

The Relationship Between BMI, Postoperative Pain Outcomes, and Patient Satisfaction in Patients Undergoing Infraclavicular Brachial Plexus Block

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ABSTRACT

Objective: Obesity may influence postoperative pain and patient-reported outcomes after regional anesthesia through mechanisms beyond technical block success. This study evaluated the association between body mass index (BMI) categories and perioperative outcomes following ultrasound-guided infraclavicular brachial plexus block for upper extremity surgery.

Methods: This retrospective observational cohort included 83 adult patients (≥ 18 years) undergoing hand, forearm, or elbow surgery with ultrasound-guided infraclavicular brachial plexus block as the primary anesthetic technique. Patients were stratified by BMI as <25 kg/m² (n=19), 25–30 kg/m² (n=46), and ≥ 30 kg/m² (n=18). Postoperative pain intensity was assessed using the Visual Analog Scale (VAS; 0–10) at 0, 6, 12, and 24 hours. Secondary outcomes included rescue analgesia, opioid consumption, and patient-reported outcome measures (PROMs), including satisfaction at 1 week and 1 month and subsequent preference for regional anesthesia at 1 month.

Results: Demographic characteristics were similar across BMI groups ($p>0.05$). Postoperative VAS scores differed by BMI at 0, 12, and 24 hours, with higher pain levels observed in the BMI ≥ 30 group, most pronounced at 24 hours (3.11 ± 1.89), while 6-hour scores were comparable between groups. Rescue analgesic use and opioid consumption did not differ between groups. Patient satisfaction and 1-month subsequent preference for regional anesthesia were significantly lower in the BMI ≥ 30 group compared with BMI <25 and BMI 25–30 ($p<0.001$).

Conclusion: Higher BMI was associated with worse postoperative pain trajectories and lower patient-reported satisfaction after ultrasound-guided infraclavicular brachial plexus block, despite similar rescue analgesic use and opioid consumption across BMI categories. These findings suggest that BMI stratification may be relevant for individualized perioperative analgesic planning and patient-centered outcome optimization.

INTRODUCTION

Perioperative anesthetic management increasingly prioritizes strategies that optimize analgesic efficacy while minimizing systemic adverse effects and resource utilization. In upper extremity surgery, ultrasound-guided regional anesthesia techniques, particularly peripheral nerve blocks, play a central role in optimizing intraoperative stability, postoperative recovery trajectories, and patient-reported outcomes by enabling targeted neural blockade with consistent analgesic efficacy and procedural efficiency across diverse patient population.^[1] Evidence to date indicates

that ultrasound-guided regional anesthesia techniques improve perioperative safety by reducing opioid-related complications and supporting more stable respiratory and hemodynamic profiles, in line with modern perioperative care strategies.^[2] In this context, the ultrasound-guided infraclavicular brachial plexus block has emerged as a commonly preferred approach, as it reliably anesthetizes the hand, forearm, and elbow while maintaining a favorable safety profile through real-time visualization of neural structures and avoidance of pleural and diaphragmatic involvement.^[3]

Against this background of increasing reliance on ultrasound-guided regional anesthesia techniques, patient-related factors have become important determinants of perioperative block performance and recovery outcomes. Obesity is an increasingly prevalent global health condition and a clinically relevant modifier of perioperative anesthetic outcomes, with potential implications for both the performance and effectiveness of regional anesthesia.^[4] Earlier observational studies raised concerns regarding reduced peripheral nerve block success in obese patients.^[5,6] Accumulating evidence indicates that, although increased body habitus may be associated with prolonged ultrasound visualization and needle advancement times, the use of modern ultrasound-guided techniques largely preserves block success rates, analgesic quality, opioid-sparing effects, and patient satisfaction across body mass index (BMI) categories.^[7] Supporting this perspective, prospective randomized data in obese surgical populations have demonstrated that ultrasound-guided peripheral plane blocks can significantly reduce postoperative opioid consumption and pain intensity without increasing block-related complications. Parallel methodological advances in ultrasound imaging and interpretation have further refined sonoanatomic identification in patients with increased tissue depth, suggesting that obesity-related differences may manifest primarily as increased procedural complexity rather than diminished downstream analgesic or patient-reported outcomes.^[8-10]

Nevertheless, this apparent equivalence in technical success may mask clinically relevant heterogeneity in postoperative pain experiences. Obesity is associated with chronic low-grade inflammation, altered nociceptive processing, and dysregulated neuroendocrine signaling, all of which may contribute to heightened pain sensitivity and increased analgesic requirements independent of block adequacy.^[11] Moreover, obesity has been identified as an independent risk factor for intraoperative supplementation and acute block-related complications in anatomically challenging approaches, underscoring the need to distinguish procedural success from downstream analgesic and patient-reported outcomes.^[4]

