Original Article

Cukurova Anestezi ve Cerrahi Bilimler Dergisi

Efficacy of Ultrasound-Guided Superior Trunk Block for Postoperative Analgesia After Proximal Humerus Surgery: A Randomised Controlled Trial

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Abstract

Aim: Moderate to severe pain is common after proximal humerus surgery, often requiring opioid-based analgesia. Superior trunk block (STB), a selective brachial plexus block, has been proposed as an alternative for postoperative pain control. This study aimed to evaluate the analgesic efficacy of STB compared with intravenous patient-controlled analgesia (PCA) following proximal humerus surgery. **Methods:** This prospective randomized controlled trial included 60 patients undergoing proximal humerus surgery who were randomly assigned to two groups. In the STB group (n = 30), patients received an ultrasound-guided superior trunk block with 10 mL of 0.25% bupivacaine in combination with intravenous PCA. The control group (n = 30) received intravenous PCA alone. The primary endpoint was pain level assessed using a visual analogue scale (VAS) at rest at 1, 2, 6, 12, and 24 hours postoperatively. Secondary endpoints included total tramadol consumption at 12 and 24 hours, subjective respiratory complaints, adverse effects, and the requirement for rescue analgesia. **Results:** The STB group had significantly lower VAS scores at all time points ($p < 0.001$). Tramadol consumption at 12 and 24 hours was also significantly lower in the STB group ($p < 0.001$). Paracetamol was required by 12% of control patients but by none in the STB group ($p = 0.007$). Adverse effects were similar; two STB patients developed Horner's syndrome, and no respiratory complications were observed. **Conclusion:** Ultrasound-guided STB provided effective postoperative analgesia for the shoulder and upper arm after proximal humerus surgery, reducing opioid consumption with minimal respiratory side effects.

Keywords: Proximal humerus fracture; nerve block; superior trunk block; analgesia; brachial plexus

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1. Introduction

Pain following proximal humerus fracture surgery is often moderate to severe. Ineffective postoperative pain management can hinder the initiation of physical therapy and early mobilization, ultimately affecting the shoulder joint and potentially contributing to the development of neuropathic pain features[1].

The innervation of the shoulder and proximal humerus involves multiple nerve roots, making comprehensive analgesia challenging. A single brachial plexus block may be insufficient or may require large volumes of local anesthetic[2,3]. Several regional anesthesia techniques, including supraclavicular, interscalene, and axillary blocks, are commonly used for proximal humerus surgery. However, these approaches may have limitations related to inconsistent coverage of all relevant nerves and the potential for unwanted side effects[2–4].

The superior trunk block (STB), performed proximal to the branching of the suprascapular nerve, has emerged as a more selective regional anesthesia technique. It has the potential to provide effective analgesia for both the shoulder and proximal arm while potentially reducing complications such as phrenic nerve paralysis, long thoracic nerve injury, and dorsal scapular nerve damage[2–4]. Therefore, this study aimed to evaluate the analgesic efficacy of ultrasound-guided STB compared with intravenous PCA for postoperative pain management following proximal humerus surgery.

2. Materials and Methods

2.1. Study Design and Setting

This prospective, randomized, controlled, single-blind clinical trial was conducted after obtaining approval from the institutional review board (Ethics Committee Approval No: 2022/06-12) and registration in the clinical trials registry (ClinicalTrials.gov Identifier: NCT05474014). The study adhered to the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment.

