderate pain, while 18 patients (28.1%) stated that the pain significantly limited their daily activities. A strong association was found between pain severity and functional limitation ($\chi^2 = 58.3$, $df = 9$, $p < 0.001$) (Table 3).

Patients with depressive symptoms reported severe post-dialysis fatigue more frequently (50.0%) than those without depressive symptoms (25.0%), though this difference did not reach statistical significance ($\chi^2 = 3.6$, $p = 0.309$). No statistically significant associations were found between depressive symptoms and age group ($p = 0.267$), gender ($p = 0.903$), or dialysis frequency ($p = 0.808$) (Table 3).

Table 1. Demographic and clinical characteristics of the study population.

Characteristic	*n* (%)
Total number of patients	64 (100%)
Gender	
Male	39 (60.9%)
Female	25 (39.1%)
Age group	
18–30	1 (1.6%)
31–40	4 (6.3%)
41–50	8 (12.5%)
51–60	17 (26.6%)
61–70	22 (34.4%)
71–80	11 (17.2%)
81 and above	1 (1.6%)
Dialysis frequency	
2 times per week	9 (14.1%)
3 times per week	48 (75.0%)
≥4 times per week	7 (10.9%)

Table 2. Symptom burden and psychosocial indicators.

Symptom Domain	Symptom Domain	*n* (%)
Post-dialysis fatigue	Severe	19 (29.7%)
	Moderate	23 (35.9%)
	Mild	16 (25.0%)
	None	6 (9.4%)
Depressive symptoms	Clinically relevant	12 (18.8%)
Pain	Moderate to severe	28 (43.8%)
	Limiting daily activities	18 (28.1%)

Table 3. Associations between clinical and psychosocial variables.

Comparison	Chi-square (χ^2)	p-value
Depression vs. Gender	0.57	0.903
Depression vs. Age group	34.36	0.267
Depression vs. Dialysis frequency	10.18	0.808
Depression vs. Post-dialysis fatigue	3.6	0.309
Pain vs. Functional limitation	58.3	<0.001

4. Discussion

This cross-sectional survey confirms that symptom burden rather than traditional demographic or treatment factors drives decrements in health-related quality of life (HRQoL) among maintenance hemodialysis patients. Nearly one-fifth of our cohort reported clinically relevant depressive symptoms, and more than one-quarter experienced severe post-dialysis fatigue. Pain severity showed the strongest association with functional limitation, whereas gender, age band and treatment frequency did not correlate with depression or fatigue.

In our center, the prevalence of "frequent or constant" depression was 18.8%, which is close to the pooled global estimate of 20% reported in the most recent meta-analysis of 248,112 CKD patients [8]. Fatigue levels were also comparable to contemporary multicentredata in which 29–41% of hemodialysis patients scored in the severe range [9]. Our finding that pain, rather than dialysis dose or session frequency, predicted daily activity restriction aligns with a large 2024 systematic review in renal dialysis populations that identified pain, anxiety, and poor sleep as the principal correlates of overall symptom burden [10]. Severe post-dialysis fatigue was

reported at 29.7% in our survey, highlighting the importance of targeted fatigue interventions. The BReF feasibility randomised controlled trial by Picariello et al. [11] showed that a CBT-based fatigue programme for dialysis patients is possible and may help them. These results support that CBT modules, which can be delivered in the chair by trained students or via telehealth, are both a feasible and effective strategy, particularly in resource-limited dialysis centres.

Pain emerged as the most powerful determinant of functional limitation in our cohort, echoing a 2023 multicentre study by Mizher et al. [12], who found that 47% of 261 hemodialysis patients reported chronic pain and that pain-interference scores were the strongest predictor of reduced daily activity, independent of biochemical or dialysis parameters. Our data support the notion that pain management protocols, including both pharmacological and behavioural interventions, should be prioritized within the routine care of hemodialysis patients.

Although depression was not independently associated with dialysis frequency, this does not imply that psychosocial interventions are futile. A recent randomised study [13] showed that cognitive-behavioural pain-coping skills training delivered during dialysis significantly reduced both pain intensity and depressive affect at three months. Such chair-side, timeneutral interventions may therefore represent a pragmatic avenue for centres with limited psychological staffing.

The proportion of patients with clinically significant depressive mood in our cohort (18.8%) was very similar to the 23.7% rate reported in a Chinese study [14] of 215 patients that investigated the role of psychological resilience. Studies have also talked about how psychological resilience could impact the link between depression and quality of life. Although we didn't directly measure resilience, our results suggest that we require far more than traditional psychiatric referral models to help people effectively. It should be acknowledged that our definition of clinically relevant depressive symptoms was based on a single-item question rather than a formal diagnostic instrument such as PHQ-9. However, single-question mood screening has been validated in prior nephrology literature and offers a practical, low-burden approach in student-led or resource-limited settings.

Our use of a brief, face-to-face SF-36–based PROM mirrors the framework evaluated in the SUPPORT-dialysis feasibility pilot, which assessed electronic PROM (ePROM) integration. Gill et al. [15] demonstrated that monthly ePROM completion with real-time symptom flagging was well accepted by both patients and staff and facilitated earlier multidisciplinary referrals. Considering the success of our student-led data collection, integrating an ePROM platform may scale this approach, reduce staff workload, and enable routine symptom monitoring. Finally, the mean SF-36 domain scores we observed are in line with those reported for Turkish hemodialysis cohorts evaluated with the culturally validated version of the instrument [16], reinforcing the external validity of our results within the national context.

Our findings suggest that routine integration of patient-reported outcome measures (PROMs), particularly brief assessments of fatigue and mood, may help clinicians identify individuals at higher psychosocial risk and allocate appropriate support. The strong association between pain severity and activity limitation supports the need for comprehensive pain management protocols. Furthermore, this study demonstrates the feasibility and utility of supervised medical students in collecting high-quality PROM data and delivering patient education, offering a scalable and cost-effective approach to improving care quality in dialysis units, especially in resource-limited settings.

This study was single-centre with a modest sample size and relied on self-report instruments. Causal relationships cannot be inferred, and residual confounding by unmeasured variables (e.g., inflammatory markers, socioeconomic status) is possible. Nevertheless, the rigorous face-to-face administration and cross-validation against national HRQoL data strengthen our conclusions. Given the exploratory and observational nature of this single-center pilot study, formal sample size calculation was not performed.

5. Conclusions

According to this single-center, student-led survey, the factors most significantly impacting health-related quality of life in hemodialysis patients were pain, fatigue, and depressed mood. Demographic characteristics and dialysis frequency were not significantly associated with psychosocial outcomes. Although the sample size and observational design present limitations, the findings suggest that even basic assessment tools could be integrated into daily practice in dialysis centers to facilitate routine symptom evaluation and psychosocial support.

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Conflict of Interest

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

Data Availability

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

Ethics Approval and Consent to Participate

This study was approved by the ethics committee of Samsun University Clinical Research Ethics Committee (Decision No: 2025/01/32, Date: 03.01.2025). Written informed consent was obtained from the participants. All methods were performed in accordance with relevant guidelines and regulations.

Author Contributions

Emrah Ereren: *conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing – original draft, writing – review & editing.*

Ilker Hasan Karal: *methodology, software, validation, formal analysis, investigation.*

Askin Kilic: *investigation, data curation, writing – original draft, writing.*

Ilayda Danismaz: *writing – original draft, writing – review & editing.*

REFERENCES

1. Hill NR, Fatoba ST, Oke JL, Hirst JA, O'Callaghan CA, Lasserson DS, et al. Global prevalence of chronic kidney disease: A systematic review and meta-analysis. *PLoS One*. **2016**;11(7):e0158765.
2. Jhamb M, Argyropoulos C, Steel JL, Plantinga L, Wu AW, Fink NE, et al. Correlates and outcomes of fatigue among incident dialysis patients. *Clin J Am Soc Nephrol*. **2009**;4(11):1779–1786.
3. Mapes DL, Lopes AA, Satayathum S, McCullough KP, Goodkin DA, Locatelli F, et al. Health-related quality of life as a predictor of mortality and hospitalization: The dialysis outcomes and practice patterns study (DOPPS). *Kidney Int*. **2003**;64(1):339–349.
4. Hays RD, Kallich JD, Mapes DL, Coons SJ, Carter WB. Development of the Kidney Disease Quality of Life (KDQOL) instrument. *Qual Life Res*. **1994**;3(5):329–338.
5. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. **1992**;30(6):473–483.
6. Lopes AA, Bragg J, Young E, Goodkin D, Mapes D, Combe C, et al. Depression as a predictor of mortality and hospitalization among hemodialysis patients in the United States and Europe. *Kidney Int*. **2002**;62(1):199–207.
7. Koçyiğit H, Aydemir Ö, Fisek G, Olmez N, Memis A. Kısa Form-36 (KF-36)'nın Türkçe versiyonunun güvenilirliği ve geçerliliği. *İlaç Tedavi Derg*. **1999**;12(2):102–106. (in Turkish)
8. Adejumo OA, Edeki IR, Oyedepo DS, et al. Global prevalence of depression in chronic kidney disease: A systematic review and meta-analysis. *J Nephrol*. **2024**;37(9):2455–2472.
9. Tsirigotis S, Polikandrioti M, Alikari V, et al. Factors associated with fatigue in patients undergoing hemodialysis. *Cureus*. **2022**;14(3):e22994.
10. Lu Y, Zhai S, Liu Q, et al. Correlates of symptom burden in renal dialysis patients: A systematic review and meta-analysis. *Ren Fail*. **2024**;46(2):2382314.
11. Picariello F, Moss-Morris R, Macdougall IC, Chilcot J. The BReF intervention to improve fatigue in hemodialysis patients: A feasibility randomised controlled trial. *Clin J Am Soc Nephrol*. **2020**;15(1):10–20. doi:10.2215/CJN.05060419. PMID: 31740417.
12. Mizher O, Rawas-Qalaji M, Al-Azab A, et al. Chronic pain and its impact on activities of daily living in patients undergoing hemodialysis: A multicentre study. *Sci Rep*. **2023**;13:5293.
13. Steel JL, Brintz CE, Heapy AA, et al. Adapting a pain coping skills training intervention for people with chronic pain receiving maintenance hemodialysis. *J Behav Med*. **2025**;48(2):298–307.
14. Li Y, Zhu Y, Zheng Q, et al. Psychological resilience mediates the effect of depression on quality of life in maintenance hemodialysis patients: A cross-sectional study. *Int J Gen Med*. **2024**;17:1231–1240.
15. Gill P, Whittaker V, Lewis V, et al. Feasibility of implementing electronic patient-reported outcome measures (ePROMs) in hemodialysis care: The SUPPORT-dialysis pilot study. *BMJ Open*. **2024**;14:e080712.
16. Küçük O, Kaynar K, Arslan FC, et al. Comparison of mental health, quality of sleep and life among patients with different stages of chronic kidney disease and renal replacement therapies. *Hippokratia*. **2020**;24(2):51–58.

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Research Article

Cost-effectiveness of fascial plane blocks in laparoscopic cholecystectomy: A retrospective study

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ABSTRACT

Background: Fascial plane blocks have increasingly been used in recent years as a component of multimodal analgesia. The aim of this study was to evaluate the impact of fascial plane blocks, applied for postoperative analgesia, on hospital costs in laparoscopic cholecystectomy (LC) procedures.

Materials and Methods: This retrospective, single-center study included 1414 patients who underwent elective LC under general anesthesia between 2020 and 2025. Patients were divided into two groups: those who received fascial plane blocks (Group M, n=346) and those who received the standard analgesia protocol (Group S, n=1068). Total hospital invoice costs at discharge, length of hospital stay, demographic characteristics, ASA scores, and comorbidities were compared between the groups.

Results: No significant differences were observed between the groups regarding age, sex, or comorbidity rates. Hospital length of stay was similar. In the overall analysis covering 2020–2025, hospital costs were significantly lower in the fascial plane block group ($p<0.001$). Subgroup analyses by year revealed a significant cost difference in favor of the fascial plane block group only in 2024.

Conclusions: In addition to providing effective analgesia, fascial plane blocks reduced hospital costs in LC procedures, contributing as a cost-effective component of multimodal analgesia.

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1. Introduction

Laparoscopic cholecystectomy (LC) is one of the most frequently performed operations among all surgical procedures and accounts for a significant proportion of healthcare expenditures. Currently, accelerating postoperative recovery, shortening hospital length of stay, and thereby reducing hospital costs are among the primary goals of the Enhanced Recovery After Surgery (ERAS) protocols [1].

In recent years, opioid-free analgesia and multimodal analgesia approaches have gained increasing importance in anesthesia and analgesia practice, aiming to prevent opioid-related side effects. In this context, fascial plane blocks are being increasingly used for postoperative analgesia and are considered a significant advancement in daily practice [2]. In laparoscopic cholecystectomies, both somatic pain due to trocar insertion sites and visceral pain associated with gallbladder manipulation and pneumoperitoneum may occur [3,4]. While postoperative pain of moderate to severe intensity was traditionally managed with paracetamol, nonsteroidal anti-inflammatory drugs, and opioids, the current trend increasingly favors the use of fascial plane blocks, particularly as alternatives to opioids.

In abdominal surgeries, various techniques such as the transversus abdominis plane block (TAP), erector spinae plane block (ESP), quadratus lumborum block

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(QLB), modified thoracoabdominal plane block (m-TAPA), and external oblique intercostal block may be employed [5–7]. The literature reports that these blocks provide effective analgesia, reduce the need for rescue analgesics, lower postoperative pain scores, and decrease opioid-related side effects such as postoperative nausea and vomiting [5–9]. A reduction in opioid consumption contributes to lowering the incidence of atelectasis secondary to pain, thromboembolic complications due to delayed mobilization, and nausea and vomiting, thereby shortening hospital length of stay and consequently reducing hospital costs.

The aim of this study is to compare the effects of fascial plane blocks applied for postoperative analgesia on hospital costs in laparoscopic cholecystectomy operations. In this context, it was planned to compare the invoice amounts generated at discharge between patients who received fascial plane blocks and those who did not.

2. Materials and Methods

2.1. Study design and ethical approval

This study was conducted as a retrospective, single-center investigation at Gaziosmanpaşa Training and Research Hospital. Ethical approval was obtained from the Non-Interventional Research Ethics Committee of Health Sciences University, Gaziosmanpaşa Training and Research Hospital on October 25, 2023 (Decision No: 2023/138).

Subsequently, an additional application was submitted to the same ethics committee to include patients operated on until June 1, 2025, and approval was granted. In this study, patients who underwent elective laparoscopic cholecystectomy (LC) under general anesthesia in the general surgery operating room of Gaziosmanpaşa Training and Research Hospital were retrospectively reviewed. During this period, a total of 2572 LC procedures were performed under general anesthesia at our institution. After excluding patients with missing data or not meeting the inclusion criteria, 346 patients in the block group (from 725 patients with block application) and 1068 patients in the non-block group (from 1847 patients without block application) were analyzed (Fig. 1).

2.2. Patient selection

The study included patients aged between 18 and 65 years who underwent elective LC under general anesthesia. Patients admitted and operated on for acute cholecystitis, those who required reoperation due to postoperative complications, and those with a hospital stay of 6 days or longer were excluded from the study.

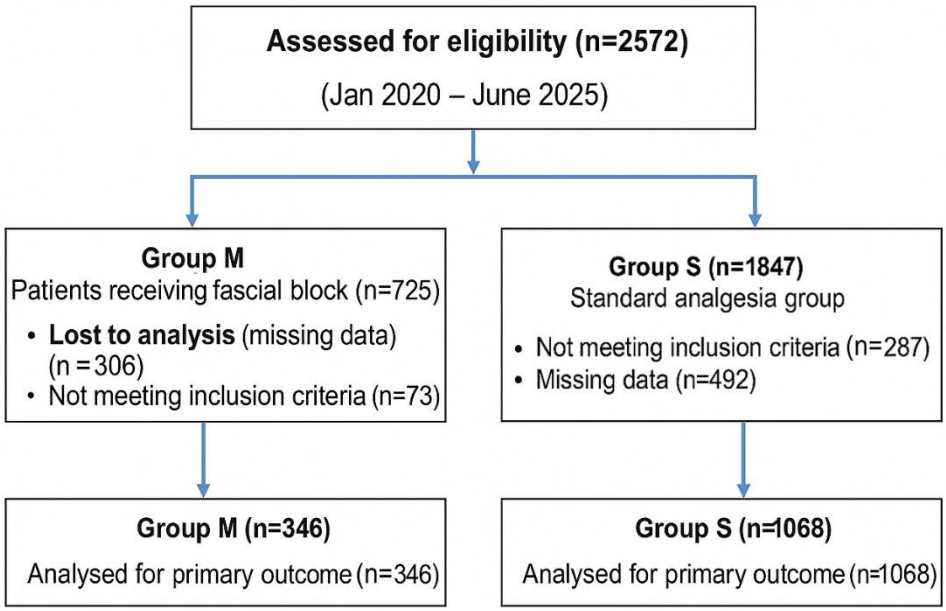

Fig. 1. Study flowchart.