Contemporary perioperative care frameworks, including enhanced recovery after surgery (ERAS) protocols, increasingly prioritize patient-centered outcomes beyond immediate analgesia.^[12] Postoperative pain trajectories, opioid consumption, and patient satisfaction are now recognized as key determinants of recovery quality and healthcare utilization. Despite this shift toward personalized perioperative medicine, evidence linking BMI stratification to integrated pain, analgesic consumption, and satisfaction outcomes following regional anesthesia remains limited.^[10]

Existing literature on ultrasound-guided peripheral nerve blocks predominantly focuses on isolated perioperative endpoints, such as technical success rates or early postoperative pain scores, without adequately capturing the temporal evolution of pain or patient satisfaction beyond the

immediate postoperative period.^[13] Assessment of longitudinal pain trajectories and patient-reported outcomes remains limited. In particular, BMI-stratified prospective and retrospective evaluations incorporating both short-term (1-week) and intermediate-term (1-month) patient-reported outcomes following ultrasound-guided infraclavicular brachial plexus block are notably scarce in the current literature.^[10,14,15]

Addressing this knowledge gap may inform more accurate preoperative counseling and individualized perioperative analgesic strategies by clarifying the influence of BMI on both technical block performance and patient-centered postoperative outcomes, in line with the principles of precision perioperative medicine.

Therefore, this retrospective cohort study aimed to evaluate the association between BMI categories and integrated perioperative outcomes in adults undergoing upper extremity surgery with ultrasound-guided infraclavicular brachial plexus block. Specifically, we investigated whether BMI-related differences exist in block performance characteristics, postoperative analgesic consumption, pain intensity trajectories, patient satisfaction at 1-week and 1-month follow-up, and patient-reported preference for regional anesthesia in future surgical procedures.

MATERIALS AND METHODS

Study Design and Ethical Approval

This retrospective observational cohort study was approved by the Institutional Ethics Committee (Decision No: 301, Date: 05 December 2025). Adult patients who underwent upper extremity surgery under ultrasound-guided infraclavicular brachial plexus block were identified through the hospital's electronic anesthesia and surgical records. All procedures were conducted in accordance with the ethical standards of the institutional ethics committee and the principles of the Declaration of Helsinki. Due to the retrospective nature of the study, the requirement for written informed consent was waived.

Study Population

Patients aged ≥ 18 years who underwent elective or urgent upper extremity surgery involving the hand, forearm, or elbow with ultrasound-guided infraclavicular brachial plexus block as the primary anesthetic technique were eligible for inclusion.

Exclusion criteria included incomplete medical records, conversion to general anesthesia, failed block requiring alternative anesthetic techniques, pre-existing chronic pain syndromes, regular opioid use, neurologic deficits affecting the operative limb, or contraindications to regional anesthesia.

BMI Classification

BMI was calculated as weight (kg) divided by height squared (m^2). Patients were stratified into three groups according

to World Health Organization criteria:

- BMI <25 kg/m² (normal weight),
- BMI 25–30 kg/m² (overweight),
- BMI ≥30 kg/m² (obese).

Anesthetic Technique

Standard American Society of Anesthesiologists (ASA) monitoring, including electrocardiography, noninvasive blood pressure, and pulse oximetry, was applied to all patients. An intravenous line was established before block placement, and sedation was provided with midazolam and fentanyl as needed. Supplemental oxygen was administered via nasal cannula throughout the procedure.

All infraclavicular brachial plexus blocks were performed preoperatively under ultrasound guidance by experienced anesthesiologists using a high-frequency linear transducer. Patients were positioned supine with the ipsilateral arm abducted, and after aseptic preparation, the axillary artery and surrounding brachial plexus cords were identified in the infraclavicular region.

A single-injection technique was used, and local anesthetic was administered incrementally under continuous ultrasound visualization to ensure circumferential spread around the neural structures. Block performance characteristics, including procedural success and the need for intraoperative supplementation, were recorded.

A standardized mixture consisting of 0.2% bupivacaine combined with 0.4% lidocaine was used for all patients, resulting in a total volume of 30 mL. The total volume and concentrations were consistent across BMI groups and were not adjusted according to body mass index.