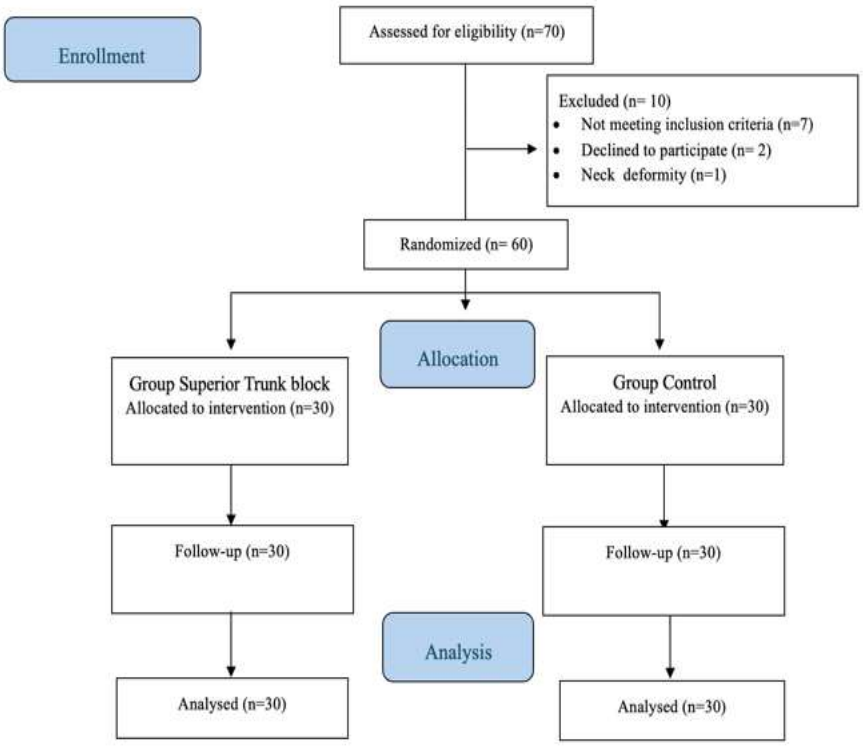

Figure 1. Flow chart of the study

2.2. Participants and Study Population

Patients aged 18–65 years with ASA physical status I–III scheduled for elective proximal humerus surgery were included. Exclusion criteria comprised allergy to local anesthetics, psychiatric disorders, bleeding diatheses, refusal to participate, and infection at the proposed block site. Patients were randomly allocated into two groups (n = 30 each) using a computer-generated randomization sequence with sealed, opaque envelopes. The Control group received intravenous PCA alone. The STB group received an ultrasound-guided superior trunk block with 10 mL of 0.25% bupivacaine in addition to IV PCA (Figure 1).

2.3. Anesthesia Management

Midazolam (IV, 0.01–0.02 mg/kg) was used for premedication. Anesthesia induction involved fentanyl, propofol, and rocuronium. For maintenance, sevoflurane was utilized alongside a continuous fentanyl infusion. Anesthetic depth was monitored with BIS values maintained between 50 and 60. Sugammadex (4 mg/kg) was administered at the conclusion of surgery. The intraoperative anesthetic and analgesic management was standardized for all patients.

2.4. Superior Trunk Block Technique

The middle and anterior scalene muscles and C5 and C6 cervical nerve roots were identified using ultrasound (8–18 MHz linear transducer). The probe was positioned transversely at the sixth cervical vertebra level and moved caudally to identify the junction of nerve roots and the point at which the suprascapular nerve separates from the trunk. The target injection site was defined as the distal part of the C5–C6 junction proximal to the suprascapular nerve separation. After skin sterilization with 10% povidone-iodine, a 100-mm, 22-gauge nerve block needle was advanced in a lateral-to-medial direction using the in-plane approach, and 10 mL of 0.25% bupivacaine was injected around the upper trunk (Figure 2). Sensory blockade was assessed 30 minutes after block administration using a cold test at C5 and C6 dermatomes.