2.3. Anesthesia and postoperative analgesia protocol

In our clinic, all patients receive standard monitoring (electrocardiography, noninvasive blood pressure measurement, pulse oximetry) and a standard general anesthesia technique. For induction of general anesthesia, propofol 2 mg/kg, lidocaine 1 mg/kg, midazolam 0.05 mg/kg, and rocuronium 0.6 mg/kg are routinely administered. General anesthesia is maintained with remifentanil and sevoflurane, while postoperative analgesia consists of paracetamol 1 g, tramadol 1 mg/kg, and ondansetron. In the general surgery clinic, paracetamol, dexketoprofen, and diclofenac are preferred as first-line postoperative analgesics, whereas tramadol is generally administered as a second-line treatment if needed. For patients experiencing nausea and vomiting, additional ondansetron or dexamethasone may be administered in the ward. Unless complications occur, all laparoscopic cholecystectomy patients are routinely discharged home after 24 hours.

2.4. Intervention and group definitions

In our clinic, fascial plane blocks may be performed in suitable patients and under appropriate conditions for postoperative multimodal analgesia in LC operations. Prior to all block procedures, patients are informed both verbally and in writing, and written consent is obtained. Blocks are usually performed preoperatively and bilaterally. The most commonly performed blocks are the modified thoracoabdominal plane block (m-TAPA), quadratus lumborum block (QLB), or erector spinae plane block (ESP).

For block applications, a standard local anesthetic solution consisting of 20 mL of 0.25% bupivacaine per side is administered under ultrasound guidance. In accordance with the national reimbursement system (SUT), block procedures are coded as a single intervention.

- Group M: Patients who, according to the SUT codes, underwent fascial plane block in addition to LC for multimodal analgesia were assigned to this group.
- Group S: Patients who underwent LC alone and received only the standard analgesia protocol without fascial plane block were assigned to this group.

2.5. Data collection and endpoints

Data were obtained by screening the hospital archives using SUT codes for laparoscopic cholecystectomy and fascial plane block procedures. Demographic characteristics, ASA scores, length of hospital stay, diagnoses of chronic diseases such as diabetes and hypertension, and total hospital invoice costs at discharge were recorded.

2.6. Outcome measures

The primary outcome of this study was the comparison of total hospital costs between 2020 and 2025 in patients who underwent elective LC under general anesthesia, comparing those who received a fascial plane block with those who received standard analgesia. The secondary outcomes were subgroup comparisons by year between the two groups and comparison of hospital length of stay.

2.7. Statistical analysis

Descriptive statistics included median (Q1–Q3), frequency, and percentage values. The distribution of variables was tested using the Kolmogorov–Smirnov test. The Mann–Whitney U test was used to analyze independent quantitative variables with non-normal distribution. The chi-square test was applied for independent qualitative variables. All analyses were performed using SPSS version 28.0.

3. Results

In this study, 346 patients in Group M and 1068 patients in Group S were analyzed. The groups were comparable in terms of age and sex distribution. There was a significant difference in ASA scores between the groups. The proportion of ASA I patients was significantly higher in Group M. The prevalence of chronic comorbidities such as hypertension (HT) and diabetes mellitus (DM) was similar between the groups. The length of hospital stay was comparable between the two groups (Table 1).

When the distribution of patients across years was compared, a significant difference was observed between the groups ($p < 0.001$) (Table 2).

When all patients operated between 2020 and 2025 were compared, there was a significant difference in hospital costs between the group that received fascial plane blocks and the group that did not (Table 3). Hospital costs were significantly lower in patients who received fascial plane blocks ($p < 0.001$).

In subgroup analyses by year, no significant difference in hospital costs was observed between the two groups in 2020. Since no fascial plane blocks were performed in 2021, data for that year were unavailable. In 2022, 2023, and 2025, no significant differences in costs were found between the groups. However, in 2024, hospital costs differed significantly between the two groups ($p < 0.001$) (Table 3) (Fig. 2).

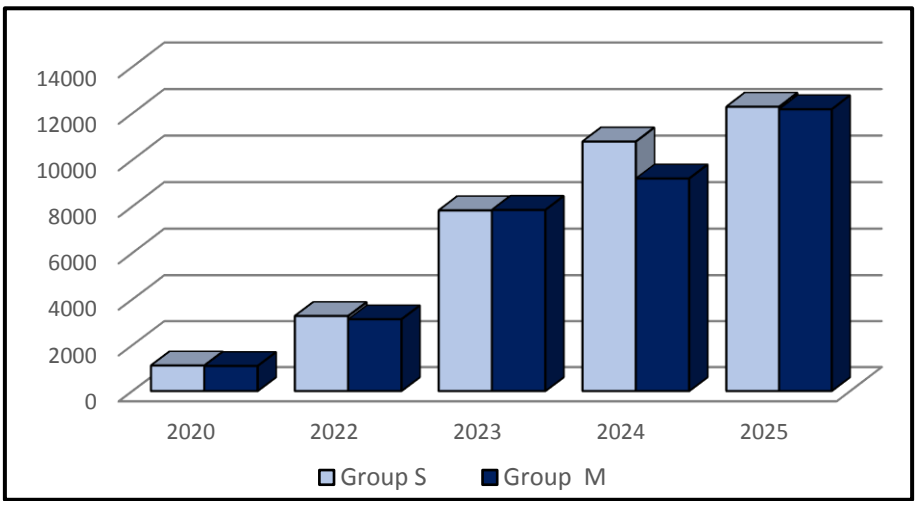

Fig. 2. Year-by-year comparison of per-patient hospital costs between groups (TRY).

Table 1. Comparison of demographic data between groups.

	Group M (n=346)	Group S (n=1068)	p
	n (%)	n (%)	
Gender			
Female	253 (73.1)	818 (76.6)	0.2
Male	93 (26.9)	250 (23.4)	
Presence of diabetes mellitus	62 (17.9)	227 (21.3)	0.2
Presence of hypertension	61 (17.6)	237 (22.2)	0.1
ASA			
I	72 (20.8)	152 (14.2)	
II	266 (76.9)	880 (82.4)	
III	8 (2.3)	35 (3.3)	0.004
IV	0 (0.0)	1 (0.1)	
	Med (Q1-Q3)	Med (Q1-Q3)	p
Age (year)	45.5 (36-53)	45.5 (36-54)	0.6
Hospital length of stay (days)	3 (2-4)	3 (2-4)	0.4

Values are expressed as median (Q1–Q3) and as number and percentage (n, %) for categorical variables, where Q1 and Q3 represent the first and third quartiles, respectively. Group M: fascial plane block; Group S: standard analgesia (no block). The distribution of variables was assessed using the Kolmogorov–Smirnov test. Since the data did not follow a normal distribution, comparisons between groups were performed using the Mann–Whitney U test. A p-value <0.05 was considered statistically significant.

Table 2. Distribution of patient numbers by year.

Year	Group M (n =346)	Group S (n = 1068)	p
	n (%)	n (%)	
2020	42 (12.1)	120 (11.2)	
2022	103 (29.8)	210 (19.2)	
2023	80 (23.1)	150 (14.0)	0<0.001
2024	94 (27.2)	397 (37.2)	
2025	27 (7.8)	191 (17.9)	

Values are presented as number and percentage (n, %) for categorical variables.
Group M: fascial plane block; Group S: standard analgesia (no block). Statistical tests: Chi-square test. $p < 0.05$

Table 3. Comparison of hospital costs (TRY) between groups.

Year	Group M (n =346)	Group S (n = 1068)	p
	Med (Q_1-Q_3)	Med (Q_1-Q_3)	
2020	1060.5 (1060.5-1060.5)	1060.5 (1060.5-1060.5)	0.199
2022	3486.2 (2497.7-3486.2)	3486.2 (2965.8-3486.2)	0.052
2023	8091.4 (8091.4-8093.8)	8091.4 (8091.4-8094.5)	0.899
2024	8094.5 (8094.5-12137.2)	12137.2 (8094.5-12137.2)	<0.001
2025	12137.2 (12137.2-12367.2)	12137.2 (12137.2-12137.2)	0.791
2020-2025 (aggregate, all years)	8091.4 (3486.2-8094.5)	8094.5 (3486.2-12137.2)	<0.001

Data are expressed as median (Q1–Q3), where Q1 = 25th percentile and Q3 = 75th percentile.
Group M: fascial plane block; Group S: standard analgesia (no block). Values are reported in Turkish Lira (TRY).
Statistical tests: Mann-Whitney U test. $p < 0.05$

4. Discussion

In this study, when hospital costs of patients who underwent elective LC between 2020 and 2025 were evaluated, the overall analysis across all years demonstrated significantly lower costs in patients who received fascial plane blocks. Considering the variable inflation conditions in Türkiye, subgroup analyses by year revealed no significant difference between the groups in 2020, 2022, 2023, and 2025, whereas in 2024, costs were found to be lower in the group that received fascial plane blocks.

Fascial plane blocks provide effective analgesia during both the intraoperative and postoperative periods, reducing the need for analgesics and consequently the use of rescue analgesics. This contributes to lowering the incidence of postoperative nausea and vomiting and complication rates, thereby indirectly reducing hospital costs.

In the present study, examination of ASA distributions revealed that the number of ASA I patients was higher in the group that received fascial plane blocks, no ASA IV patients were present in this group, whereas one ASA IV patient was identified in the standard analgesia group. This difference may be attributable to the preference in our clinic for selecting ASA I–II patients in randomized controlled trials. The distribution of diabetes mellitus and hypertension, the proportion of ASA II–III patients, and the mean age were comparable between the groups. Only the proportion of ASA I patients was higher in the multimodal analgesia group, which may have introduced a minor imbalance. Nevertheless, considering the similarity in age, comorbidities, and higher ASA classifications, the generalizability of the results appears to be largely preserved.

In order to ensure homogeneity, patients with a hospital stay longer than five days were excluded from the analysis, as prolonged hospitalization was considered likely to indicate the occurrence of complications that could compromise group comparability. At our institution, patients scheduled for elective LC are routinely admitted one day before surgery and are generally discharged within 24 hours postoperatively. Since patients with a hospital stay exceeding five days were presumed to have a higher probability of developing complications, their exclusion was deemed necessary to preserve homogeneity. This decision was also based on the possibility that complication-related diagnostic codes may not have been consistently entered into the hospital records.

In 2021, due to the COVID-19 pandemic, the number of elective surgeries was very low, and since no fascial plane blocks were performed during this period, analyses could not be conducted for that year.

We initially aimed to compare the postoperative analgesic requirements of all patients. However, upon reviewing the data, we noticed that analgesic information was missing in approximately 30 % of the patients, including even routinely administered agents such as paracetamol and NSAIDs. This deficiency was most likely due to changes in the hospital information software system implemented in 2024, which led to incomplete transfer of medication records. To avoid biased results, we therefore decided not to analyze postoperative analgesic consumption and instead focused our comparison on total hospital costs, for which complete and reliable data were available.

Although it could be anticipated that intraoperative remifentanil and sevoflurane consumption might be lower in patients who received fascial plane blocks, we believe that the reductions in the need for postoperative analgesics and antitussive medications were primarily responsible for the observed cost differences. Despite the use of one vial of bupivacaine per patient and the procedure being billed, the lower costs observed in patients who received fascial plane blocks were attributed to the lower cost of the analgesics used.

Our findings were consistent with previous studies demonstrating the cost-effectiveness of fascial plane blocks in LC cases [10]. In a double-blind randomized clinical trial, laparoscopically guided TAP block was shown to reduce postoperative analgesic requirements, decrease the incidence of Postoperative Nausea and Vomiting (PONV), and be approximately 20 times more cost-effective compared to the non-TAP technique [10]. Considering that TAP blocks provide only somatic analgesia, better analgesia would be expected with techniques such as QLB and ESP blocks. Studies have demonstrated that in ESP and QLB blocks, the local anesthetic can spread along the thoracolumbar fascia into the paravertebral space, thereby providing visceral analgesic efficacy [11–15].

In a meta-analysis published by Oraee et al. [16], QLB and ESP blocks were reported to provide similar analgesic effects in laparoscopic surgeries, with both blocks offering superior analgesia compared to TAP blocks. Furthermore, meta-analyses have shown that m-TAPA and ESP blocks provide effective analgesia in LC procedures and reduce postoperative analgesic consumption [17–19].

In this study, subgroup analyses by year demonstrated similar costs between the groups in 2020, 2022, 2023, and 2025. However, in 2024, costs were found to be higher in the standard analgesia group. These results may be attributed not only to the lower requirements for analgesic medications and reduced incidence of complications such as nausea and vomiting secondary to opioid use in the fascial plane block group, but also to the relatively higher number of patients in the standard analgesia group, of whom 37% belonged to the year 2024, which may have influenced the outcomes. In addition, changes in SUT pricing for LC operations were noted in mid-2024. Furthermore, due to the conduct of randomized controlled trials, fascial plane block applications were more concentrated in the early part of 2024, which may have altered the mean hospital costs.

Similar to our findings, studies in the literature have reported the cost-effectiveness of fascial plane blocks in different surgical contexts. For instance, in a study comparing TAP blocks with liposomal bupivacaine to oral opioids in patients undergoing laparoscopic hysterectomy, the liposomal bupivacaine group was found to be more cost-effective [20]. Likewise, in posterior lumbar fusion surgery, the addition of ESP blocks to standard analgesics was shown to reduce postoperative pain, shorten hospital stay, and thereby contribute to cost reduction [21]. These findings suggest that fascial plane blocks may contribute to cost-effectiveness across various surgical fields and are consistent with our results.

This study has several limitations. First, it was conducted in a single center, and the imbalance in ASA distribution between groups, with a higher proportion of ASA I patients in the block group, may have influenced the results. Second, postoperative analgesic requirements could not be fully analyzed because of missing data in approximately one-third of the patients, most likely related to deficiencies in data transfer during the

transition between hospital information systems. Third, no sample size or power calculation was performed due to the retrospective design. Although all eligible patients during the study period were included to maximize study power, the absence of a priori power analysis may restrict the interpretation of subgroup analyses. In addition, the cost analysis has some constraints. Although cost data were directly obtained from the hospital billing system, no adjustment for inflation or currency fluctuations was applied. Given the highly variable inflation in Türkiye and the substantial currency fluctuations during the global economic crisis period (2020–2025), standardizing costs to a single year or currency was considered potentially misleading; therefore, subgroup analyses were performed by year, which we believe provides a clearer and more reliable comparison. Finally, although different fascial plane block techniques (m-TAPA, QLB, ESP) are performed in our institution, they are recorded under the same procedure code in the hospital information system in accordance with national reimbursement regulations. As a result, we were unable to analyze patients according to block type, which may limit the reproducibility and generalizability of the findings.

5. Conclusions

Fascial plane blocks reduced hospital costs in laparoscopic cholecystectomy, supporting their role as a cost-effective component of multimodal analgesia.

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Conflict of Interest

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

Data Availability

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

Ethics Approval and Consent to Participate

This study was approved by the ethics committee of Non-Interventional Research Ethics Committee of Health Sciences University, Gaziosmanpaşa Training and Research Hospital (Approval Number:2023/138; Date: 25.20.2023). Written informed consent was obtained from the participants. All methods were performed in accordance with relevant guidelines and regulations.