Perioperative and Postoperative Management

Standardized intraoperative monitoring and postoperative analgesia protocols were applied across all BMI groups. Rescue analgesia was administered according to the institutional postoperative pain management protocol. When the Visual Analog Scale (VAS) score was ≥3, diclofenac sodium 75 mg or dexketoprofen 50 mg was given as first-line therapy. If the VAS score remained ≥3, paracetamol 1 g and tramadol 50 mg were administered. Rescue analgesic use and opioid requirements were routinely recorded as part of postoperative care.

Outcome Measures

The primary outcome was postoperative pain intensity trajectory across BMI categories. Pain intensity was assessed using the Visual Analog Scale (VAS), defined as a 10-cm horizontal line ranging from 0 (no pain) to 10 (worst imaginable pain), at postoperative 0, 6, 12, and 24 hours.

Secondary outcomes included rescue analgesic requirement, opioid consumption, and patient-reported satisfaction. Postoperative satisfaction was assessed using a two-item Likert-type global satisfaction scale documented in routine clinical follow-up notes. The first item evalu-

ated overall satisfaction with the anesthetic technique and postoperative pain management (1 = very dissatisfied, 5 = very satisfied). The second item assessed willingness to choose regional anesthesia again for a similar procedure (1 = definitely no, 5 = definitely yes). Satisfaction scores were obtained from postoperative 1-week and 1-month follow-up records.

Demographic characteristics, anthropometric data, ASA physical status, operative duration, and sex-based comparisons were also analyzed.

Statistical Analysis

Descriptive statistics were presented as mean ± standard deviation (SD), median (minimum–maximum), or number and percentage, as appropriate. The distribution of continuous variables was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests.

For normally distributed continuous variables, comparisons between independent groups were performed using the independent samples t-test. Non-normally distributed continuous variables were analyzed using the Mann–Whitney U test or the Kruskal–Wallis test, as appropriate. Categorical variables were compared using the chi-square test, and Fisher's exact test was applied when chi-square assumptions were not met.

All statistical analyses were conducted using SPSS Statistics software (version 27.0; IBM Corp., Armonk, NY, USA). A *p* value <0.05 was considered statistically significant.

RESULTS

The study population consisted of 83 patients with a mean age of 40.4±16.0 years. The majority were male (66.3%). The mean BMI was 27.2±4.5 kg/m². According to BMI classification, 22.9% of patients had BMI <25 kg/m², 55.4% had BMI between 25–30 kg/m², and 21.7% had BMI ≥30 kg/m² (Table 1).

There were no statistically significant differences among BMI <25, BMI 25–30, and BMI ≥30 groups with respect to age, sex distribution, height, or ASA physical status (*p*>0.05 for all). Body weight differed significantly across BMI groups (*p*<0.001), with the BMI ≥30 group exhibiting significantly higher body weight compared with both BMI <25 and BMI 25–30 groups. Additionally, the BMI 25–30 group had a significantly higher body weight than the BMI <25 group. No significant difference in operative time was observed between the groups (*p*=0.065). At postoperative hour 0, VAS scores were significantly higher in patients with BMI ≥ 30 compared with those with BMI 25–30 (*p*=0.040). No significant difference was observed between the BMI <25 group and the other BMI categories at this time point. VAS scores at postoperative hour 6 did not differ significantly among the BMI groups (*p*=0.742). At postoperative hour 12, the BMI ≥30 group demonstrated significantly higher VAS scores compared with the BMI 25–30 group (*p*=0.032). Similarly, at post-

Table I. Baseline demographic, clinical, and outcome characteristics of the study population

	Min-Max	Median	mean±SD, n (%)
Age (years)	18.0-78.0	38.0	40.4±16.0
Sex			
Male			55 (66.3)
Female			28 (33.7)
Height (cm)	145.0-195.0	170.0	170.6±9.4
Weight (kg)	34.0-130.0	78.0	79.3±15.1
BMI	16.2-45.0	27.0	27.2±4.5
BMI (kg/m ²)			
<25			19 (22.9)
25-30			46 (55.4)
≥30			18 (21.7)
ASA Score			
I			20 (24.1)
II			62 (74.7)
III			1 (1.2)
Surgical duration (min)	20.0-205.0	105.0	105.9±43.4
VAS Score			
0. hr	0.00-4.00	0.00	0.51±0.85
6. hr	0.00-4.00	1.00	1.07±0.92
12. hr	0.00-5.00	2.00	2.17±1.02
24. hr	0.00-5.00	2.00	2.40±1.07
Rescue analgesia			
(-)			55 (66.3)
(+)			28 (33.7)
Opioid dose (mg)			
0			71 (85.5)
100			2 (2.4)
200			10 (12.0)
I-month overall satisfaction score	3.0-5.0	5.0	4.5±0.7
I-month satisfaction			
Neutral			11 (13.3)
Satisfied			20 (24.1)
Very satisfied			52 (62.7)
I-month preference for RA score	2.0-5.0	4.0	4.3±0.8
I-month preference for RA			
No			1 (1.2)
Neutral			14 (16.9)
Yes			29 (34.9)
Definitely yes			39 (47.0)