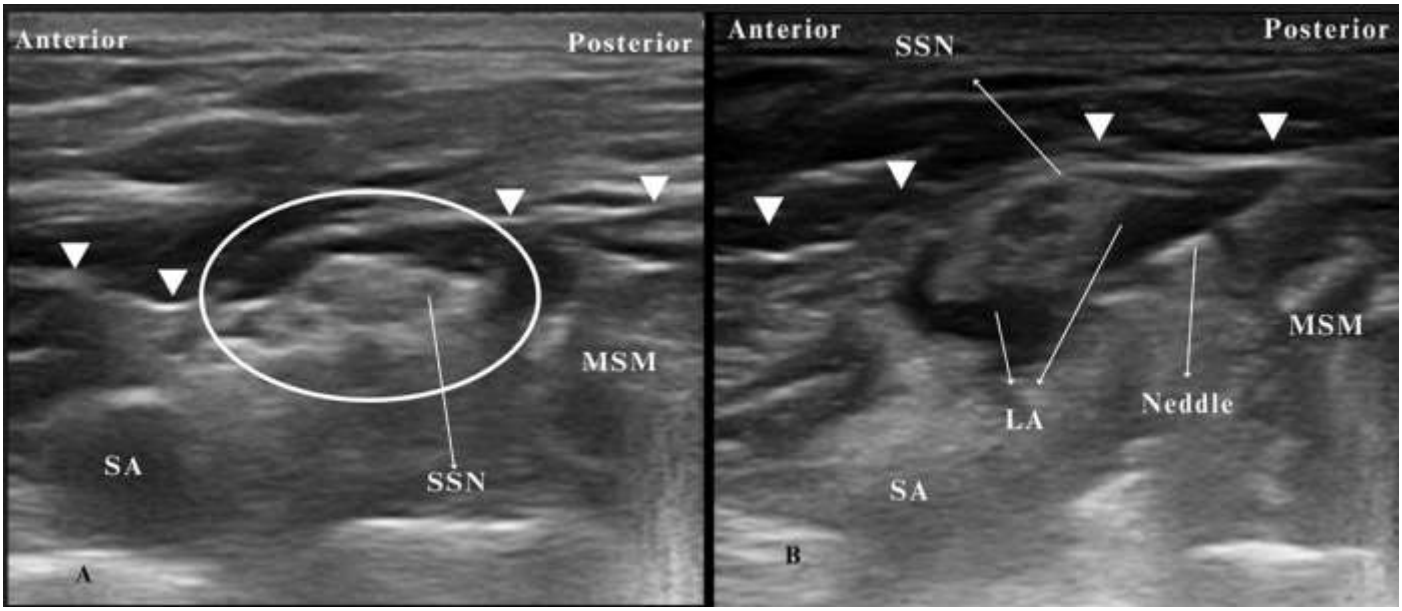

Figure 2. (A) Sonoanatomy showing the suprascapular nerve (SSN), middle scalene muscle (MSM), superior trunk (white circle), and subclavian artery (SA). (B) Needle placement and spread of local anesthetic (LA) around the superior trunk.

2.5. Pain Management

Intravenous PCA was prepared with tramadol (5 mg/mL). The PCA device delivered an initial bolus of 0.3 mg/kg, with a fixed demand dose of 10 mg and a 20-minute lockout interval (maximum 400 mg/day). Tenoxicam 20 mg was administered intravenously approximately 10 minutes before the end of surgery. Rescue analgesia (paracetamol 1 g IV every 8 hours) was administered when VAS exceeded 5 (maximum 3 g/day).

2.6. Surgical Procedure

Deltopectoral approach: A 10–15 cm incision from the coracoid process along the anterior deltoid edge. The cephalic vein was dissected and retracted laterally, providing access to the fracture site for internal fixation. Deltoid-split approach: A 5–8 cm incision along the lateral humerus, approximately 4 cm below the acromion. Dissection proceeds between the middle and anterior deltoid portions, noting the axillary nerve approximately 5 cm deep. Fracture reduction and internal fixation were then applied.

2.7. Outcome Measures

The primary outcome was postoperative pain assessed using VAS at rest at 1, 2, 6, 12, and 24 hours postoperatively. Secondary outcome measures included tramadol consumption at 12 and 24 hours, incidence of side effects (nausea and vomiting), subjective respiratory symptoms (respiratory distress, hiccough, hoarseness), occurrence of Horner's syndrome, and the need for additional analgesics. Respiratory distress was defined as respiratory rate exceeding 30 breaths/min and SpO_2 below 90%.

2.8. Statistical Analysis

Descriptive characteristics were examined via the chi-square test. The Kolmogorov–Smirnov test was employed to assess normality. The independent-samples t-test was used to analyze comparisons between groups. Data are presented as mean ± SD. Statistical significance was set at $p < 0.05$.

2.9. Power Analysis

Based on a pilot study, the mean VAS score at postoperative hour 6 was 4.3 (±1.0). To detect a 20% reduction with 85% power and $\alpha = 0.05$, a minimum of 26 patients per group was required. To allow for potential dropouts, 30 patients were enrolled per group (total $n = 60$).

3. Results

Table I presents demographic and descriptive data. There were no statistically significant differences between groups ($p > 0.05$).