Author Contributions

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

REFERENCES

1. Feldheiser A, Aziz O, Baldini G, et al. Enhanced Recovery After Surgery (ERAS) for gastrointestinal surgery, part 2: consensus statement for anaesthesia practice. *Acta Anaesthesiol Scand* **2016**;60(3):289-334.
2. Bourgeois C, Oyaert L, Van de Velde M, et al. Pain management after laparoscopic cholecystectomy: A systematic review and procedure-specific postoperative pain management (PROSPECT) recommendations. *Eur J Anaesthesiol.* **2024**;41(11):841-855.
3. Ekstein P, Szold A, Sagie B, Werbin N, Klausner JM, Weinbroum AA. Laparoscopic surgery may be associated with severe pain and high analgesia requirements in the immediate postoperative period. *Ann Surg.* **2006**;243(1):41-6.
4. Mitra S, Khandelwal P, Roberts K, Kumar S, Vadivelu N. Pain relief in laparoscopic cholecystectomy--a review of the current options. *Pain Pract.* **2012**;12(6):485-496.
5. Bilge A, Başaran B, Altıparmak B, Et T, Korkusuz M, Yarımoğlu R. Comparing ultrasound-guided modified thoracoabdominal nerves block through perichondrial approach with oblique subcostal transversus abdominis plane block for patients undergoing laparoscopic cholecystectomy: a randomized, controlled trial. *BMC Anesthesiol.* **2023**;23(1):139.
6. Tulgar S, Selvi O, Thomas DT, Deveci U, Özer Z. Modified thoracoabdominal nerves block through perichondrial approach (M-TAPA) provides effective analgesia in abdominal surgery and is a choice for opioid sparing anesthesia. J Clin Anesth. 2019;55:109–109.
7. Ökmen K, Metin Ökmen B, Topal S. Ultrasound-guided posterior quadratus lumborum block for postoperative pain after laparoscopic cholecystectomy: A randomized controlled double blind study. *J Clin Anesth*. **2018**;49:112-117.
8. Shin HJ, Oh AY, Baik JS, Kim JH, Han SH, Hwang JW. Ultrasound-guided oblique subcostal transversus abdominis plane block for analgesia after laparoscopic cholecystectomy: a randomized, controlled, observer-blinded study. *Minerva Anestesiol* **2014**; 80:185-193.
9. Genc C, Tulgar S, Akgun C, Avci MA, Yesilyurt B, Yildiz B et al. Maximum extension and regression rate of cutaneous sensory block obtained with the external oblique intercostal block or the modified thoracoabdominal nerves block through perichondrial approach in patients undergoing laparoscopic cholecystectomy. *Minerva Anestesiol.* **2024**;90(11):979-988.
10. Nair AS, Seelam S, Naik V, Upputuri O, Sriprakash V. Laparoscopic-guided subcostal transversus abdominis plane block in laparoscopic cholecystectomy: A double-blinded randomized clinical trial. *Anesth Essays Res.* **2022**;16(3):227-32.
11. Elsharkawy H, El-Boghdadly K, Barrington M. Quadratus Lumborum Block: Anatomical Concepts, Mechanisms, and Techniques. *Anesthesiology.* **2019**;130(2):322-335.
12. Willard FH, Vleeming A, Schuenke MD, Danneels L, Schleip R. The thoracolumbar fascia: anatomy, function and clinical considerations. *J Anat* **2012**;221:507-536.
13. Adhikary SD, Bernard S, Lopez H, Chin KJ. Erector Spinae Plane Block Versus Retrolaminar Block: A Magnetic Resonance Imaging and Anatomical Study. *Reg Anesth Pain Med* **2018**; 43: 756-62.
14. Schwartzmann A, Peng P, Maciel MA, Forero M. Mechanism of the erector spinae plane block: insights from a magnetic resonance imaging study. *Can J Anaesth* **2018**; 65:1165-1166.
15. Sørenstua M, Zantalis N, Raeder J, Vamnes JS, Leonardsen AL. Spread of local anesthetics after erector spinae plane block: an MRI study in healthy volunteers. Reg Anesth Pain Med. 2023;48(2):74-79.
16. Oraee S, Rajai Firouzabadi S, Mohammadi I, Alinejadfard M, Golsorkh H, Hatami S. Erector spinae plane block for laparoscopic surgeries: a systematic review and meta-analysis. *BMC Anesthesiol*. **2024**;24(1):389.
17. DE Cassai A, Dost B, Bugada D, et al. Modified thoracoabdominal nerves block through perichondrial approach is effective in reducing postoperative opioids requirements in patients undergoing laparoscopic cholecystectomy: a meta-analysis with trial sequential analysis. *Minerva Anestesiol.* **2025**;91(5):440-449.

18. Yang X, Zhang Y, Chen Y, Xu M, Lei X, Fu Q. Analgesic effect of erector spinae plane block in adults undergoing laparoscopic cholecystectomy: a systematic review and meta-analysis of randomized controlled trials. *BMC Anesthesiol*. **2023**;23(1):7.
19. Zewdu D, Tantu T, Eanga S, Tilahun T. Analgesic efficacy of erector spinae plane block versus transversus abdominis plane block for laparoscopic cholecystectomy: a systematic review and meta-analysis of randomized controlled trial. *Front Med (Lausanne)*. **2024**;29;11:1399253.
20. Seagle BL, Miller ES, Strohl AE, Hoekstra A, Shahabi S. Transversus abdominis plane block with liposomal bupivacaine compared to oral opioids alone for acute postoperative pain after laparoscopic hysterectomy for early endometrial cancer: a cost-effectiveness analysis. *Gynecol Oncol Res Pract*. **2017**;4:12.
21. van den Broek RJC, van de Geer R, Schepel NC, Liu WY, Bouwman RA, Versyck B. Evaluation of adding the Erector spinae plane block to standard anesthetic care in patients undergoing posterior lumbar interbody fusion surgery. *Sci Rep*. **2021**;11(1):7631.

Challenge Journal of Perioperative Medicine

Research Article

Retrospective comparison of anesthetic effects of bupivacaine and bupivacaine + dexmedetomidine in infraclavicular brachial plexus block in upper limb surgery

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ABSTRACT

Background: The objective of this study was to evaluate the anesthetic efficacy of dexmedetomidine as an adjuvant to bupivacaine in infraclavicular brachial plexus blocks administered for surgical procedures involving the hand and forearm.

Materials and Methods: 84 patients, aged between 18-70 years, who underwent elective hand and forearm surgery in between January 2021 and July 2021, had American Society of Anesthesiologists (ASA) classification I-II, and were anesthetized with ultrasound-guided infraclavicular brachial plexus block were included in the study. Group B (n=42): 20 ml bupivacaine 0.5%+20 ml SF, Group B+D (n=42): 20ml bupivacaine 0.5% + 1 mcg/kg dexmedetomidine diluted to a volume of 20 mL was selected from the patients who underwent block. Demographic information of the patients were taken from the preoperative anesthesia evaluation form and recorded. From the information recorded in the patient follow-up form, peak heart rate, mean arterial pressure, oxygen saturation percentage, Visual Analogue Scale (VAS) scores, pinprick test score and Bromage score were recorded as study data.

Results: Compared to group B, the onset time of sensory and motor blockade was statistically significantly earlier and the duration of sensory block, motor block and analgesia was statistically significantly longer in group B+D ($p<0.05$). In Group B+D, VAS score was statistically significantly lower at 10th, 20th, 8th and 12th hours ($p<0.05$).

Conclusions: The addition of 1 mcg/kg dexmedetomidine to 20 ml of 0.5% bupivacaine in infraclavicular brachial plexus block was found to significantly accelerate the onset of sensory and motor block, and to extend the duration of motor block, sensory block, and postoperative analgesia.

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1. Introduction

Brachial plexus blocks are frequently administered for anesthesia and analgesia in patients undergoing arm, forearm, and hand surgeries. By eliminating the need for general anesthesia and its associated risks—such as airway complications, postoperative nausea and vomiting—these regional techniques facilitate earlier oral intake, mobilization, and discharge [1].

Brachial plexus blocks can be performed at four distinct anatomical levels: the interscalene groove, the subclavian sheath (supraclavicular region), the infraclavicular fossa, and around the axillary artery. Among these, the infraclavicular approach is preferred for anesthesia

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or analgesia in surgeries involving the forearm, wrist, hand, and fingers. Compared to the infraclavicular block, the axillary approach often fails to anesthetize the axillary and musculocutaneous nerves, as these branch off at higher levels. Similarly, the interscalene and supraclavicular approaches are typically insufficient for achieving complete anesthesia in the distribution of the ulnar nerve [2]. In addition, the incidence of tourniquet pain is lower in infraclavicular block [3]. The infraclavicular block does not require abduction of the arm at the shoulder and can be performed in any arm position, making it an ideal site for catheter placement for continuous local anesthetic infusion [4].

Although the use of peripheral nerve catheters has increased in recent years, single-injection peripheral nerve blocks remain the most commonly employed technique among anesthesiologists [5]. Local anesthetic agents such as bupivacaine, levobupivacaine and ropivacaine are used in brachial plexus blocks. Long-acting local anesthetics alone can provide analgesia for up to 9-14 hours [5]. Bupivacaine is a widely used long-acting local anesthetic agent. The dose of bupivacaine administered can be increased to prolong the block duration or shorten the block onset time. However, due to the increased incidence of seizures and cardiac arrest related to the dose of bupivacaine administered, researchers have turned to the use of adjuvant agents that shorten the block onset time and prolong the block duration instead of this approach [6].

The limited duration of analgesia provided by peripheral nerve blocks may necessitate the use of systemic analgesics, increasing the risk of opioid-related side effects and potentially contributing to the development of chronic pain [7]. There are many adjuvant agents used to enhance the analgesic effect of local anesthetic agents such as clonidine, magnesium, opioids, vasoconstrictor agents and steroids [8]. Dexmedetomidine is an agent with selective α-2 agonist effect in the central nervous system. Recently, it has been used as an adjuvant agent in general anesthesia and regional anesthesia applications to provide sedation in intensive care. Many studies have reported that dexmedetomidine prolongs the duration of nerve block when administered perineurally with local anesthetics [9–11].

The primary aim of this study was to compare the onset times and durations of motor and sensory block in infraclavicular brachial plexus blocks performed with bupivacaine alone versus a combination of bupivacaine and dexmedetomidine in patients undergoing upper extremity surgery. Secondary objectives included the duration of analgesia, evaluation of differences in hemodynamic responses and the incidence of side effects between the two groups.

2. Materials and Methods

The study was conducted following the approval of the Uludağ University Medical Research Ethics Committee (Decision No: 2021-10/41, dated July 28, 2021). In this retrospective study, a total of 84 patients who underwent hand and/or forearm surgery between January 1 and July 1, 2021; ASA I-II, aged 18-70 years, and whose anesthesia was performed with ultrasound-guided infraclavicular brachial plexus block were included. Patients with ASA 3-4, those under 18 years of age, those over 70 years of age, pregnant women, those who had to switch to general anesthesia because sufficient sensory and motor blockade could not be achieved surgically after peripheral blockade, and those whose anesthesia records did not provide the necessary data for the study were excluded from the study.

After being taken to the operating room, the patients underwent ECG, pulse oximetry, and noninvasive arterial blood pressure monitoring. It was determined from patient file notes that, to perform ultrasound-guided infraclavicular block under sterile conditions before surgery, the USG probe was placed in the sagittal plane, just 1 cm anterior to the intersection between the coracoid process and the clavicle. After visualizing the subclavian artery and the lateral, medial, and posterior cords of the surrounding brachial plexus, the tip of the blocking needle (22 Ga. x 2 inch (50 mm) 30° Curved Insulated Echogenic Needle with Extension Set) was directed in-plane toward the posterolateral aspect of the subclavian artery at the 8 o'clock position. After aspiration, the "U"-shaped spread of the local anesthetic around the subclavian artery was monitored on the USG screen.

Demographic information (name-surname, protocol number, weight, height, age, body mass index, comorbidity, ASA score) and peak heart rate (HR), arterial blood pressure (BP), oxygen saturation percentage (SpO_2), onset time of motor and sensory block, duration of motor and sensory block, and duration of analgesia were recorded from the peroperative anesthesia evaluation form.

2.1. Statistical analysis

The analyses of the study were performed with SPSS 21.0 package program. Categorical variables were presented as number, percentage, continuous numerical variables were presented as mean ± standard deviation and median values. Pearson Chi-square test and Fisher's Exact test were used to compare categorical variables between groups. The conformity of continuous numerical variables to normal distribution was evaluated by Shapiro Wilk test. The independent samples t test was used to compare the numerical variables that conformed to the normal distribution between two independent groups, and the Mann Whitney U test was used to compare the numerical variables that did not conform to the normal distribution between two independent groups. Box and line graphs were used for visualization of nonparametric data and linear graphs were used for visualization of measurements made at different times. Statistically, a p value less than 0.05 was accepted as the significance limit.

3. Results

In this study comparing the intraoperative and postoperative characteristics of dexmedetomidine (group B+D) adjuvantly added to bupivacaine (group B)

in infra-clavicular brachial plexus block in upper extremity surgery, the results of a total of 84 patients, 42 B and 42 B+D, were evaluated. Gender, comorbidity and ASA score distribution were similar between the groups (p =1.0, p = 1.0, p = 0.746, respectively) (Table 1).

There was no statistically significant difference between the groups in terms of age, height, body weight and BMI (p>0.05) (Table 2).

Compared with group B, mean arterial pressure in group B+D was statistically significantly lower at 10, 20, 30, 60 and 120 minutes (p < 0.05). Compared with group B, heart rate in group B+D was statistically significantly lower in all measurements at 10 min and later (p<0.05). There was no statistically significant difference in peripheral oxygen saturation between the groups (p > 0.05) (Table 3).

Compared to Group B, the VAS scores in Group B+D were statistically significantly lower at 10 and 20 minutes, as well as at 8 and 12 hours postoperatively (p < 0.05). Furthermore, Group B+D demonstrated a significantly shorter onset time for both sensory and motor block, and a significantly longer duration of sensory block, motor block, and analgesia compared to Group B (p < 0.05) (Table 4).

Table 1. Distribution of gender, ASA score and comorbidities between study groups.

	B (n = 42)		B+D (n = 42)		p
Variables	Number	Percent	Number	Percent	
Gender					
Male	39	92.9	39	92.9	1.000
Female	3	7.1	3	7.1	
ASA score					
1	35	83.3	35	83.3	1.000
2	7	16.7	7	16.7	
Comorbidity					
No	36	66.7	37	88.1	0.746
Yes	6	14.3	5	11.9	
Hypertension	4	9.5	4	9.5	1.000
Coronary artery disease	4	9.5	0	0	0.116
Diabetes mellitus	2	4.8	1	2.4	0.557

Table 2. Distribution of age, height, body weight and body mass index between study groups.

	B (n = 42)		B+D (n = 42)		p
	Mean ± SD	Median	Mean ± SD	Median	
Age (year)	39.88 ± 15.41	38.5	38.29 ± 15.79	35.5	0.601
Length (cm)	173.69 ± 7.71	175.0	174.60 ± 7.66	174.5	0.591*
Weight (kg)	75.67 ± 16.86	75.0	79.17 ± 13.43	80.0	0.296*
Body Mass Index (kg/m^2)	25.64 ± 3.86	25.54	25.60 ± 3.78	25.46	0.962*

4. Discussion

Inadequate management of postoperative pain is associated with increased morbidity and mortality, reduced quality of life, and elevated hospital costs due to prolonged hospitalization and higher complication rates [12]. The use of peripheral regional anesthesia provides significant benefits in the postoperative period, including lower pain scores, early hospital discharge, and reduced use of additional analgesics, including opioids [13].

The duration of analgesia provided by single injection nerve blocks is limited to 6-8 hours, even if only long-lasting local anesthetic drugs (e.g. bupivacaine or ropivacaine) are used [11,14]. Increasing the dose of local anesthetic may prolong the duration of analgesia, but may also increase the risk of local anesthetic systemic toxicity [15].

Continuous peripheral nerve blocks have been associated with a reduction in rebound pain and improved postoperative analgesia compared to peripheral nerve blocks performed with a single injection. However, secondary block failure rates have been reported to be as high as 20-50% due to catheter displacement, occlusion or interruption, fluid leakage and infusion pump malfunction [16].

In recent years, researchers have focused on topical, neuraxial, perineural or intravenous adjuvants (opioids, dexamethasone and α-2-agonists) in order to accelerate the onset of sensory and motor block, prolong the duration of analgesia, improve the quality of nerve block, reduce the dose of local anesthetic and thus its side effects [11,17].

In a study by Ammar et al. [18], which parallels our research, 60 patients undergoing ultrasound-guided infraclavicular block were randomly assigned into two groups. One group received 30 ml of 0.33% bupivacaine with dexmedetomidine at a dose of 0.75 mcg/kg, while the other received 30 ml of 0.33% bupivacaine alone. Their prospective and randomized study revealed that dexmedetomidine significantly accelerated the onset of sensory and motor block, prolonged the duration of analgesia, increased the duration of both sensory and motor blocks, reduced pain scores, and decreased the need for supplementary opioids.

Table 3. Distribution of mean arterial pressure, heart rate and peripheral oxygen saturation between study groups.