Data are presented as mean ± standard deviation (SD), median, minimum–maximum (Min–Max), or number (n) and percentage (%), as appropriate. BMI: Body mass index; ASA: American Society of Anesthesiologists physical status classification; VAS: Visual Analog Scale for pain; RA: Regional anesthesia.

operative hour 24, VAS scores were significantly higher in the BMI ≥ 30 group compared with both BMI <25 and BMI 25–30 groups ($p=0.007$), whereas no significant difference was observed between BMI <25 and BMI 25–30 groups (Fig. 1). No statistically significant differences were found among BMI groups with respect to rescue analgesic use or opioid consumption ($p>0.05$ for all comparisons). Patient satisfaction scores were significantly lower in the BMI ≥

30 group compared with both BMI <25 and BMI 25–30 groups ($p<0.001$). No significant difference was observed between BMI <25 and BMI 25–30 groups. Similarly, one-month overall satisfaction scores were significantly higher in the BMI <25 and BMI 25–30 groups compared with the BMI ≥ 30 group ($p<0.001$), while no significant difference was detected between BMI <25 and BMI 25–30 groups. Patients with BMI 25–30 demonstrated significantly higher

Table 2. Comparison of demographic, perioperative, and outcome variables across bmi groups

	BMI <25 (n:19)	BMI 25-30 (n=46)	BMI ≥30 (n=18)	p
Age				
(mean±SD)	35.1±15.6	41.1±15.7	44.1±16.9	0.169
Median	28.0	44.0	41.0	
Sex				
Male, n (%)	13 (68.4)	30 (65.2)	12 (66.7)	0.969
Female n (%)	6 (31.6)	16 (34.8)	6 (33.3)	
Height (cm)				
(mean ± SD)	173.0±12.1	169.5±8.8	170.9±7.8	0.409
Median	173.0	170.0	169.0	
Weight (kg)				
(mean ± SD)	65.7±11.2	77.8±8.6	97.6±14.4	0.000
Median	70.0 ²³	78.0 ³	90.0	
ASA Score				
I, n (%)	6 (31.6)	12 (26.1)	2 (11.1)	0.310
II, n (%)	13 (68.4)	33 (71.7)	16 (88.9)	
III, n (%)	0 (0.0)	1 (2.2)	0 (0.0)	
Surgical duration (min)				
(mean±SD)	81.2±44.3	102.7±35.9	140.0±40.5	0.000
Median	75.0 ³	105.0 ³	152.5	
VAS Score				
0. hr (mean±SD)	0.63±1.07	0.30±0.59	0.89±1.02	0.040
Median	0.00	0.00 ³	1.00	
6. hr (mean±SD)	1.00±1.05	1.04±0.82	1.22±1.06	0.742
Median	1.00	1.00	1.00	
12. hr (mean±SD)	2.11±1.10	1.98±0.93	2.72±1.02	0.032
Median	2.00	2.00 ³	2.00 ³	2.00
24. hr (mean±SD)	2.37±1.12	2.13±0.93	3.11±1.08	0.007
Median	2.00 ³	2.00 ³	4.00	
Rescue analgesia				
(-), n (%)	13 (68.4)	29 (63.0)	13 (72.2)	0.764
(+), n (%)	6 (31.6)	17 (37.0)	5 (27.8)	
Opioid dose (mg)				
0, n (%)	16 (84.2)	39 (84.8)	16 (88.9)	0.900
100, n (%)	0 (0.0)	2 (4.3)	0 (0.0)	
200, n (%)	3 (15.8)	5 (10.9)	2 (11.1)	
I-month overall satisfaction score				
(mean±SD)	4.6±0.5	4.8±0.4	3.6±0.8	0.000
Median	5.00	5.00	3.00 ¹²	
I-month satisfaction				
Neutral, n (%)	0 (0.0)	0 (0.0)	11 (61.1)	0.000
Satisfied, n (%)	7 (36.8)	10 (21.7)	3 (16.7)	
Very satisfied, n (%)	12 (63.2)	36 (78.3)	4 ¹² (22.2)	
I-month preference for RA score				
(mean±SD)	4.2±0.5	4.7±0.5	3.3±0.8	0.000
Median	4.00 ²	5.00	3.00 ¹²	
I-month preference for RA				
No, n (%)	0 (0.0)	0 (0.0)	1 (5.6)	0.000
Neutral, n (%)	1 (5.3)	0 (0.0)	13 (72.2)	
Yes, n (%)	13 (68.4)	15 (32.6)	1 (5.6)	
Definitely yes, n (%)	5 (26.3)	31 (67.4)	3 ¹² (16.7)	