Table I. Comparison of the demographic characteristics of the patients

	Group STB (n=30)	Group Control (n=30)	p
Age (year)	60 ± 8.2	61.2 ± 8.3	0.593
BMI (kg/m^2)	26.1 ± 2.1	25.84 ± 2.2	0.423
Gender: F	18 (60%)	16 (53.3%)	0.605
Gender: M	12 (40%)	14 (46.7%)	
ASA I	3 (9%)	3 (9%)	0.775
ASA II	20 (60%)	21 (63%)	
ASA III	7 (21%)	6 (18%)	
Neer: Two-part	19 (63%)	18 (60%)	0.783
Neer: Three-part	7 (23%)	7 (24%)	
Neer: Four-part	4 (13%)	5 (16%)	
Surgery: Deltopectoral	20 (60%)	21 (63%)	0.823
Surgery: Deltoid-split	10 (40%)	9 (37%)	0.764
Duration of surgery (min)	174 ± 30.5	180.6 ± 20.8	0.558

Mean ± SD values. BMI: body mass index; M: male; F: female. Bold values indicate statistical significance ($p < 0.05$).

The control group exhibited significantly higher VAS scores at every recorded time point ($p < 0.05$). Tramadol consumption was significantly lower in the STB group at both 12 hours (37.2 ± 21.8 vs. 87.6 ± 50.9 mg) and 24 hours (52.6 ± 35.4 vs. 140.6 ± 77.1 mg) ($p < 0.05$; Figure 3). Four patients (12%) in the control group required paracetamol as supplemental analgesia, whereas none in the STB group needed additional medication ($p = 0.007$). Horner's syndrome occurred in two patients in the STB group; no subjective respiratory symptoms or other block-related complications were recorded (Table II).

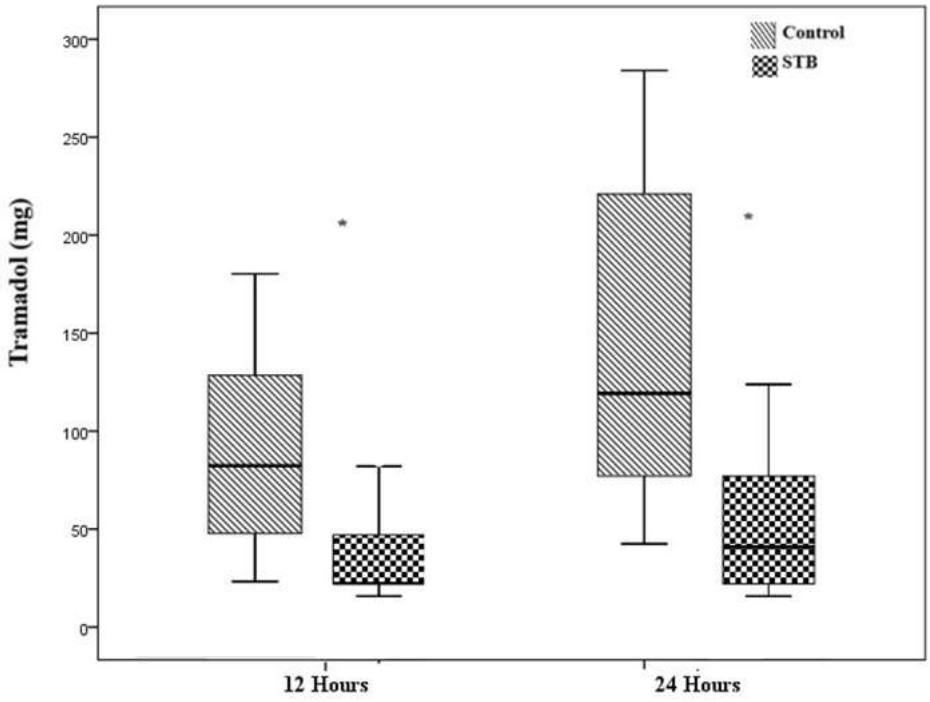

Figure 3. Tramadol consumption at 12 and 24 hours in the STB and Control groups.