	B (n = 42)		B+D (n = 42)		p
MAP (mmHg)	Mean ± SD	Median	Mean ± SD	Median	
Pre-Block	103.79 ± 17.42	104.5	101.79 ± 17.34	101.5	0.599*
0 min	106.43 ± 16.71	107.0	118.88 ± 97.18	104.5	0.687
10 min	100.57 ± 15.61	100.0	91.83 ± 15.53	91.5	0.012*
20 min	97.38 ± 15.18	98.0	86.98 ± 16.02	87.5	0.003*
30 min	97.36 ± 15.14	98.5	84.74 ± 14.10	87.5	<0.001*
60 min	95.52 ± 15.91	96.0	86.19 ± 13.34	87.0	0.009
120 min	95.02 ± 14.75	95.0	87.12 ± 14.27	88.0	0.015*
4 hour	96.81 ± 15.88	98.5	90.10 ± 15.26	90.0	0.052*
8 hour	96.40 ± 15.87	99.0	92.38 ± 14.57	93.0	0.230*
12 hour	100.29 ± 15.56	101.0	98.45 ± 16.39	100.0	0.600*
Pulse (rate/min)					
Pre-Block	84.67 ± 13.38	86.0	82.07 ± 12.34	81.5	0.358*
0 min	87.36 ± 13.50	88.5	88.50 ± 13.52	86.5	0.699*
10 min	83.29 ± 10.98	85.0	73.69 ± 12.86	70.0	0.001
20 min	80.14 ± 10.22	81.0	68.52 ± 12.50	67.0	<0.001
30 min	78.93 ± 8.84	79.5	67.19 ± 11.01	67.0	<0.001
60 min	78.19 ± 9.55	80.0	68.05 ± 11.20	65.0	<0.001
120 min	78.38 ± 9.34	78.5	68.31 ± 15.23	65.0	<0.001
4 hour	80.69 ± 8.64	80.5	72.10 ± 9.80	70.0	<0.001
8 hour	80.60 ± 10.31	82.0	75.14 ± 10.32	72.0	0.015
12 hour	82.52 ± 12.12	82.5	77.00 ± 10.93	75.0	0.015
SpO_2 (%)					
Pre-Block	96.98 ± 2.17	97.0	97.02 ± 1.89	97.0	0.996
0 min	97.33 ± 1.98	97.5	97.67 ± 3.23	98.0	0.809
10 min	97.26 ± 2.00	97.5	97.10 ± 1.74	97.5	0.561
20 min	97.45 ± 1.80	98.0	97.02 ± 2.12	98.0	0.425
30 min	97.62 ± 1.75	98.0	97.24 ± 2.14	98.0	0.371
60 min	97.43 ± 1.74	98.0	95.26 ± 13.72	97.0	0.528
120 min	97.57 ± 1.58	98.0	97.40 ± 1.53	97.5	0.494
4 hour	97.31 ± 1.60	97.0	97.14 ± 1.34	97.0	0.570
8 hour	97.17 ± 1.78	97.0	96.88 ± 1.35	97.0	0.314
12 hour	97.55 ± 1.64	98.0	97.21 ± 1.55	97.0	0.215

MAP: Mean arterial pressure; HR: Heart rate; SpO_2: Peripheral oxygen saturation.

Table 4. Distribution of VAS score, sensory block and motor block onset time/duration, duration of analgesia and duration of operation between study groups.

	B (n = 42)		B+D (n = 42)		p
VAS score	Mean ± SD	Median	Mean ± SD	Median	
Pre-Block	5.55 ± 1.48	6	5.57 ± 1.77	6	0.931
0 min	4.71 ± 1.45	5	4.21 ± 2.02	5	0.377
10 min	2.71 ± 2.18	3	0.88 ± 1.53	0	<0.001
20 min	1.29 ± 1.86	0	0.14 ± 0.52	0	<0.001
30 min	0 ± 0	0	0 ± 0	0	-
60 min	0 ± 0	0	0 ± 0	0	-
120 min	0 ± 0	0	0.02 ± 0.15	0	0.317
4 hour	0.26 ± 0.70	0	0.07 ± 0.34	0	0.133
8 hour	0.83 ± 1.21	0	0.31 ± 0.98	0	0.003
12 hour	1.81 ± 1.40	2	0.69 ± 1.37	0	<0.001
Variables					
Sensory block onset time (min)	21.19 ± 8.03	20	15.24 ± 6.34	15	0.001
Motor block onset time (min)	23.81 ± 7.64	30	16.90 ± 7.49	20	<0.001
Sensory block duration (min)	520.48 ± 166.73	500	645.71 ± 129.3	700	<0.001
Motor block duration (min)	606.90 ± 128.36	690	649.76 ± 114.03	700	0.010
Analgesia duration (min)	580.71 ± 121.88	555	645.00 ± 127.26	700	<0.001
Operation time (min)	103.45 ± 53.58	100	101.67 ± 57.15	90	0.546

VAS: Visual analog scale.

In a prospective, randomized, and double-blind study, Mirkheshti et al. [19] assigned 111 patients undergoing ultrasound-guided infraclavicular block into three groups. They added either 100 mcg dexmedetomidine, 5 ml ketorolac, or 5 ml saline to 25 ml of 1.5% lidocaine. Their findings demonstrated that the onset of motor block was faster and the durations of sensory and motor block were longer in the dexmedetomidine group. Additionally, the duration of analgesia was significantly prolonged in patients receiving dexmedetomidine compared to those receiving saline. However, the time to first analgesic requirement was longer in the ketorolac group than in the dexmedetomidine group. Consistent with these findings, our study also showed that the addition of dexmedetomidine to local anesthetic in infraclavicular block resulted in a faster onset and prolonged duration of both sensory and motor block, as well as extended analgesia duration.

In a prospective study in which they randomized 80 patients randomly divided into 2 groups and applied dexmedetomidine added to 30 ml of 0.5% ropivacaine and 30 ml of 0.5% ropivacaine at a dose of 1 mcg/kg, Das et al. [20] found that the onset of sensory and motor block was faster and the duration of sensory and motor block was longer in the dexmedetomidine group compared to the control group, similar to this study, but they applied supraclavicular block instead of infraclavicular block.

The mechanism by which alpha 2 adrenergic receptor agonists produce analgesia and sedation is not fully understood but is likely to be multifactorial. Peripherally, α-2 agonists produce analgesia by reducing norepinephrine release and causing α-2 receptor-independent inhibitory effects on nerve fiber action potentials. Centrally, α-2 agonists produce analgesia and sedation by inhibition of substance P release in the nociceptive pathway at the dorsal root neuron level and activation of α-2 adrenoceptors in the locus coeruleus [21].

Intraoperative analgesia is also important to keep hemodynamics stable throughout surgery. Inadequate analgesia may result in increased heart rate or mean arterial pressure, increased myocardial O_2 consumption and consequent myocardial damage. Dexmedetomidine improves perioperative hemodynamic stability in tachycardic and hypertensive patients. However, due to its bradycardia and hypotension effects, it may have unfavorable consequences in patients with congestive heart failure with rate-dependent cardiac output or impaired conduction [22,23]. In a meta-analysis by Vorobeichik et al. [24], which included 34 studies and data from 2,007 patients, the perineural use of dexmedetomidine as an adjuvant in brachial plexus blocks was shown to accelerate the onset of sensory and motor block and prolong the duration of analgesia as well as sensory and motor block. However, an increased incidence of bradycardia was also reported. The variability in dexmedetomidine's effects across different levels of the brachial plexus was attributed to differences in systemic absorption and neuraxial spread. The authors suggested that a dose of 50–60 mcg may provide optimal prolongation of sensory block with minimal hemodynamic side effects. Notably, no neurotoxicity or neurologic complications were reported in any patient.

Similarly, in a meta-analysis of 18 studies examining dexmedetomidine as an adjuvant in brachial plexus blocks, Hussain et al. [10] reported prolonged durations of analgesia and motor and sensory blocks, along with decreased opioid consumption and fewer opioid-related side effects. Nonetheless, a higher frequency of reversible bradycardia was observed.

In another meta-analysis by Schnabel et al. [11], which included 46 studies and 3,149 patients comparing local anesthetics alone, local anesthetics combined with perineural dexmedetomidine, and systemic dexmedetomidine in peripheral nerve blocks, it was concluded that perineural dexmedetomidine significantly prolonged analgesia duration but was also associated with an increased risk of bradycardia and hypotension.

It was considered interesting that systemic and perineural dexmedetomidine did not differ in terms of the risk of intraoperative bradycardia and hypotension, and it was emphasized that the level of evidence for this conclusion was very low. There was also no difference in the effect of systemic or perineural use of dexmedetomidine on the duration of analgesia.

In a meta-analysis of 3332 patients from 57 randomized trials, Hai et al. [25] investigating the optimal perineural dose of dexmedetomidine to prolong the duration of analgesia in brachial plexus block, found that 30-50μg dexmedetomidine as an adjuvant provided longer analgesic duration than local anesthetic alone and did not increase the risk of bradycardia and hypotension. In our study in which we added dexmedetomidine perineurally at a dose of 1mcg/kg, we found no statistically significant difference in the frequency of hypotension and bradycardia between the groups.

The potential neurotoxic effects of dexmedetomidine in humans have not been extensively studied. However, in animal models of spinal anesthesia [26] and sciatic nerve block [27], dexmedetomidine did not show toxicity and was potentially neuroprotective when combined with lidocaine [26] and bupivacaine [27]. No neurotoxic effect was found in our study.

The positive effects of dexmedetomidine, such as prolonged duration of motor and sensory block, should be carefully weighed against the increased risks of sedation, bradycardia and hypotension. While prolonged duration of motor block may be desirable in some surgeries, the use of dexmedetomidine in lower limb blocks may delay postoperative recovery and increase the risk of falls. Sedation, bradycardia and hypotension are dose-dependent and transient, but these side effects may preclude its use in high-risk patients who may be more easily affected by changes in heart rate and blood pressure and in procedures performed in the sitting position. Patients should be closely monitored [17,24].

5. Conclusions

In this retrospective study, the perineural addition of 1 mcg/kg dexmedetomidine to 20 ml of 0.5% bupivacaine in infraclavicular brachial plexus blocks for hand and forearm surgeries was associated with a shorter onset time of sensory and motor block, as well as prolonged durations of sensory block, motor block, and analgesia. This technique also resulted in increased patient and surgeon satisfaction, without any observed adverse hemodynamic effects. These findings suggest that the use of dexmedetomidine as an adjuvant to local anesthetics may significantly enhance block quality and support its routine clinical application in infraclavicular brachial plexus blocks.

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Conflict of Interest
The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this manuscript.

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

Ethics Approval and Consent to Participate
This study was approved by the ethics committee of Uludağ University Medical Research Ethics Committee (Decision No: 2021-10/41, dated July 28, 2021). Written informed consent was obtained from the participants. All methods were performed in accordance with relevant guidelines and regulations.

Author Contributions
Şahan Şahinkaya: *conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing – original draft, writing – review & editing, visualization, supervision, project administration, funding acquisition.*
Elif Başağan Moğol: *conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing – original draft, writing – review & editing.*
Leman Gökçenur Aydın: *investigation, resources, data curation.*
Selcan Akesen: *conceptualization, methodology, writing – original draft, writing – review & editing.*

REFERENCES

1. Chin KJ, Singh M, Velayutham V, Chee V. Infraclavicular brachial plexus block for regional anaesthesia of the lower arm. *Anesth Analg*. **2010**;111(4):1072.
2. Macfarlane A, Anderson K. Infraclavicular brachial plexus blocks. *Cont Educ Anaesth Crit Care Pain*. **2009**;9(5):139–143.
3. Sandhu NS, Manne JS, Medabalmi PK, Capan LM. Sonographically guided infraclavicular brachial plexus block in adults: A retrospective analysis of 1146 cases. *J Ultrasound Med*. **2006**;25(12):1555–1561.
4. Marhofer P, Greher M, Kapral S. Ultrasound guidance in regional anaesthesia. *Br J Anaesth*. **2005**;94(1):7–17.
5. Brummett CM, Norat MA, Palmisano JM, Lydic R. Perineural administration of dexmedetomidine in combination with bupivacaine enhances sensory and motor blockade in sciatic nerve block without inducing neurotoxicity in rats. *Anesthesiology*. **2008**;109(3):502–511.

6. Casati A, Putzu M. Bupivacaine, levobupivacaine and ropivacaine: Are they clinically different?. *Best Pract Res Clin Anaesthesiol*. **2005**;19(2):247–268.
7. Sreeja R, Mathew A, Velayuden M. Effect of added alpha 2 agonists with local anaesthetic in infraclavicular brachial plexus block: A comparative study between dexmedetomidine and clonidine. *Anesth Essays Res*. **2020**;14(4):638–643.
8. Yaghoobi S, Shahamat H, Alizadeh A, Khezri MB. Comparing postoperative analgesic effect of dexmedetomidine or dexamethasone added to lidocaine through infraclavicular block in forearm surgery. *Clin J Pain*. **2019**;35(9):766–771.
9. Song JH, Shim HY, Lee TJ, Jung JK, Cha YD, Lee DI, et al. Comparison of dexmedetomidine and epinephrine as an adjuvant to 1% mepivacaine in brachial plexus block. *Korean J Anesthesiol*. **2014**;66(4):283–289.
10. Hussain N, Grzywacz VP, Ferreri CA, et al. Investigating the efficacy of dexmedetomidine as an adjuvant to local anesthesia in brachial plexus block: A systematic review and meta-analysis of 18 randomized controlled trials. *Reg Anesth Pain Med*. **2017**;42(2):184–196.
11. Schnabel A, Reichl SU, Weibel S, Kranke P, Zahn PK, Pogatzki-Zahn EM, et al. Efficacy and safety of dexmedetomidine in peripheral nerve blocks: A meta-analysis and trial sequential analysis. *Eur J Anaesthesiol*. **2018**;35(10):745–758.
12. Lovich-Sapola J, Smith CE, Brandt CP. Postoperative pain control. *Surg Clin North Am*. **2015**;95(2):301–318.
13. Reisli R, Akkaya ÖT, Arıcan Ş, Can ÖS, Çetingök H, Güleç MS, et al. Akut postoperatif ağrının farmakolojik tedavisi: Türk Algoloji-Ağrı Derneği klinik uygulama kılavuzu. *Agri*. **2021**;33:1–51. (in Turkish)
14. Lomate PA, Mane MV. Efficacy of multimodal analgesia with perineural buprenorphine or dexmedetomidine for surgeries performed under ultrasound-guided infraclavicular brachial plexus block. *J Anaesthesiol Clin Pharmacol*. **2020**;36(1):66–71.
15. Safa B, Flynn B, McHardy PG, Kiss A, Haslam L, Henry PD, et al. Comparison of the analgesic duration of 0.5% bupivacaine with 1:200,000 epinephrine versus 0.5% ropivacaine versus 1% ropivacaine for low-volume ultrasound-guided interscalene brachial plexus block: A randomized controlled trial. *Anesth Analg*. **2021**;1129–1137.
16. Desai N, Kirkham KR, Albrecht E. Local anaesthetic adjuncts for peripheral regional anaesthesia: A narrative review. *Anaesthesia*. **2021**;76(Suppl 1):100–109.
17. Rao S, Rajan N. Dexmedetomidine as an adjunct for regional anesthetic nerve blocks. *Curr Pain Headache Rep*. **2021**;25(2):8.
18. Ammar AS, Mahmoud KM. Ultrasound-guided single injection infraclavicular brachial plexus block using bupivacaine alone or combined with dexmedetomidine for pain control in upper limb surgery: A prospective randomized controlled trial. *Saudi J Anaesth*. **2012**;6(2):109–114.
19. Mirkheshti A, Saadatniaki A, Salimi A, Rasi M, Memary E, et al. Effects of dexmedetomidine versus ketorolac as local anesthetic adjuvants on the onset and duration of infraclavicular brachial plexus block. *Anesth Pain Med*. **2014**;4(3):17620.
20. Das B, Lakshmegowda M, Sharma M, Mitra S, Chauhan R. Supraclavicular brachial plexus block using ropivacaine alone or combined with dexmedetomidine for upper limb surgery: A prospective, randomized, double-blinded, comparative study. *Rev Esp Anestesiol Reanim*. **2016**;63(3):135–140.
21. Esmaoglu A, Yegenoglu F, Akin A, Turk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. *Anesth Analg*. **2010**;111(6):1548–1551.
22. Laycock H, Bantel C. Objective assessment of acute pain. *J Anesth Clin Res*. **2016**;7(6):1000630.
23. Bahraini A, Banerjee O, Ra J. Bradycardia resulting in cardiac arrest in a critically ill patient receiving dexmedetomidine. *Trauma Case Rep*. **2021**;36:100548.
24. Vorobeichik L, Brull R, Abdallah FW. Evidence basis for using perineural dexmedetomidine to enhance the quality of brachial plexus nerve blocks: A systematic review and meta-analysis of randomized controlled trials. *Br J Anaesth*. **2017**;118(2):167–181.
25. Cai H, Fan X, Feng P, Wang X, Xie Y. Optimal dose of perineural dexmedetomidine to prolong analgesia after brachial plexus blockade: A systematic review and meta-analysis of 57 randomized clinical trials. *BMC Anesthesiol*. **2021**;21(1):233.
26. Zhang H, Zhou F, Li C, et al. Molecular mechanisms underlying the analgesic property of intrathecal dexmedetomidine and its neurotoxicity evaluation: An in vivo and in vitro experimental study. *PLoS One*. **2013**;8(2):e55556.
27. Tüfek A, Kaya S, Tokgöz O, Firat U, Evliyaoğlu O, Çelik F, et al. The protective effect of dexmedetomidine on bupivacaine-induced sciatic nerve inflammation is mediated by mast cells. *Clin Invest Med*. **2013**;36(2):1–8.