Data are presented as mean ± standard deviation (SD), median or number (n) and percentage (%), as appropriate. Comparisons among BMI groups were performed using the Kruskal–Wallis test for continuous variables and the chi-square (χ^2) test or Fisher's exact test, as appropriate, for categorical variables. A p value <0.05 was considered statistically significant. BMI: body mass index; ASA: American Society of Anesthesiologists physical status classification; VAS: Visual Analog Scale for pain; RA: Regional anesthesia.

Table 3. Comparison of perioperative characteristics and postoperative pain outcomes between male and female patients

	Male (n=55)		Female (n=28)		p
	Mean±SD, n (%)	Median	Mean±SD, n (%)	Median	
Age (years)	34.7±13.2	32.0	51.4±15.6	51.0	0.000
Height (cm)	175.2±6.7	173.0	161.6±7.1	161.0	0.000
Weight (kg)	83.2±13.6	80.0	71.9±15.4	72.0	0.001
BMI	27.1±4.5	26.3	27.3±4.7	27.5	0.616
BMI<25	13 (23.6)		6 (21.4)		0.969
25-30	30 (54.5)		16 (57.1)		
≥30	12 (21.8)		6 (21.4)		
ASA Score					
I	17 (30.9)		3 (10.7)		0.042
II	38 (69.1)		24 (85.7)		
III	0 (0.0)		1 (3.6)		
Surgical duration (min)	102.1±46.4	105.0	113.2±36.4	110.0	0.274
VAS Score					
0. hr	0.6±1.0	0.0	0.3±0.5	0.0	0.313
6. hr	1.2±1.0	1.0	0.9±0.8	1.0	0.264
12. hr	2.3±1.1	2.0	2.0±0.9	2.0	0.453
24. hr	2.5±1.1	2.0	2.2±1.0	2.0	0.267
Rescue analgesia					
(-)	39 (70.9)		16 (57.1)		0.210
(+)	16 (29.1)		12 (42.9)		
Opioid dose (mg)					
0	50 (90.9)		21 (75.0)		0.051
100	0 (0.0)		2 (7.1)		
200	5 (9.1)		5 (17.9)		
I-month overall satisfaction score	4.4±0.8	5.0	4.6±0.6	5.0	0.197
I-month satisfaction					
Neutral	9 (16.4)		2 (7.1)		0.400
Satisfied	14 (25.5)		6 (21.4)		
Very satisfied	32 (58.2)		20 (71.4)		
I-month preference for RA score	4.2±0.8	4.0	4.4±0.8	5.0	0.231
I-month preference for RA					
No	0 (0.0)		1 (3.6)		0.522
Neutral	11 (20.0)		3 (10.7)		
Yes	21 (38.2)		8 (28.6)		
Definitely yes	23 (41.8)		16 (57.1)		

Values are presented as mean ± standard deviation (SD), median, or number (percentage), as appropriate. Continuous variables were compared between sexes using the Student's t-test or Mann-Whitney U test, depending on data distribution. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. A p value <0.05 was considered statistically significant. VAS: Visual Analog Scale; BMI: Body mass index; ASA: American Society of Anesthesiologists physical status classification; RA: Regional anesthesia.

scores for subsequent preference for regional anesthesia score compared with both BMI <25 and BMI ≥30 groups (p<0.001). Additionally, the BMI <25 group showed significantly higher subsequent preference for regional anesthesia scores compared with the BMI ≥30 group. At one month, patients' subsequent preference for regional anesthesia (patient-reported outcome measure, PROM) scores were significantly higher in the BMI <25 and BMI 25–30 groups compared with the BMI ≥30 group (p<0.001), with no significant difference between the BMI <25 and BMI 25–30 groups (Table 2).