Table II. Comparison of postoperative VAS scores, PCA use, additional analgesic requirement, and side effects between groups

	Group STB (n=30)	Group Control (n=30)	p
VAS 1st hour	1.4 (0–3)	2.5 (0–5)	<0.001
VAS 2nd hour	1.3 (0–3)	2.7 (0–4)	<0.001
VAS 6th hour	1.2 (0–3)	2.4 (0–4)	<0.001
VAS 12th hour	0.7 (0–3)	2.7 (0–4)	<0.001
VAS 24th hour	1.2 (0–2)	2.6 (0–4)	<0.001
Given dose PCA	3.1 ± 3.4	12.9 ± 9.6	<0.001
Demand dose PCA	5.4 ± 5.9	18.2 ± 12.4	<0.001
Additional analgesic (paracetamol)	—	4 (12%)	0.007
Nausea and vomiting	—	—	N/S
Horner's syndrome	2 (6%)	—	
Hoarseness	—	—	
Respiratory distress	—	—	

VAS: Visual Analogue Scale; PCA: patient-controlled analgesia. Mean ± SD for normal distribution; independent-samples t-test for intergroup comparisons. Bold values indicate statistical significance ($p < 0.05$).

4. Discussion

This study evaluated the efficacy of STB for postoperative pain after proximal humerus surgery. Both VAS scores and tramadol consumption were significantly lower in the STB group. The mean 24-hour VAS was 1.6 ± 0.9 in the STB group and 2.58 ± 1.3 in the control group. The 24-hour tramadol consumption was 52.6 ± 35.4 mg vs. 140.6 ± 77.1 mg. No respiratory complications were observed in the STB group. Proximal humerus fractures represent nearly 4–5% of all fractures in orthopedic practice and involve dermatomal regions most commonly accessed via the deltopectoral or deltoid-split approaches[5]. A single brachial plexus block may not provide sufficient coverage or may require higher volumes of local anesthetic.

Iliaens et al. described that moderate pain can occur after proximal humerus fracture surgery, and the most commonly used method of regional anesthesia is the interscalene brachial plexus block[1]. Although ISB can provide adequate analgesia, phrenic nerve palsy is expected and the proximity of the long thoracic and dorsal scapular nerves increases complication risk. Even with efforts to inimize phrenic nerve involvement, the reported incidence of diaphragmatic paralysis can reach up to 45%[6,7,8].

Burckett-St. Laurent et al.[4] introduced the upper trunk block to inimize ISB-related complications. The STB has been increasingly utilized in arthroscopic shoulder surgeries with comparable efficacy to ISB. In a study by Kang et al.[6], pain scores and cumulative opioid consumption at 24 hours were similar between STB and ISB groups. A meta-analysis of four RCTs reported that STB provides similar analgesia to ISB with lower incidences of hemidiaphragmatic paralysis, subjective dyspnoea, and Horner's syndrome[10].

Regarding STB for proximal humerus surgery specifically, Mistry et al.[11] reported successful perioperative management using only 5 mL of local anesthetic with no evidence of hemidiaphragmatic paresis. Sinha et al.[13] compared STB and ISB in proximal or mid-humerus surgery, finding better preservation of diaphragmatic function with STB. However, Zhang H et al.[14] noted that the phrenic nerve's accessory branches may not be fully protected by STB, and additional techniques or dose reduction may be necessary to ensure complete diaphragm sparing[15,16]. In our study, the injection site was placed immediately proximal to the suprascapular nerve branching point, and effective analgesia was achieved with 10 mL—lower than the commonly used 15 mL—without respiratory complications.

4.1. Limitations

The primary limitation is the reliance on subjective methods to assess pulmonary function; objective respiratory measurements such as diaphragmatic ultrasonography were not performed. Postoperative pain was evaluated only at rest using VAS, and dynamic pain was not assessed. The single-center design and single-operator block technique may limit generalizability. The absence of an active comparator such as ISB also limits direct clinical comparison.

5. Conclusion

Superior trunk block appears to be a promising alternative to ISB, offering comparable analgesic efficacy with a lower incidence of phrenic nerve-related complications following proximal humerus surgery, as supported by findings in the literature.

Author Contributions: All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by K.Ö., G.K.Ü., and D.K.Y. The first draft of the manuscript was written by K.Ö. and all authors commented on previous versions. A.K.D.

supervised the whole process and critically reviewed the drafting process. All authors read and approved the final manuscript.

Ethical Approval: The study was approved by the institutional review board of Bursa Yuksek Ihtisas Training and Research Hospital (Approval No: 2022/06-12). The study was conducted in accordance with the ethical standards of the institution and the principles of the Declaration of Helsinki.

Informed Consent: Written informed consent was obtained from all participants prior to enrollment.

ClinicalTrials.gov Identifier: NCT05474014.

Conflict of Interest: The authors have no conflict of interest to declare.