Challenge Journal of Perioperative Medicine

Research Article

Levobupivacaine versus bupivacaine for spinal anesthesia in jackknife position: A randomized trial in pilonidal sinus surgery

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ABSTRACT

Background: This study aimed to compare the efficacy and clinical characteristics of levobupivacaine and bupivacaine for spinal anesthesia in the jackknife position during pilonidal sinus surgery.

Materials and Methods: The onset and maximum level of sensory block were similar between groups. Regression to S2 occurred significantly earlier in the levobupivacaine group (139.7 ± 7.3 min) compared with the bupivacaine group (165.2 ± 8.0 min, p=0.001). The duration of motor block was also shorter in the levobupivacaine group (125.8 ± 6.5 vs. 148.5 ± 7.2 min, p=0.001). Hemodynamic stability and side-effect profiles were comparable between groups.

Results: The onset and maximum level of sensory block were similar between groups. Regression to S2 occurred significantly earlier in the levobupivacaine group (139.7 ± 7.3 min) compared with the bupivacaine group (165.2 ± 8.0 min, p=0.001). The duration of motor block was also shorter in the levobupivacaine group (125.8 ± 6.5 vs. 148.5 ± 7.2 min, p=0.001). Hemodynamic stability and side-effect profiles were comparable between groups.

Conclusions: Levobupivacaine provides shorter motor block duration and faster recovery compared with bupivacaine, making it particularly suitable for short procedures performed in the jackknife position. Larger multicenter trials are warranted to validate these findings.

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1. Introduction

Pilonidal sinus disease is a frequent chronic disorder of the sacrococcygeal region, primarily affecting young adults, and surgical excision remains the treatment of choice [1]. Given the demographic profile of these patients, procedures are commonly performed in ambulatory settings, where anesthesia must balance efficacy with rapid recovery and safety [2]. Spinal anesthesia has become the preferred technique in anorectal surgery owing to its rapid onset, technical simplicity, cost-effectiveness, and favorable safety profile [2–4].

The characteristics of spinal anesthesia are determined by several factors, including the type, dose, and baricity of the local anesthetic, as well as patient positioning [5]. In perianal surgery, the prone jackknife position offers optimal surgical exposure [6]. However, the use of hyperbaric solutions in this posture carries the risk of unintended cephalad spread, potentially producing higher block levels and hemodynamic instability [4,7]. By contrast, isobaric solutions distribute more predictably, largely independent of patient position, and are increasingly employed for anorectal surgery [3,7,8].

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Bupivacaine is one of the most frequently used long-acting local anesthetics for spinal anesthesia, but its dose-dependent cardiotoxicity and neurotoxicity remain significant concerns [9]. Levobupivacaine, the pure S(–)-enantiomer of bupivacaine, demonstrates a more favorable safety profile with reduced cardiotoxicity and central nervous system toxicity, while providing comparable sensory blockade [9–11]. Recent trials and reviews consistently report that levobupivacaine yields equivalent sensory block characteristics but with shorter and less intense motor block, a property that is especially advantageous in day-case surgery [3,12].

Despite these advances, evidence remains limited regarding the comparative use of isobaric levobupivacaine and bupivacaine specifically in the prone jackknife position for pilonidal sinus excision. The gravitational and hemodynamic implications of this posture may differentially affect anesthetic spread and block quality. Given the potential advantages of levobupivacaine in reducing motor blockade and facilitating faster recovery, a focused evaluation in this surgical context is warranted.

Therefore, the present study aimed to compare spinal anesthesia induced with isobaric levobupivacaine versus isobaric bupivacaine in the prone jackknife position for pilonidal sinus surgery, with emphasis on sensory and motor block dynamics, hemodynamic stability, and patient and surgeon satisfaction.

2. Materials and Methods

This prospective, randomized, controlled clinical trial was conducted at a tertiary university hospital between 2010–2011. The study protocol was approved by the Institutional Ethics Committee of Yıldırım Beyazıt Training and Research Hospital, Ankara (Decision No. 23, dated 24.09.2010) and conducted in accordance with the Declaration of Helsinki and CONSORT guidelines. Written informed consent was obtained from all participants.

Forty adult patients aged 18–60 years (ASA I–II) scheduled for elective day-case pilonidal sinus surgery were included. Exclusion criteria were patient refusal, infection at the puncture site, allergy to amide-type local anesthetics, BMI>35 kg/m^2, contraindications to neuraxial anesthesia, significant systemic disease, or history of neurological disorder.

Randomization was performed in a 1:1 ratio using a computer-generated sequence. Group allocation was concealed in sealed opaque envelopes opened immediately before injection. Both patients and surgeons were blinded to group assignment; the anesthesiologist preparing the drugs was not.

Premedication consisted of intramuscular midazolam 0.03 mg·kg^{-1} (Dormicum®, Roche, Switzerland) administered 30 minutes before surgery. Standard non-invasive monitoring (SBP, DBP, MAP, HR, SpO_2) was applied, and a 20-G intravenous line was placed for lactated Ringer's infusion (7 mL·kg^{-1}·h^{-1}).

Spinal anesthesia was performed with a 22-G Quincke needle at the L3–L4 or L4–L5 interspace after confirming free CSF flow. Group L received 7.5 mg of 0.5% isobaric levobupivacaine, and Group B received 7.5 mg of 0.5% isobaric bupivacaine. Each drug was injected intrathecally over 20 seconds.

Sensory block onset was tested with the pinprick method (24-G needle). Onset time, highest sensory level, two-segment regression, and regression to S2 were recorded. Motor block was assessed using the Bromage scale (0–3). Hemodynamic variables were measured at baseline, 1, 3, 5, 7, and 10 minutes, then every 5 minutes. Hypotension (SBP < 90 mmHg or >30% decrease from baseline) was treated with ephedrine 5 mg; bradycardia (HR < 45 bpm) with atropine 0.5 mg.

Patient and surgeon satisfaction were scored on a 5-point Likert scale (0 = poor, 4 = excellent).

2.1. Statistical analysis and sample size

The sample size was calculated using G*Power 3.1 software. Based on previous studies reporting a mean difference of 20% in motor block duration between groups, an effect size (Cohen's d) of 0.72 was assumed. With α=0.05 and power (1–β)=0.80, a minimum of 28 patients per group was required. Considering possible dropouts, 30 patients were included in each group.

All data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were tested for normality using the Shapiro–Wilk test and are presented as mean ± SD, whereas categorical variables are shown as frequencies and percentages. Between-group comparisons of normally distributed variables were performed with the independent-samples t-test; non-normally distributed variables were assessed with the Mann–Whitney U test. Categorical variables were compared using the χ^2 or Fisher's exact test, as appropriate. A p value <0.05 was considered statistically significant.

3. Results

Forty patients were enrolled and randomized equally into two groups. All patients completed the study protocol. The two groups were comparable with respect to demographic variables and surgical duration (Table 1). Mean age was 25.0 ± 5.2 years in the levobupivacaine group and 27.5 ± 5.7 years in the bupivacaine group (p=0.23). Body weight, height, and mean surgical time were also similar between groups (all p>0.05).

Baseline systolic, diastolic, and mean arterial pressures and heart rate did not differ between groups. During the perioperative period, blood pressure and heart rate showed modest declines relative to baseline but remained within clinically acceptable ranges in both groups. No patient required intervention for severe hypotension or bradycardia. There were no significant intergroup differences in SBP, DBP, MAP, or HR at any time point (all p>0.05).

The median onset time of sensory block to L5 was shorter with levobupivacaine (4.4 ± 0.2 min) compared with bupivacaine (4.6 ± 0.3 min, p=0.015). The peak sensory level achieved was L2 in both groups. However, regression of the sensory block was faster in the levobupivacaine group: two-segment regression occurred at

58.8 ± 8.2 min with levobupivacaine versus 65.9 ± 6.9 min with bupivacaine (p=0.005), and regression to S2 occurred at 139.7 ± 7.3 min versus 165.2 ± 8.0 min, respectively (p=0.001). At serial assessments, sensory block levels were consistently higher in the bupivacaine group from 20 to 45 minutes after injection (all p<0.05). These findings indicate a shorter overall duration of sensory block with levobupivacaine.

Motor blockade differed significantly between groups. In the levobupivacaine group, the maximum motor block reached was Bromage 2, with 55% of patients achieving grade 1 and 45% grade 2; no patient de-veloped complete block (Bromage 3). In contrast, in the bupivacaine group, 30% of patients experienced complete motor block (grade 3), 35% grade 1, and 35% grade 2 (p=0.028). Median motor block scores from 25 to 45 minutes were consistently higher in the bupivacaine group (p<0.05).

Patient and surgeon satisfaction scores were high in both groups, with no significant differences observed. In the levobupivacaine group, 65% of patients and 70% of surgeons rated anesthesia as "excellent," compared with 55% and 65%, respectively, in the bupivacaine group (p>0.05).

Table 1. Demographic data and duration of surgery (mean ± SD).

	Group L (Levobupivacaine n=20)	Group B (Bupivacaine n=20)	p-value
Age (years)	25.0 ± 5.2	27.5 ± 5.7	0.23
Weight (kg)	75.0 ± 8.3	72.0 ± 8.9	0.31
Height (cm)	171.0 ± 5.1	168.0 ± 8.9	0.28
Duration of surgery (min)	52.0 ± 4.6	55.0 ± 8.8	0.17
ASA I/II (n)	15/5	14/6	0.72

ASA: American Society of Anesthesiologists; HR: Heart Rate;
MAP: Mean Arterial Pressure; CSF: Cerebrospinal Fluid.

Table 2. Median sensory block levels over time (median; min–max).

Time after injection	Group L (Levobupivacaine n=20)	Group B (Bupivacaine n=20)	p-value
1 min	S2 (S2–S1)	S2 (S2–S2)	0.017*
3 min	L5 (S1–L5)	L5 (S1–L5)	1.000
5 min	L5 (L5–L5)	L5 (L5–L5)	–
7 min	L5 (L5–L4)	L5 (L5–L4)	0.752
10 min	L4 (L5–L4)	L4 (L5–L3)	0.082
15 min	L3 (L4–L3)	L3 (L4–L3)	0.429
20 min	L3 (L3–L2)	L2 (L4–L2)	0.013*
25 min	L2 (L3–L2)	L2 (L3–L1)	0.008*
30 min	L2 (L3–L2)	L2 (L3–L1)	0.003*
35 min	L2 (L3–L2)	L2 (L3–L1)	0.004*
40 min	L2 (L3–L2)	L2 (L3–L1)	0.004*
45 min	L2 (L3–L2)	L2 (L4–L1)	0.005*

* Significant at p<0.05

Table 3. Characteristics of sensory and motor block (mean ± SD or n (%)).

Variable	Group L (Levobupivacaine, n=20)	Group B (Bupivacaine, n=20)	p-value
Onset of sensory block (min)	4.4 ± 0.2	4.6 ± 0.3	0.015*
Peak sensory block level	L2 (L2–L3)	L2 (L4–L1)	0.212
Two-segment regression time (min)	58.8 ± 8.2	65.9 ± 6.9	0.005*
Regression to S2 (min)	139.7 ± 7.3	165.2 ± 8.0	0.001*
Motor block (Bromage scale)	11/9/0 (55%, 45%, 0%)	7/7/6 (35%, 35%, 30%)	0.028*

* Significant at p<0.05

4. Discussion

This randomized trial demonstrates that both isobaric levobupivacaine and isobaric bupivacaine provide effective spinal anesthesia for pilonidal sinus surgery performed in the prone jackknife position. The two agents were comparable in terms of hemodynamic stability and overall patient and surgeon satisfaction. However, important differences emerged in sensory and motor block profiles: levobupivacaine was associated with shorter sensory block duration and a markedly lower incidence of complete motor block compared with bupivacaine.

A central concern in spinal anesthesia, particularly in the jackknife position, is the potential for exaggerated cephalad spread with baricity-dependent solutions, leading to high block levels and hemodynamic compromise [7]. In our study, the use of isobaric formulations avoided such complications, and hemodynamic parameters remained stable across groups. These findings are consistent with recent data indicating that isobaric local anesthetics yield more predictable spread and fewer hemodynamic perturbations in non-supine positions [4,13,14].

Levobupivacaine produced a slightly faster onset of sensory block and earlier regression compared to bupivacaine. Similar observations have been reported in orthopedic and obstetric populations [12,15], where levobupivacaine provided adequate anesthesia with shorter block duration, a property advantageous for ambulatory surgery [3]. Piacherski et al. compared isobaric levobupivacaine with bupivacaine in lower limb surgery and reported comparable peak sensory levels but shorter regression times with levobupivacaine [7]. Our results align with these findings and suggest that levobupivacaine may optimize turnover in day-case proctologic surgery.

Perhaps the most clinically relevant difference observed was in motor block intensity. Complete motor blockade occurred in nearly one-third of patients with bupivacaine but in none with levobupivacaine. This supports prior reports that levobupivacaine is associated with less intense motor block, a feature that improves early mobilization and discharge readiness [3,14,16,17]. A recent review on spinal anesthesia emphasized that reducing unnecessary motor block is crucial in enhancing postoperative recovery in day-case procedures [4].

From a pharmacological perspective, levobupivacaine offers a superior safety margin due to its reduced affinity for cardiac sodium channels and lower risk of central nervous system toxicity compared with racemic bupivacaine [11,18]. Recent comparative studies in cesarean delivery and perianal surgery confirm similar anesthetic efficacy but fewer adverse effects with levobupivacaine [8,19,20]. Our findings reinforce this safety advantage, as no major hemodynamic events or complications occurred in either group, though the reduced motor block seen with levobupivacaine may further minimize postoperative immobility-related risks.

Taken together, these findings suggest that isobaric levobupivacaine may represent a more suitable choice than bupivacaine for spinal anesthesia in prone jackknife procedures such as pilonidal sinus excision. Its favorable balance of adequate sensory anesthesia, lower motor blockade, and reliable hemodynamic stability makes it particularly well suited for day-case settings.

4.1. Limitations

The present study has some limitations. First, the relatively small sample size limits the detection of infrequent adverse events and reduces statistical power for secondary outcomes. Second, as this was a single-center study including only young, ASA I–II patients, the findings may not be generalizable to higher-risk or elderly populations. Finally, postoperative analgesic consumption and long-term recovery outcomes were not assessed, which could provide further insights in future studies.

5. Conclusions

In patients undergoing pilonidal sinus surgery in the prone jackknife position, both isobaric levobupivacaine and isobaric bupivacaine provided effective and safe spinal anesthesia. However, levobupivacaine was associated with faster sensory recovery and significantly less motor blockade, without compromising hemodynamic stability or satisfaction. These characteristics make levobupivacaine a more suitable option for ambulatory anorectal surgery, where rapid recovery and early mobilization are essential. Larger multicenter studies are warranted to validate these findings across broader surgical and patient populations.

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

Ethics Approval and Consent to Participate
This study was approved by the ethics committee of Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Türkiye (Approval Number: 2010/23; Date: 24.09.2010). Written informed consent was obtained from the participants. All methods were performed in accordance with relevant guidelines and regulations.