Female patients were significantly older than male patients

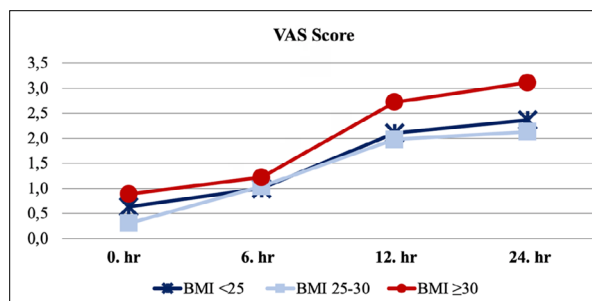


Figure 1. Postoperative VAS scores across BMI groups during the first 24 hours. VAS: Visual Analog Scale; BMI: Body Mass Index.

($p < 0.05$). Females also had significantly lower height and body weight compared with males ($p < 0.05$ for both). However, BMI values and BMI distribution did not differ significantly between sexes ($p > 0.05$). ASA scores were significantly higher in female patients ($p < 0.05$). Operative duration did not differ significantly between male and female patients. Postoperative VAS scores at 0, 6, 12, and 24 hours showed no significant sex-related differences. Similarly, rescue analgesic use, opioid consumption, patient satisfaction, one-month overall satisfaction, and subsequent preference for regional anesthesia score at one month did not differ significantly between males and females ($p > 0.05$ for all) (Table 3).

DISCUSSION

This retrospective cohort study demonstrates that BMI serves as a critical determinant of perioperative outcomes following ultrasound-guided infraclavicular brachial plexus block, encompassing broader perioperative clinical and analgesic outcomes. While our findings reveal comparable block success rates across BMI categories, postoperative pain trajectories, analgesic consumption patterns, and patient satisfaction scores exhibit significant deterioration with advancing BMI classification. These observations underscore the importance of viewing BMI not solely as a demographic variable, but rather as an independent perioperative outcome determinant informing tailored therapeutic strategies.

The time-dependent trajectory of postoperative pain intensity in our cohort demonstrates a distinct pattern of BMI-stratified heterogeneity, particularly pronounced at the 24-hour interval where patients with BMI ≥ 30 kg/m² demonstrated VAS scores of 3.11 ± 1.89 , substantially exceeding those of patients with lower BMI. This finding aligns with contemporary evidence from Zengin et. al.,^[16] who similarly documented elevated VAS scores at 4, 12, and 48 hours in obese patients receiving thoracic paravertebral block anesthesia. However, our investigation further elaborates this time-course characterization, demonstrating that BMI-related pain differences remain evident beyond the early postoperative period, extending through the 12- and 24-hour recovery intervals.

The heterogeneous pain profile observed across BMI categories cannot be fully explained by variability in block technical success alone, suggesting that obesity influences adverse pain-related outcomes primarily through alterations in nociceptive processing rather than regional anesthesia performance in itself. Growing evidence suggests that chronic low-grade inflammation associated with adipose tissue, marked by increased interleukin-6, tumor necrosis factor- α , and C-reactive protein levels, together with altered neuroendocrine signaling, promotes heightened nociceptive sensitivity independent of regional anesthetic effectiveness.^[17] De Cassai et. al.^[4] underscore this mechanistic distinction, emphasizing that altered bioactive adipokine profiles in obese patients predispose toward

enhanced nociceptive processing and attenuated analgesic responsiveness. This represents a key pathophysiologic mechanism acting independently of technical block success.

These clinical findings are supported by emerging mechanistic data indicating that obesity alters nociceptive processing and inflammatory signaling, thereby modifying postoperative pain and patient-reported outcomes independently of block performance. Lin et. al.^[18] report that, despite advances in ultrasound imaging, identification of neural structures in obese patients remains limited by adipose-related acoustic attenuation. The pattern observed in our study, with technically successful blocks accompanied by higher postoperative pain in patients with BMI ≥ 30 at 24 hours, indicates that adequate sonographic visualization does not reliably predict anesthetic effectiveness in the context of obesity-related inflammatory changes.

Obesity-related pain phenotypes arise from the integrated effects of genetic susceptibility, neuroendocrine dysregulation, and altered peripheral nociceptive signaling. Emerging mechanistic studies indicate that genetic variants influencing μ -opioid receptor expression in obese individuals are associated with increased receptor levels together with reduced pain thresholds and higher opioid requirements.^[19] The progressive increase in pain observed in our cohort, most evident at 24 hours in patients with BMI ≥ 30 , likely reflects the interaction between pre-existing obesity-related inflammation and the acute inflammatory response to surgery.