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Generative AI: No artificial intelligence-based tools or generative AI technologies were used in this study.

Data Availability: Data are available from the corresponding author upon reasonable request.

References

1. Iliaens J, Metsemakers WJ, Coppens S, et al. Regional anaesthesia for surgical repair of proximal humerus fractures: a systematic review and critical appraisal. Arch Orthop Trauma Surg. 2019;139:1731-1741.
2. Falyar CR, Grossman EC. Ultrasound-guided interscalene-supraclavicular block for an intramedullary nailing of a pathologic humeral fracture: practical application of ultrasound-guided regional anesthesia. AANA J. 2014;82:219-222.
3. Beaudet V, Williams SR, Tetreault P, Perrault M-A. Perioperative interscalene block versus intra-articular injection of local anesthetics for postoperative analgesia in shoulder surgery. Reg Anesth Pain Med. 2008;33:134-138.
4. Burckett-St Laurent D, Chan V, Chin KJ. Refining the ultrasound-guided interscalene brachial plexus block: the superior trunk approach. Can J Anaesth. 2014;61:1098-1102.
5. Buecking B, Mohr J, Bockmann B, Zettl R, Ruchholtz S. Deltoid-split or deltopectoral approaches for the treatment of displaced proximal humeral fractures? Clin Orthop Relat Res. 2014;472:1576-1585.
6. Kang R, Jeong JS, Chin KJ, et al. Superior trunk block provides noninferior analgesia compared with interscalene brachial plexus block in arthroscopic shoulder surgery. Anesthesiology. 2019;131:1316-1326.
7. Kessler J, Schafhalter-Zoppoth I, Gray AT. An ultrasound study of the phrenic nerve in the posterior cervical triangle: implications for the interscalene brachial plexus block. Reg Anesth Pain Med. 2008;33:545-550.
8. Lee JH, Cho SH, Kim SH, et al. Ropivacaine for ultrasound-guided interscalene block: 5 mL provides similar analgesia but less phrenic nerve paralysis than 10 mL. Can J Anaesth. 2011;58:1001-1006.
9. Kim DH, Lin Y, Beathe JC, et al. Superior trunk block: a phrenic-sparing alternative to the interscalene block: a randomized controlled trial. Anesthesiology. 2019;131:521-533.
10. Amaral S, Arsky Lombardi R, Medeiros H, Nogueira A, Gadsden J. Superior Trunk Block Is an Effective Phrenic-Sparing Alternative to Interscalene Block for Shoulder Arthroscopy: a systematic review and meta-analysis. Cureus. 2023;15(11):e48217.
11. Mistry T, Dey S, Kalbande JV. Superior Trunk block for humerus surgery: application beyond the shoulder analgesia. Saudi J Anaesth. 2020;14:547-548.
12. Wardhan R, Nimma SR. Ultrasound-Guided Upper Trunk Perineural Catheter for Shoulder Surgery: a description of catheter technique. Cureus. 2020;12:e11095.
13. Sinha C, Kumari P, Kumar A, et al. Superior trunk versus interscalene brachial plexus block in humerus surgery: a randomised controlled trial. Anaesthesiol Intensive Ther. 2024;56:194-198.
14. Zhang H, Miao Y, Qu Z. Upper trunk block for shoulder analgesia with potential phrenic nerve sparing: a preliminary anatomical report one fascia, two blocks, and a concern on diaphragm-sparing. Reg Anesth Pain Med. 2019;1:rapm-2019-100746.
15. Cros Campoy J, Domingo Bosch O, Sala-Blanch X. Upper trunk block: 'primum non nocere'. Reg Anesth Pain Med. 2019;1:rapm-2019-101162.

16. Wang H, Bao Q, Cao D, Zhu L, Chen L, Yu Y. Effect of low-volume ropivacaine in ultrasound-guided superior trunk block on diaphragmatic movement in patients undergoing shoulder arthroscopy: a randomized controlled trial. J Orthop Surg Res. 2024;19:604.
17. Tessler O, Gilardino MS, Bartow MJ, et al. Transverse cervical artery: consistent anatomical landmarks and clinical experience with its use as a recipient artery in complex head and neck reconstruction. Plast Reconstr Surg. 2017;139:745e-751e.
18. Sutcliffe P, Lasrado S. Anatomy, Head and Neck, Deep Cervical Neck Fascia. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024.