Author Contributions
Hamiyet Senol Çakmak: *conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing – original draft.*
Onur Ozlu: *methodology, software, validation, formal analysis, investigation, resources, data curation, writing – original draft, writing – review & editing, visualization, supervision.*

REFERENCES

1. Bi S, Sun K, Chen S, Gu J. Surgical procedures in the pilonidal sinus disease: A systematic review and network meta-analysis. *Sci Rep*. **2020**;10(1):13720.
2. Urmey WF. Spinal anaesthesia for outpatient surgery. *Best Pract Res Clin Anaesthesiol*. **2003**;17(3):335–346.
3. Verma AK, Kumar N, Srinivas C, Sahu P. Comparison of the effectiveness and safety of segmental thoracic spinal anesthesia using isobaric levobupivacaine 0.5% versus hyperbaric levobupivacaine 0.5% in performing laparoscopic cholecystectomy: A prospective randomized controlled trial. *Cureus*. **2024**;16(12):e76060.
4. Pierson D, Certoma R, Hobbs J, Cong X, Li J. A narrative review on multimodal spinal anesthesia: Old technique and new use. *J Anesth Transl Med*. **2025**;4(1):25–32.
5. Fonseca NM, Guimarães GMN, Pontes JPJ, Azi L, de Ávila Oliveira R. Safety and effectiveness of adding fentanyl or sufentanil to spinal anesthesia: Systematic review and meta-analysis of randomized controlled trials. *Braz J Anesthesiol*. **2023**;73(2):198–216.
6. Kumar P, Mishra TS, Sarthak S, Sasmal PK. Lithotomy versus prone position for perianal surgery: A randomized controlled trial. *Ann Coloproctol*. **2022**;38(2):117–123.
7. Piacherski V, Muzyka L. Comparison of the efficacy of 0.5% isobaric bupivacaine, 0.5% levobupivacaine, and 0.5% hyperbaric bupivacaine for spinal anesthesia in lower limb surgeries. *Sci Rep*. **2023**;13(1):2736.
8. Yazhini S, Venkatraman R, Kandan K. Comparison of fentanyl with midazolam as adjuvants to levobupivacaine in spinal anesthesia for cesarean sections: A randomized controlled trial. *Cureus*. **2024**;16(7):e64732.
9. Deleon AM, Wong CA. Levobupivacaine versus bupivacaine: Is there a winner?. *Minerva Anestesiol*. **2010**;76(12):979–981.
10. Bardsley H, Gristwood R, Baker H, Watson N, Nimmo W. A comparison of the cardiovascular effects of levobupivacaine and rac-bupivacaine following intravenous administration to healthy volunteers. *Br J Clin Pharmacol*. **1998**;46(3):245–249.
11. Morrison SG, Dominguez JJ, Frascarolo P, Reiz S. A comparison of the electrocardiographic cardiotoxic effects of racemic bupivacaine, levobupivacaine, and ropivacaine in anesthetized swine. *Anesth Analg*. **2000**;90(6):1308–1314.
12. Glaser C, Marhofer P, Zimpfer G, et al. Levobupivacaine versus racemic bupivacaine for spinal anesthesia. *Anesth Analg*. **2002**;94(1):194–198.
13. Ariyama J, Hayashida M, Sugimoto Y, Imanishi H, To-Oyma Y, Kitamura A. Spread of spinal anesthesia in patients having perianal surgery in the jackknife position: Effects of baricity of 0.5% bupivacaine and positioning during and after induction of spinal anesthesia. *J Clin Anesth*. **2009**;21(6):408–413.
14. Goyal A, Shankaranarayan P, Ganapathi P. A randomized clinical study comparing spinal anesthesia with isobaric levobupivacaine with fentanyl and hyperbaric bupivacaine with fentanyl in elective cesarean sections. *Anesth Essays Res*. **2015**;9(1):57–62.
15. Fattorini F, Ricci Z, Rocco A, Romano R, Pascarella MA, Pinto G. Levobupivacaine versus racemic bupivacaine for spinal anaesthesia in orthopaedic major surgery. *Minerva Anestesiol*. **2006**;72(7–8):637–644.
16. Zhang L, Hu Y, Wu X, M JP, Zhang X. A systematic review and meta-analysis of randomized controlled trials of labor epidural analgesia using moderately high concentrations of plain local anesthetics versus low concentrations of local anesthetics with opioids. *J Pain Res*. **2021**;14:1303–1313.
17. Sethi D. Randomised control trial comparing plain levobupivacaine and ropivacaine with hyperbaric bupivacaine in caesarean deliveries. *Turk J Anaesthesiol Reanim*. **2019**;47(6):471–479.
18. Čižmáriková R, Čižmárik J, Valentová J, Habala L, Markuliak M. Chiral aspects of local anesthetics. *Molecules*. **2020**;25(12).
19. Naithani U, Saxena G, Jain S, Navaria R, Somani M, Negi A. Comparative evaluation of clinical efficacy and safety profiles of hyperbaric levobupivacaine versus hyperbaric bupivacaine in spinal anesthesia for lower segment cesarean section: A randomized double-blind study. *J Obstet Anaesth Crit Care*. **2025**;15(2).
20. Sundarathiti P, Sangdee N, Sangasilpa I, Prayoonhong W, Papoun S. Comparison of intrathecal bupivacaine and levobupivacaine for cesarean section. *J Med Assoc Thai*. **2014**;97(7):710–716.

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Research Article

Evaluation of the content quality of regional anesthesia and postoperative analgesia approaches generated by ChatGPT-4.0 according to surgical incision sites

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ABSTRACT

Background: Large language models (LLMs) are increasingly consulted for perioperative decision support, yet their ability to give professional-grade guidance for regional anesthesia and analgesia remains uncertain.

Materials and Methods: In a prospective observational study, we presented eight incision-based figures (Items 2–9) representing common abdominal incisions to ChatGPT-4.0 and requested a regional anesthesia technique and postoperative analgesia plan for each. Five independent anesthesiologists rated each response on Accuracy, Comprehensiveness, and Safety using a 5-point Likert scale. Inter-rater reliability was summarized with Fleiss' κ. One non-incision item (Item 10) was analyzed descriptively and excluded from pooled statistics. Single-shot prompts were used.

Results: Mean ratings were high: Accuracy 4.28, Comprehensiveness 4.30, Safety 4.00 (1–5 scale). Inter-rater agreement was substantial for Safety (κ=0.76) and lower for Accuracy (κ=0.33) and Comprehensiveness (κ=0.31). Two consistent low points emerged: right-lower-quadrant (McBurney/Lanz) incision–Safety mean 3.0 and suprapubic (Pfannenstiel) incision–Accuracy 3.0; Comprehensiveness 3.4; Safety 3.4. When explicitly asked for postoperative plans, the model rarely proposed neuraxial techniques (e.g., epidural), favoring fascial-plane/peripheral strategies.

Conclusions: An LLM produced clinically usable suggestions for common abdominal incisions with strong safety agreement, but performance was not uniform, and neuraxial options were under-recommended. These tools may serve as a helpful adjunct for education and option-generation, yet they should be used with expert oversight and local protocols. Future work should test repeated sampling, prompt standardization, model/tier comparisons, and link recommendations to patient outcomes.

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1. Introduction

Regional anesthesia has undergone a major transformation, particularly since the integration of ultrasound into anesthetic practice, shifting its focus from neuraxial to peripheral techniques [1,2]. However, many anesthesiologists–especially those primarily engaged in clinical practice–have lacked the advanced anatomical knowledge required to keep pace with this evolution. New techniques are continuously being described, and even the most recent editions of textbooks often fall short of encompassing the rapidly expanding and dynamic body of knowledge in this field [3].

Clinicians and trainees in anesthesiology are constantly seeking educational resources that are accessible, easy to understand, and time-efficient. For a period,

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YouTube videos seemed to meet this need; however, this approach also produced inconsistent and sometimes unsafe outcomes, as most videos were not created by professionals nor subjected to any form of oversight [4]. Today, large language models (LLMs) such as ChatGPT have begun to fill a similar role, offering rapid, on-demand information to eager learners. Yet, the same concerns regarding accuracy, reliability, and content control inevitably arise with these new tools as well [5].

This study aimed to assess how well ChatGPT-4.0, one of the most commonly used free large language models, provides accurate and practical information about regional anesthesia and postoperative analgesia in various surgical settings. To introduce a clinically grounded perspective, we applied an incision-based evaluation framework that allows model performance to be assessed within realistic surgical contexts rather than through generic question sets. As these techniques continue to expand and change, many clinicians now look to such tools for quick guidance and learning support. Our goal was to see if ChatGPT-4.0 could offer explanations that feel trustworthy, complete, and clinically useful.

2. Materials and Methods

2.1. Study design

This prospective observational study was designed to evaluate the validity of data generated by an artificial intelligence tool in the clinical context. Ethical approval was obtained from the Samsun University Non-Interventional Clinical Research Ethics Committee (Decision No: GOKAEK 2025/11/7). The study was conducted in line with the principles of the Declaration of Helsinki. The main purpose was to assess the quality of regional anesthesia and postoperative analgesia suggestions produced by ChatGPT-4.0 based on visual representations of surgical incisions. No patient data or direct clinical intervention was involved.

2.2. Evaluator selection

Twenty anesthesiologists experienced in fascial plane blocks and active in national and international regional anesthesia meetings were invited by email. Written consent was obtained from those who agreed, and five anesthesiologists participated as evaluators. All evaluators were senior anesthesiologists recognized for their expertise in regional anesthesia, each having conducted training sessions, contributed to international publications, and held active roles within the National Society of Regional Anesthesia. To avoid bias, evaluators were not included as study authors and did not take part in data analysis. All evaluations were performed independently, and their identities were kept confidential. Evaluators were blinded to each other's assessments, and no formal calibration session was conducted; however, a brief orientation was provided to ensure consistent understanding of the scoring criteria.

2.3. Preparation of figures and ChatGPT-4.0 responses

We prepared several visuals representing different surgical incision sites to simulate common surgical approaches (Fig. 1). Each image was presented to ChatGPT-4.0, asking for a suitable regional anesthesia method and postoperative analgesia recommendation. The model's written responses were saved without any editing or modification.

2.4. Incision items presented to ChatGPT

- Item 2: Median midline laparotomy (vertical midline).
- Item 3: Left lower quadrant incision.
- Item 4: Right lower quadrant (McBurney/Lanz region).
- Item 5: Right upper quadrant (Kocher-type) incision.
- Item 6: Suprapubic (Pfannenstiel) incision.
- Item 7: Suprapubic (Pfannenstiel)–second scenario.
- Item 8: Paramedian vertical incision (just off the midline).
- Item 9: Transverse midline laparotomy.

2.5. Evaluation of the responses

Each response was independently scored by the five evaluators under three criteria:

1. Scientific accuracy
2. Comprehensiveness
3. Patient safety

A five-point Likert scale (1 = very poor, 5 = excellent) was used. Evaluators rated the content separately to maintain objectivity and prevent mutual influence.

2.6. Statistical analysis

Descriptive statistics and data handling were performed in IBM SPSS Statistics v22; inter-rater agreement (Fleiss' κ with $\bar{P}$ and P_e) and all figures were generated with custom Python scripts, and the heatmap layout/caption was prepared with assistance from ChatGPT. The primary analysis was restricted to incision-based items (Items 2–9). Five anesthesiologists rated each item on Accuracy, Comprehensiveness, and Safety using a 5-point Likert scale (1–5); item×criterion results are summarized as mean±SD, with overall item means and rater-level means also reported. Inter-rater reliability was estimated per criterion across Items 2–9 using Fleiss' κ with five categories, treating Likert responses as ordinal for κ and approximately interval for means/SDs. Item 10 (non-incision) was analyzed descriptively and excluded from pooled estimates; a sensitivity check including Item 10 produced only modest shifts and did not change interpretation. No formal hypothesis tests were prespecified; where applicable, p-values would be two-sided (α=0.05). κ values are interpreted by conventional thresholds (≤0.20 poor; 0.21–0.40 fair; 0.41–0.60 moderate; 0.61–0.80 substantial; ≥0.81 almost perfect) and emphasized for magnitude rather than statistical significance.

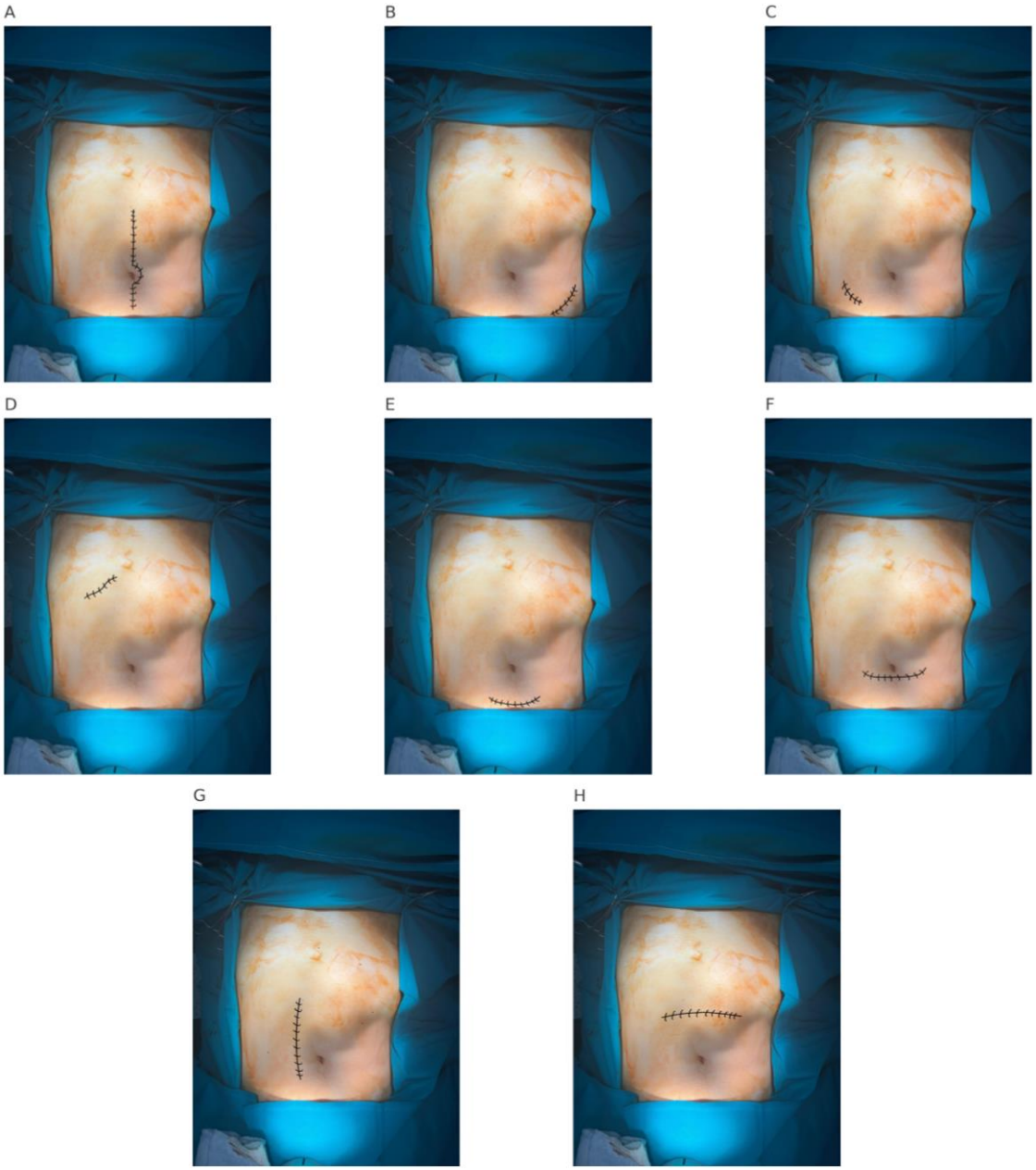

Fig. 1. Images presented to ChatGPT. Panels A–H correspond to the manuscript items in order: (a) Item 2; (b) Item 3; (c) Item 4; (d) Item 5; (e) Item 6; (f) Item 7; (g) Item 8; (h) Item 9.

3. Results

Eight incision-based items (Items 2–9) were analyzed. For each visual prompt, ChatGPT-4.0 was asked to suggest a regional anesthesia method and a postoperative analgesia plan. Five anesthesiologists independently rated each response on a five-point Likert scale (1–5) under three domains: Accuracy, Comprehensiveness, and Safety. Inter-rater reliability was quantified using Fleiss' kappa (κ). Item 10 differed in format and was treated as exploratory; it is summarized descriptively and excluded from pooled statistics.

3.1. Domain-level performance

Mean scores were high across domains: Accuracy 4.28, Comprehensiveness 4.30, and Safety 4.00. Inter-rater agreement was substantial for Safety (κ=0.76), while Accuracy (κ=0.33) and Comprehensiveness (κ=0.31) showed lower, fair-to-moderate agreement (Table 1).

3.2. Item-level highlights

Overall scores were highest for Item 2 (mean 4.93) and lowest for Item 6 (mean 3.27). By domain: Accuracy peaked at Item 2 (5.00) and was lowest at Item 6 (3.00); Comprehensiveness peaked at Item 3 (5.00) and was lowest at Item 6 (3.40); Safety was highest at Item 2 (5.00) and lowest at Item 4 (3.00) (Table 2).

3.3. Interpretation

Safety judgments were the most consistent among raters, suggesting clearer shared thresholds for risk and

feasibility. Comprehensiveness varied more, indicating differences in how breadth and depth of content were weighed. Accuracy fell between these two patterns. Exploratory analysis of Item 10 did not materially change the overall interpretation (Table 3).

Table 1. Domain-level summary (primary: Items 2–9).

Domain	Mean across items & raters	Fleiss' κ	$\bar{P}$ (observed agreement)	P_e (chance agreement)
Accuracy	4.275	0.332	0.60	0.401
Comprehensiveness	4.300	0.310	0.60	0.420
Safety	4.000	0.760	0.85	0.375

Interpretation (κ): ≤0.20 poor, 0.21–0.40 fair, 0.41–0.60 moderate, 0.61–0.80 substantial, ≥0.81 almost perfect.

Table 2. Per-item summary (primary: Items 2–9).