Zengin et. al.^[16] demonstrated through genetic polymorphism screening that elevated mu receptor expression in morbidly obese patients correlated paradoxically with increased morphine and fentanyl consumption requirements, suggesting that polymorphism-related alterations in opioid receptor physiology may contribute to the enhanced analgesic demands observed in our obese cohort. Furthermore, altered nociceptor sensitization mediated by chronic elevations in inflammatory mediators leads to persistent hyperalgesia that perioperative regional anesthesia, even when technically successful, may not fully mitigate.

De Cassai et. al.^[4] report that local anesthetic distribution in obesity is better predicted by lean body weight rather than total body weight (TBW), such that TBW-based dosing may result in relatively lower effective exposure in obese patients, contributing to reduced analgesic effectiveness despite technical block success. Additionally, increased adipose tissue depth during infraclavicular block in obese patients may compromise effective local anesthetic distribution, as shown by Kavakli et. al.,^[8] who demonstrated progressive ultrasound signal attenuation with increasing fatty tissue thickness.

An important finding of our study relates to patients' subsequent preference for regional anesthesia as a PROM. This preference was markedly higher among patients with BMI < 25 (94.7%) compared with those with BMI ≥ 30 (27.8%), reflecting clinically relevant variation in patient-perceived benefit across BMI categories. This difference is consistent

with the observed variation in postoperative pain intensity and suggests that procedural block success, in the absence of effective pain control, may not be sufficient to ensure patient satisfaction.

Admiraal et al.^[14] support the greater incorporation of PROMs in regional anesthesia research, alongside technical metrics such as block success rate and procedure duration. Consistent with this approach, our findings show that BMI-related differences in patient-reported satisfaction occur despite similar block success and are more closely related to postoperative pain patterns than to procedural block performance.

Current perioperative care models, including ERAS protocols, increasingly emphasize individualized, patient-centered outcomes.^[12] In obese patients undergoing infraclavicular brachial plexus block, several targeted strategies may improve analgesic effectiveness and patient experience. Local anesthetic dosing should be guided by lean body weight rather than total body weight, particularly for lipophilic agents such as bupivacaine, to better reflect pharmacokinetic behavior in obesity.^[4] In addition, ultrasound-guided block performance in obese patients should be optimized through technique modifications.^[20] Optimization of ultrasound settings and patient positioning may facilitate target visualization, and regional anesthesia is best applied within an opioid-sparing multimodal strategy; in bariatric populations, Baytar et al.^[21] reported improved postoperative respiratory outcomes and reduced opioid consumption with a modified thoracoabdominal nerve block approach.

By extending follow-up beyond the early postoperative period and incorporating patient-reported outcome measures, this study complements existing infraclavicular block literature, which has largely focused on technical success and early pain. In this context, Saranlal et al.^[15] evaluated infraclavicular block performance across BMI groups but did not assess postoperative pain, analgesic use, or patient satisfaction, whereas our analysis integrates both technical and patient-centered outcomes.

These findings have important implications for the perioperative management of obese patients undergoing regional anesthesia. Preoperative evaluation should acknowledge that technical block success may not ensure adequate postoperative analgesia in obese patients, and that multimodal pain management may be required. Local anesthetic dosing is better based on lean body weight rather than total body weight, with consideration of agent-specific pharmacokinetic properties and monitoring for local anesthetic systemic toxicity; De Cassai et al.^[4] provide evidence-based dosing frameworks stratified by BMI category and specific local anesthetic agents. In addition, the use of anti-inflammatory medications, perineural adjuvants, and supplementary regional techniques, when feasible, should be incorporated into perioperative care pathways to improve analgesic outcomes in obese patients.

Finally, PROMs from our study indicate that the quality of

analgesia during the first 24 postoperative hours is closely associated with subsequent patient experience. Optimizing early pain control in the post-anesthesia care unit may improve patient satisfaction and subsequent patient-reported outcomes related to regional anesthesia.

Limitations

This study has several limitations. Its retrospective design introduces potential sources of bias, and the relatively small sample size with limited representation of patients with BMI >40 kg/m² reduces the precision of subgroup analyses. Pain was assessed only with the visual analog scale, without quantitative sensory or functional measures, and sensory block distribution was not systematically evaluated. In addition, although all procedures involved upper extremity surgeries within the infraclavicular block distribution area, variability in surgical type may have influenced postoperative analgesic requirements and could represent a potential confounding factor. Finally, the restriction to upper extremity surgery limits the generalizability of these findings to other surgical settings.