Item	Accuracy Mean	Accuracy SD	Comprehensiveness Mean	Comprehensiveness SD	Safety Mean	Safety SD	Overall Mean	Overall SD
2	5.000	0	4.800	0.447	5.000	0	4.933	0.258
3	4.600	0.548	5.000	0	5.000	0	4.867	0.352
4	4.400	0.548	3.800	0.447	3.000	0	3.733	0.704
5	4.200	0.447	4.400	0.548	4.000	0	4.200	0.414
6	3.000	0	3.400	0.548	3.400	0.548	3.267	0.458
7	4.200	0.447	4.400	0.548	4.000	0	4.200	0.414
8	4.400	0.548	4.000	0	3.600	0.548	4	0.535
9	4.400	0.548	4.600	0.548	4.000	0	4.333	0.488

Table 3. Rater-level overall means.

Rater	Overall mean across items & domains
Rater 1	4.167
Rater 2	4.208
Rater 3	4.333
Rater 4	4.083
Rater 5	4.167

Across incision-based items, average ratings were high (Fig 2). Item 2 (median midline) and Item 3 (LLQ) reached 5.0 in all three criteria. Item 5 (RUQ/Kocher), Item 7 (Pfannenstiel), Item 8 (paramedian), and Item 9 (transverse midline) clustered between 4.0–4.6. Two clear low points emerged: Item 4—Safety mean 3.0 for the right-lower-quadrant (McBurney/Lanz) incision, and Item 6—Accuracy 3.0; Comprehensiveness 3.4; Safety 3.4 for the suprapubic (Pfannenstiel) incision. These dips align with the agreement results—Safety had the highest κ, indicating that lower safety scores likely reflect shared caution rather than rater noise.

4. Discussion

In this study, we found that ChatGPT-4.0 generally produced satisfactory recommendations for abdominal incisions across accuracy, comprehensiveness, and safety. However, performance clearly dipped in two scenarios: the right-lower-quadrant (McBurney/Lanz) incision—especially on Safety—and the suprapubic (Pfannenstiel) incision, where scores were lower across multiple criteria. Notably, when we explicitly asked for postoperative analgesia plans, the model rarely proposed neuraxial techniques at all, favoring peripheral/fascial-plane blocks. Taken together with the substantial inter-rater agreement on Safety, these findings suggest not random variability but a consistent, clinically meaningful concern in these specific contexts and a systematic omission of neuraxial options.

In abdominal surgery, contemporary ERAS pathways increasingly reserve—rather than routinely use—neuraxial analgesia (e.g., thoracic epidural), particularly for laparoscopic cases and fast-track recovery protocols [6]. This shift reflects practical concerns about urinary retention, hemodynamic instability, and catheter logistics, alongside wider adoption of multimodal systemic analgesia and fascial-plane blocks (TAP, QL, ESP) that can support early mobilization [7,8]. Consistent with this trend, ChatGPT-4.0 likewise tended to de-emphasize neuraxial options in its postoperative plans, favoring peripheral/fascial-plane techniques. While this alignment with modern protocols is reassuring, it also raises the possibility of under-recommending neuraxial techniques in selected open procedures where epidural analgesia may still offer meaningful benefit.

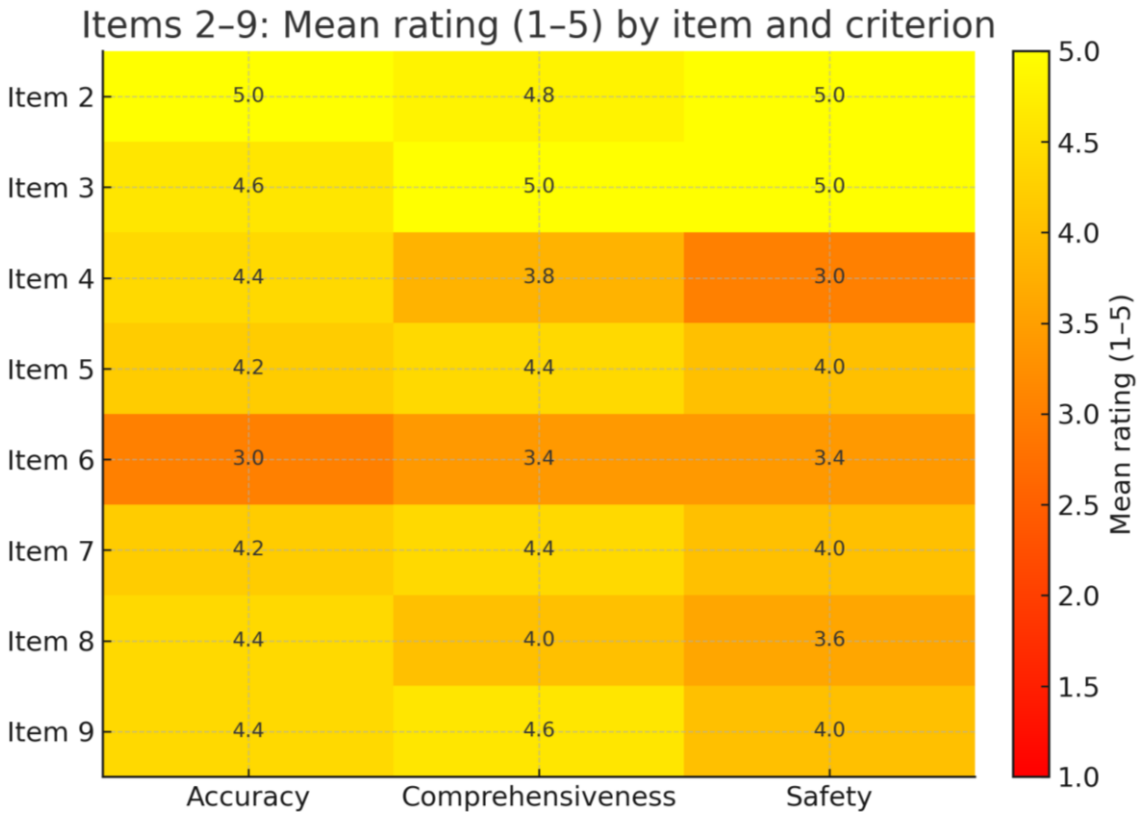

Fig. 2. Heat-map of mean ratings (1–5) for ChatGPT-4.0 recommendations across eight incision-based items (Items 2–9) and three criteria (Accuracy, Comprehensiveness, Safety). Cells show the mean of five anesthesiologist ratings; the colour scale maps red = 1 (low) to yellow = 5 (high).

Beyond lay-facing evaluations of LLMs—where readability, basic factual accuracy, and patient safety are usually the endpoints—judging whether a model can advise an anesthesiologist on analgesia is a different task [9,10]. It requires professional judgment about anatomy, block selection, contraindications (e.g., coagulopathy, infection risk), neuraxial vs. peripheral trade-offs, multimodal rescue options, and feasibility in real operating pathways. Our incision-based design, the use of independent expert raters, and criterion-specific scoring with inter-rater agreement move the assessment squarely into that professional space. The results show that while ChatGPT-4.0 often delivers clinically usable suggestions, it also exhibits context-specific gaps (e.g., RLQ safety, Pfannenstiel underperformance, and under-recommendation of neuraxial options). In short, the study successfully differentiates where the model's guidance aligns with professional standards and where caution or augmentation is warranted for real-world anesthetic pain management.

This evaluation has several constraints. First, we used a single-shot prompt per scenario; because LLM outputs are stochastic and time-varying, repeated queries at different times (or with seed control) might have yielded greater response variability. Second, we queried only one product configuration (ChatGPT-4.0) from a single account; we did not compare free vs. paid tiers, alternate accounts/devices (which may be subject to silent A/B tests), or other LLMs—so generalisability across platforms is uncertain. Third, the visual stimuli were simulated incision images, not real operative photos or ultrasound-based views; important contextual cues (e.g., intraoperative findings, comorbidities, coagulation status) were intentionally withheld, which may have constrained the model's recommendations (notably for neuraxial options). Fourth, we used one prompt phrasing and did not test few-shot/system-prompt strategies; prompt engineering can materially shift outputs. Fifth, the rater panel was small (n=5) and composed of fascial-plane block experts; while this aligns with our focus, it may limit applicability to broader anesthesiology practice. Sixth, outcomes were scored on a five-point Likert scale and agreement summarised with Fleiss' κ; given the ordinal nature of the scale and the limited number of primary items (n=8), these statistics should be interpreted with caution. Confidence intervals or bootstrapped estimates could not be calculated due to the small sample size, and this limitation should be considered when interpreting the reliability of the findings. Finally, we assessed content quality, not clinical effectiveness; no patient-level analgesic outcomes, adverse events, or workflow metrics were captured, so real-world impact remains to be demonstrated.

5. Conclusions

This prospective, expert-rated study found that a large language model generally provided clinically usable regional anesthesia and postoperative analgesia suggestions for common abdominal incisions, with substantial agreement on Safety. Performance was not uniform: recommendations for the right-lower-quadrant (McBur-

ney/Lanz) and suprapubic (Pfannenstiel) incisions scored lower—especially on Safety—and postoperative plans rarely included neuraxial techniques, which may mirror ERAS trends yet risk underuse in selected open cases. Overall, such models can serve as a helpful adjunct for option-generation and education, but they are not a substitute for anesthesiologist judgment and local protocols. Responsible use requires expert oversight and clear guardrails; future work should examine repeated sampling, prompt standardization, version/tier comparisons, and linkage of recommendations to patient outcomes. Beyond these findings, the proposed methodology offers a practical framework that may guide future AI evaluation standards and support responsible integration of AI tools into anesthesia education.

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Conflict of Interest

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

Data Availability

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

Ethics Approval and Consent to Participate

This study was approved by the ethics committee of Samsun University Clinical Research Ethics Committee (Reference Number: GOKAEK 2025/11/7; Date: 28/05/2025). Written informed consent was obtained from the participants. All methods were performed in accordance with relevant guidelines and regulations.

Author Contributions

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

REFERENCES

1. Yamamoto T, Schindler E. Regional anesthesia as part of enhanced recovery strategies in pediatric cardiac surgery. *Curr Opin Anaesthesiol*. **2023**;36(3):324–333.
2. Ahiskalioglu A, Yayik AM, Celik EC, et al. The shining star of the last decade in regional anesthesia part I: Interfascial plane blocks for breast, thoracic, and orthopedic surgery. *Eurasian J Med*. **2022**;54(Suppl 1):97–105.
3. Yayik AM, Celik EC, Aydin ME, et al. The shining star of the last decade in regional anesthesia part II: Interfascial plane blocks for cardiac, abdominal, and spine surgery. *Eurasian J Med*. **2023**;55(Suppl 1):9–20.
4. Nelms MW, Javidan A, Chin KJ, et al. YouTube as a source of education in perioperative anesthesia for patients and trainees: A systematic review. *Can J Anaesth*. **2024**;71(9):1238–1250.
5. Gul S, Erdemir I, Hanci V, Aydogmus E, Erkoc YS. How artificial intelligence can provide information about subdural hematoma: Assessment of readability, reliability, and quality of ChatGPT, BARD, and Perplexity responses. *Medicine (Baltimore)*. **2024**;103(18):e38009.
6. Wagemans MF, Scholten WK, Hollmann MW, Kuipers AH. Epidural anesthesia is no longer the standard of care in abdominal surgery with ERAS: What are the alternatives?. *Minerva Anestesiol*. **2020**;86(10):1079–1088.
7. Roofthooft E, Joshi GP, Rawal N, Van de Velde M, PROSPECT Working Group of the European Society of Regional Anaesthesia and Pain Therapy and supported by the Obstetric Anaesthetists' Association. PROSPECT guideline for elective caesarean section: Updated systematic review and procedure-specific postoperative pain management recommendations. *Anaesthesia*. **2021**;76(5):665–680.
8. Lirk P, Thiry J, Bonnet MP, Joshi GP, Bonnet F. Pain management after laparoscopic hysterectomy: Systematic review of literature and PROSPECT recommendations. *Reg Anesth Pain Med*. **2019**;44(4):425–436.
9. Ismaiel N, Nguyen TP, Guo N, Carvalho B, Sultan P, study collaborators. The evaluation of the performance of ChatGPT in the management of labor analgesia. *J Clin Anesth*. **2024**;98:111582.
10. Meyer MKR, Kandathil CK, Davis SJ, et al. Evaluation of rhinoplasty information from ChatGPT, Gemini, and Claude for readability and accuracy. *Aesthetic Plast Surg*. **2024**;49:1868–1873.

Challenge Journal of Perioperative Medicine

Research Article

Deep serratus anterior plane block vs. rhomboid intercostal plane block for analgesia after breast cancer surgery: A prospective, double-blind randomized study

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ABSTRACT

Background: Ultrasound-guided interfascial plane blocks are widely used in breast cancer surgery, but direct comparisons of deep serratus anterior plane block (SAPB) and rhomboid intercostal plane block (RIPB) are limited.

Materials and Methods: Single-center, prospective, randomized, double-blind trial of 40 women (ASA I–III) undergoing oncologic breast surgery. Participants were allocated to SAPB or RIPB, both as single-shot, ultrasound-guided adjuncts to standardized multimodal analgesia. The primary outcome was 24-hour morphine consumption; secondary outcomes were pain scores (NRS at rest and with 90° arm abduction at prespecified times), time to first analgesic request, and adverse events.

Results: All randomized patients completed follow-up. Baseline features were comparable except for higher body weight in the SAPB group. The primary outcome did not differ between groups; pain scores were low throughout and showed no between-group differences. Time to first analgesic was similar (log-rank p=0.439). No block-related serious adverse events occurred.

Conclusions: Within a standardized multimodal pathway, SAPB and RIPB provided similar early analgesia with low opioid use and a reassuring safety profile. Although the study was not designed for non-inferiority, the findings support RIPB as a practical alternative to SAPB in routine breast cancer surgery. Larger, procedure-stratified studies–including quality-of-recovery and longer-term outcomes–are warranted.

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1. Introduction

Breast cancer surgery has moved from radical operations toward modified and breast-conserving techniques [1]. Postoperative pain remains a day-to-day issue for the anesthesiologist. Earlier diagnosis and the availability of alternative systemic and locoregional therapies have improved survival; the perioperative pain phase, however, demands careful, patient-specific management to support early mobilization, limit opioid exposure, and reduce the chance of pain lingering beyond the immediate recovery [2]. The breast's complex innervation, together with procedure modifications driven by tumor location, means the chosen regional technique will inevitably vary [3]. That variability, in turn, feeds the inconsistencies seen across clinical studies.

As ultrasound technology has matured and entered routine anesthesia practice, thoracic epidural and landmark-guided paravertebral techniques have given way to interfascial plane blocks [4]. The main options are pectoral nerve blocks (PECS), serratus anterior blocks (superficial and deep), the erector spinae plane block, and—

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among the more recent additions—the rhomboid intercostal plane block (RIPB) [4,5]. Compared with conventional neuraxial approaches, interfascial plane blocks offer practical advantages: a lower risk of major complications such as pneumothorax, analgesia limited to the surgical field, and relatively less sympathetic blockade. The trade-off is that coverage can be insufficient when the surgical extent widens, and block quality may drop as the field grows.

The deep serratus anterior block targets the lateral cutaneous branches of the intercostal nerves. In most breast cancer operations these branches need to be blocked, yet coverage can still be incomplete. The RIPB, originally described to block the entire hemithorax, may be insufficient parasternally. Both techniques also miss contributions from the superficial cervical plexus and branches of the brachial plexus. In the literature, deep serratus anterior plane block—hereafter SAPB—is frequently reported to reduce perioperative opioid consumption in breast cancer surgery. Throughout this manuscript, the abbreviation *SAPB* has been used to denote the deep serratus anterior plane block (DSAPB). This clarification has been added to avoid confusion with the superficial variant. For the rhomboid intercostal plane block (RIPB), the evidence base is smaller, but available reports describe similar opioid-sparing effects and acceptable analgesia. Comparative clinical studies of these two techniques are limited.

Accordingly, we conducted a prospective, double-blind, randomized trial to compare deep serratus anterior plane block (SAPB) with rhomboid intercostal plane block (RIPB) as adjuncts to a standardized multimodal analgesia regimen in breast cancer surgery. The hypothesis of this study is null, indicating no expected difference between the groups. The primary outcome was cumulative 24-hour morphine consumption; secondary outcomes included pain scores at rest and with movement at prespecified intervals, time to first analgesic request, and adverse events.

2. Materials and Methods

2.1. Study design

This prospective, randomized, double-blind study was conducted at Maltepe University Faculty of Medicine Hospital operating rooms in accordance with the Declaration of Helsinki. The protocol was approved by the Maltepe University Clinical Research Ethics Committee (decision No. 4, 01 Nov 2022). Written informed consent was obtained from all participants prior to enrollment.

2.2. Participants

Eligible patients were women aged 18 – 70 years, ASA I – III, scheduled for elective breast cancer surgery. Exclusion criteria were: neurologic/psychiatric disorders that could alter pain perception; regular use of antipsychotics or antidepressants; ASA $\geqslant$ IV; allergy to local anesthetics; coagulopathy/bleeding diathesis; or refusal to participate.

2.3. Randomization and blinding

Patients were randomized 1:1 to receive either deep serratus anterior plane block (SAPB; Group S) or rhomboid intercostal plane block (RIPB; Group R) using a sealed opaque envelope method. Patients and postoperative assessors were blinded to allocation. The block-performing anesthesiologist could not be blinded to the technique but did not take part in postoperative assessments.

2.4. Perioperative care and general anesthesia

Standard monitoring included pulse oximetry, ECG, and noninvasive blood pressure. After 3 min preoxygenation (100% O_2), general anesthesia was induced with propofol 2–3 mg·kg^{-1}, fentanyl 1–2 μg·kg^{-1}, and rocuronium 0.6 mg·kg^{-1} for orotracheal intubation. Ventilation was set to a tidal volume of 6–8 mL·kg^{-1}, with respiratory rate adjusted to maintain end-tidal CO_2 30–35 mmHg. Anesthesia was maintained with sevoflurane ~2% in 50% O_2/air (flow 2 L·min^{-1}) and remifentanil 0.05 μg·kg^{-1}·min^{-1}. Hemodynamics (blood pressure, heart rate), end-tidal CO_2, and end-tidal sevoflurane were recorded every 10 minutes intraoperatively. Thirty minutes before the end of surgery, patients received paracetamol 1 g, tenoxicam 20 mg, and ondansetron 4 mg intravenously.

2.5. Regional block interventions

All blocks were performed before extubation by the same senior anesthesiologist (last-year resident under supervision) experienced in peripheral nerve blocks, using a linear 8–12 MHz ultrasound probe (LOGIQ e, GE Medical Systems, Jiangsu, China) and an in-plane technique with a 22G 80-mm needle (Stimuplex® Dplus, B. Braun, Germany). The local anesthetic (LA) mixture for both techniques was 40 mL total: 20 mL 0.25% bupivacaine + 10 mL 0.5% lidocaine + 10 mL saline.

Deep SAPB (Group S). With the patient supine, the linear probe was placed to identify the 2nd rib and advanced caudo-laterally to the 4th–5th rib level. The serratus anterior muscle (deep to latissimus dorsi, superficial to the ribs) was identified. The needle was inserted in-plane from the probe's supero-anterior aspect, and the LA mixture was injected between the serratus anterior muscle and the rib surface.

RIPB (Group R). With the lateral decubitus position (block side up), the upper arm was crossed over the chest to retract the scapula laterally. The probe was placed along the medial border of the scapula at approximately T5–T6. Skin, subcutaneous tissue, trapezius, rhomboid, intercostal muscles, rib, pleura, and lung were identified. The LA mixture was deposited between the rhomboid major muscle and the 5th rib.

After block completion, atropine 0.02 mg·kg^{-1} and neostigmine 0.04 mg·kg^{-1} were administered for neuromuscular reversal, and patients were extubated once adequate spontaneous breathing was confirmed.

2.6. Postoperative analgesia protocol

All patients received morphine patient-controlled analgesia (PCA) (Eitan Q Core Sapphire™ Multi-Therapy Infusion System). Morphine was prepared at 1 mg·mL^{-1}; the PCA was programmed with no basal infusion, 1 mg bolus, 20-minute lockout, and a maximum of 4 mg per 2 hours. Paracetamol 1 g was administered every 8 hours. For NRS $\geqslant$ 4, diclofenac sodium 75 mg was given as rescue analgesia.

2.7. Outcomes and follow-up

Pain intensity was assessed using the Numerical Rating Scale (NRS, 0–10; 0 = no pain, 10 = worst pain imaginable) at 20 and 40 minutes, 1, 3, 6, 12, 18, and 24 hours postoperatively. At the same time points, the number of PCA bolus attempts and cumulative morphine dose were recorded. The primary outcome was 24-hour morphine consumption. Secondary outcomes included NRS scores over time, number of PCA demands, time to first analgesic request, and adverse events/complications. Recorded complications were pneumothorax, nausea, vomiting, pruritus, and local anesthetic systemic toxicity (LAST).

2.8. Statistical analysis and sample size

The target sample size was 40 patients (n=20 per group), calculated to detect a between-group difference in postoperative opioid requirement with 80% power at a two-sided α=0.05.

Data were analyzed using IBM SPSS Statistics v22 (IBM SPSS, Türkiye). Normality was assessed with the Shapiro–Wilks test. Descriptive statistics are presented as mean ± SD or median [quartiles] for continuous variables and counts (%) for categorical variables. Independent-samples t-test was used for normally distributed continuous data; Mann–Whitney U for non-normal data. Chi-square or Fisher's Freeman–Halton tests were applied to categorical comparisons. Time to first analgesic was analyzed by Kaplan–Meier with the log-rank test. All tests were two-sided with α=0.05.

3. Results

A total of 40 patients were enrolled and randomized to the SAPB (n=20) or RIPB (n=20) group; all completed follow-up and were included in the analyses. Baseline characteristics were similar between groups with the exception of higher body weight in SAPB (Table 1). Cumulative 24-hour morphine consumption was low and did not differ between groups, and time-point analyses showed no significant differences (Table 2). Pain scores were likewise low in both groups, with no between-group differences at any scheduled time point (Tables 3 and 4). Time to first analgesic request did not differ significantly between techniques on Kaplan–Meier analysis (log-rank p=0.439). No block-related serious adverse events occurred; postoperative nausea/vomiting occurred in 6/40 (15%) and only one patient (2.5%) required rescue diclofenac.

Table 1. Baseline characteristics (mean ± SD or n (%)).

Variable	SAPB (n=20)	RIPB (n=20)	p-value
Age (years)	53.9 ± 14.0	50.9 ± 13.2	0.483
Height (cm)	162.0 ± 6.0	159.5 ± 5.3	0.161
Weight (kg)	69.8 ± 11.7	62.3 ± 8.7	0.027
BMI (kg·m^{-2})	26.7 ± 4.9	24.5 ± 3.4	0.113
Surgical duration (min)	140.8 ± 43.7	124.5 ± 23.2	0.150
ASA I / II / III	6 / 11 / 3	6 / 14 / 0	0.186
Axillary dissection, n (%)	14 (48.3%)	15 (51.7%)	0.723

Table 2. Morphine consumption by time point (median [IQR]).

Time	SAPB	RIPB	p-value
1 h	1 [0–1]	1 [0–1]	0.968
3 h	1 [0–1.75]	1 [0–1.75]	0.738
6 h	1 [1–2]	1 [0–2]	0.414
9 h	1.5 [1–2]	1 [0–2]	0.314
12 h	2 [1–3.75]	1.5 [0–2]	0.201
18 h	2 [1–4]	2 [0–3]	0.183
24 h	2 [1–4.75]	2 [0–3]	0.192
Total 0–24 h (mean; median)	3.05; 2	1.75; 2	NS

Table 3. NRS at rest (median [IQR]).

Time	SAPB	RIPB	p-value
1 h	1.5 [0–2]	1 [0–2]	0.862
3 h	0.5 [0–1]	1 [0–2]	0.383
6 h	0 [0–1]	0 [0–1]	0.947
12 h	0 [0–1]	0 [0–0]	0.445
18 h	0 [0–1]	0 [0–0]	0.478
24 h	0 [0–0]	0 [0–0]	0.841

Table 4. NRS with 90° arm abduction (median [IQR]).

Time	SAPB	RIPB	p-value
1 h	2 [1–3]	2 [0.25–3]	0.989
3 h	1 [0.25–2]	1 [0–2.75]	0.925
6 h	1 [0–1.75]	1 [0–1]	0.461
12 h	0.5 [0–2]	0 [0–1]	0.383
18 h	0 [0–1]	0 [0–1]	0.820
24 h	0 [0–1]	0 [0–1]	0.718

4. Discussion

In this randomized, double-blind trial, adding either deep serratus anterior plane block (SAPB) or rhomboid intercostal plane block (RIPB) to a standardized multimodal regimen yielded comparable early analgesia and opioid sparing after breast cancer surgery. Pain trajectories overlapped, time to first analgesic did not differ, and no block-related serious adverse events were observed. Within this protocol, SAPB and RIPB appear broadly interchangeable as adjuncts.

Deep serratus anterior plane block (SAPB) is already known as one of the most opioid-sparing options for breast cancer surgery, with many studies supporting its effectiveness [6]. In our randomized study—although not designed as a formal non-inferiority trial—rhomboid intercostal plane block (RIPB) performed at least as well as SAPB within the same multimodal pathway [7]. Pain scores and morphine use moved in parallel, and we saw no safety signal that would argue against RIPB as a practical alternative. Although direct comparisons between SAPB and RIPB are still limited, some meta-analyses have reported a signal in favor of RIPB [7]. That said, these syntheses mostly weight pain scores and opioid consumption, while quality-of-recovery (QoR) and functional endpoints remain underrepresented. We also did not assess QoR in this trial, which is a limitation. Future studies should include validated QoR scales (e.g., QoR-15/40), sleep and shoulder function, readiness for discharge, and longer-term outcomes such as persistent postoperative pain and return to usual activity.

A straightforward reason for our similar results is the shared plane anatomy. The rhomboid–intercostal plane (RIPB) deep to the rhomboid major is contiguous anteriorly with the plane deep to the serratus anterior used for deep SAPB [8]. Injectate in either space can travel along the lateral thoracic wall and bathe the lateral cutaneous branches of T2–T7 intercostal nerves (including their anterior divisions that supply the breast envelope) [9]. With scapular retraction in RIPB, spread often runs anterolaterally beneath serratus—functionally resembling a two-level/deep SAPB effect across one or two interspaces [10]. In other words, both techniques end up targeting the same nerve set in the same fascial continuum, so it is not surprising that early pain scores and opioid use tracked each other. (The caveat remains parasternal coverage, where neither technique reliably reaches the anterior cutaneous branches without an adjunct.) As recently highlighted by Fusco et al. [11], interfascial plane blocks (FPBs) are significantly volume-dependent, with injectate volume being a key determinant of the spread and efficacy. Accordingly, we opted for a 40 mL volume in our study to maximise craniocaudal diffusion and dermatomal coverage, and suggest that in future comparative analyses of plane blocks the volume variable should always be accounted for.

The axillary region receives sensory innervation mainly from the intercostobrachial (T2) and partially from the long thoracic and thoracodorsal nerves. Although the anatomical spread of SAPB may theoretically provide broader coverage toward the axillary area than RIPB, this difference did not appear to influence our findings [9]. In our study, the proportion of patients who underwent axillary dissection was similar between the groups (48% vs. 51%), and no difference in postoperative analgesic outcomes was observed. The deep fascial plane beneath the serratus anterior was preferred in this study because it lies closer to the lateral cutaneous branches of the intercostal nerves, which are responsible for the anterolateral thoracic wall sensation [10]. Local anesthetic injected in this plane tends to spread more uniformly along the thoracic wall and provides more reliable analgesia for lateral chest incisions. In contrast, the superficial plane, located between the latissimus dorsi and serratus anterior muscles, may produce variable spread, and combined injections can increase procedure time and local anesthetic volume without proven additional benefit.

Several limitations merit mention. Our sample size was modest (n=40), which narrows precision and does not support a formal non-inferiority claim or robust subgroup analyses. Surgical procedures were not fully homogeneous (a spectrum of oncologic breast operations with/without axillary dissection); although the proportion undergoing axillary dissection was similar between groups, variation in field extent and tissue trauma can meaningfully affect pain trajectories and block requirements. This was a single-center study with a single operator and a fixed local anesthetic mixture delivered as single-shot blocks, which may limit generalizability to other settings or catheter strategies. Outcomes were confined to the first 24 hours and did not include quality-of-recovery measures or longer-term endpoints (e.g., sleep, shoulder function, persistent postoperative pain). Baseline weight differed between groups and could confound pharmacokinetics; we did not adjust outcomes for weight beyond randomization. These constraints should temper interpretation and motivate larger, procedure-stratified trials with standardized ERAS pathways, QoR endpoints, and consideration of catheter or layered plane techniques. Another limitation of this study is the fixed injectate volume of 40 mL. Although this volume was selected to achieve adequate craniocaudal spread and consistent anterolateral thoracic coverage while maintaining safety through dilution, different volumes (e.g., 30–40 mL) reported in the literature may influence the extent of block spread and analgesic effect. The last limitation is that all blocks were performed by a single experienced operator. While this ensured procedural consistency, it may limit the generalizability of the findings to settings with varying levels of operator expertise.

5. Conclusions

Both SAPB and RIPB provided good early pain control after breast cancer surgery. Opioid use was low in both groups, and we saw no block-related serious events. Although the trial was not designed to prove non-inferiority, the results looked clinically similar for pain scores, opioid use, and time to first analgesic. In everyday practice, RIPB seems a reasonable alternative to SAPB; the choice can follow surgical field access, patient anatomy, and operator experience. Larger studies with quality-of-recovery measures and longer follow-up would help confirm these findings.

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Conflict of Interest

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

Data Availability

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

Ethics Approval and Consent to Participate

This study was approved by the ethics committee of Maltepe University Clinical Research Ethics Committee (decision No. 4, 01 Nov 2022). Written informed consent was obtained from the participants. All methods were performed in accordance with relevant guidelines and regulations.

Author Contributions

Doğukan Kilit: *conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing – original draft, writing – review & editing,*
Zeliha Özer: *writing – original draft, writing – review & editing.*

REFERENCES

1. Sencha AN, Evseeva EV, Ozerskaya IA, Fisenko EP, Patrunov YN, Mogutov MS, Sergeeva ED, Kashmanova AV. Treatment strategies for breast diseases, types of breast surgery, the postoperative breast, and follow-up principles [Internet]. In: *Imaging Male Breast Cancer*. **2015**;125–132.
2. Jogerst K, Coe TM, Gupta N, Pockaj B, Fingeret A. How to teach ERAS protocols: Surgical residents' perspectives and perioperative practices for breast surgery patients. *Glob Surg Educ*. **2023**;2(1):33.
3. FitzGerald S, Odor PM, Barron A, Pawa A. Breast surgery and regional anaesthesia. *Best Pract Res Clin Anaesthesiol*. **2019**;33(1):95–110.
4. Ahiskalioglu A, Yayik AM, Celik EC, Aydin ME, Ciftci B, Oral Ahiskalioglu E, Bilal B, Narayanan M, Tulgar S. The shining star of the last decade in regional anesthesia part I: Interfascial plane blocks for breast, thoracic, and orthopedic surgery. *Eurasian J Med*. **2022**;54(Suppl 1):97–105.
5. Ghebremichael S, Dehaan B, Hernandez N, Anthony Pryce R. Breast surgery: Are we doing the right blocks?. In: Poster displayed – Ultrasound guided RA (UGRA). *BMJ Publ Group Ltd*. **2024**;49:A331–A332.
6. De Cassai A, Zarantonello F, Geraldini F, Boscolo A, Pasin L, De Pinto S, Leardini G, Basile F, Disarò L, Sella N, Mariano ER, Pettenuzzo T, Navalesi P. Single-injection regional analgesia techniques for mastectomy surgery: A network meta-analysis. *Eur J Anaesthesiol*. **2022**;39(7):591–601.
7. An R, Wang D, Liang XL, Chen Q, Pang QY, Liu HL. The postoperative analgesic efficacy of different regional anesthesia techniques in breast cancer surgery: A network meta-analysis. *Front Oncol*. **2023**;13:1083000.
8. Tulgar S, Ciftci B, Ahiskalioglu A, Bilal B, Sakul BU, Korkmaz AO, Bozkurt NN, De Cassai A, Torres AJ, Elsharkawy H, Alici HA. Serratus posterior superior intercostal plane block: A technical report on the description of a novel periparavertebral block for thoracic pain. *Cureus*. **2023**;15(2):e34582.
9. Tulgar S, Kiziltunç B, Thomas DT, Manukyan MN, Ozer Z. The combination of modified pectoral nerves block and rhomboid intercostal block provides surgical anesthesia in breast surgery. *J Clin Anesth*. **2019**;58:44.
10. Ekinci M, Ciftci B, Alici HA, Ahiskalioglu A. Ultrasound-guided rhomboid intercostal block effectively manages myofascial pain. *Korean J Anesthesiol*. **2020**;73(6):564–565.
11. Fusco P, Pascarella G, Stecco C, Blanco R, Forero M, Pawa A, Tulgar S, Strumia A, Remore LM, De Cassai A, Colantonio LB, Del Buono R, Fattorini F, Sepolvere G, Tedesco M, Petroni GM, Ciaschi W, Crassiti M, Costa F. Factors to consider for fascial plane blocks' success in acute and chronic pain management. *Minerva Anestesiol*. **2024**;90(1–2):87–97.

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Erratum

Erratum to: The impact of vagal nerve stimulation from the lateral neck region on venous cannulation pain: A randomized controlled trial

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Due to an editorial error, the original article listed only the corresponding author. The correct authorship should be as follows:

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The scientific content of the article remains unchanged.

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