CONCLUSION

This study indicates that obesity influences infraclavicular brachial plexus block outcomes through mechanisms that extend beyond technical block success, with higher postoperative pain and lower patient-reported satisfaction observed in patients with higher BMI. These findings support the need for BMI-specific approaches to perioperative pain management. Future prospective studies should evaluate weight-adjusted dosing strategies, optimized block techniques, multimodal analgesia, and longitudinal patient-reported outcomes, while also exploring the role of inflammatory and neurobiological mechanisms underlying altered pain responses in obesity. Such work may help to define more individualized perioperative strategies that improve both analgesic effectiveness and patient-centered outcomes in this patient group.

Ethics Committee Approval

The study was approved by the SBÜ Istanbul Training and Research Hospital Ethics Committee (Date: 05.12.2025, Decision No: 301).

Informed Consent

The requirement for informed consent was waived due to the retrospective nature of the study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: G.C.; Design: G.C., E.E.; Supervision: A.S.; Fundings: G.C., E.E.; Materials: A.T., E.E., M.K.; Data collection &/or processing: E.E., M.K.; Analysis and/or interpretation: A.T., G.C.; Literature search: G.C., M.K., A.S.; Writing: G.C., A.S.; Critical review: A.S.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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İnfraklaviküler Brakial Pleksus Bloğu Uygulanan Hastalarda Vücut Kitle İndeksi ile Postoperatif Ağrı Sonuçları ve Hasta Memnuniyeti Arasındaki İlişki

Amaç: Obezite, rejyonel anestezi sonrası postoperatif ağrı ve hasta bildiriyle ölçülen sonuçları, teknik blok başarısının ötesindeki mekanizmalar yoluyla etkileyebilir. Bu çalışmada, ultrason eşliğinde infraklaviküler brakial pleksus bloğu uygulanan üst ekstremitte cerrahisi hastalarında vücut kitle indeksi (VKİ) kategorileri ile perioperatif sonuçlar arasındaki ilişki değerlendirilmiştir.

Gereç ve Yöntem: Bu retrospektif gözlemsel kohort çalışmasına, el, önkol veya dirsek cerrahisi için primer anestezi tekniği olarak ultrason eşliğinde infraklaviküler brakial pleksus bloğu uygulanan 83 erişkin hasta (≥ 18 yaş) dahil edildi. Hastalar VKİ'ye göre <25 kg/m² (n=19), 25–30 kg/m² (n=46) ve ≥ 30 kg/m² (n=18) olarak sınıflandırıldı. Postoperatif ağrı şiddeti, Görsel Analog Skala (VAS; 0–10) kullanılarak 0., 6., 12. ve 24. saatlerde değerlendirildi. İkincil sonlanım ölçütleri; kurtarma analjezi gereksinimi, opioid tüketimi ve hasta bildiriyle ölçülen sonuçları (PROM'lar) kapsadı. PROM'lar, 1. hafta ve 1. ayda hasta memnuniyeti ile 1. ayda gelecekte rejyonel anestezi tercihine ilişkin değerlendirmeleri içerdi.

Bulgular: Demografik özellikler, BMI grupları arasında benzerdi ($p>0.05$). Postoperatif VAS skorları VKİ'ye göre 0., 12. ve 24. saatlerde anlamlı farklılık gösterdi; en yüksek ağrı özellikle 24. saatte VKİ ≥ 30 olan hastalarda saptandı (3.11 ± 1.89), 6. saat skorları ise benzerdi. Kurtarma analjezi kullanımı ve opioid tüketimi gruplar arasında farklılık göstermedi. Hasta memnuniyeti ve 1. ayda rejyonel anesteziyi tekrar tercih etme skorları VKİ ≥ 30 grubunda, VKİ <25 ve VKİ 25–30 gruplarına kıyasla anlamlı olarak daha düşüktü ($p<0.001$).

Sonuç: Yüksek VKİ, ultrason eşliğinde infraklaviküler brakial pleksus bloğu sonrasında daha olumsuz ağrı seyri ve daha düşük hasta bildiriyle ölçülen memnuniyet ile ilişkili bulunmuştur; buna karşın kurtarma analjezi ve opioid kullanımı VKİ grupları arasında benzerdir. Bu bulgular, bireyselleştirilmiş perioperatif analjezik planlama ve hasta odaklı sonuçların iyileştirilmesi açısından VKİ sınıflamasının dikkate alınması gerektiğini düşündürmektedir.

Anahtar Sözcükler: İnfraklaviküler brakial pleksus bloğu; postoperatif ağrı; rejyonel anestezi; vücut kitle indeksi.