Joint Diseases and Related Surgery

Jt Dis Relat Surg
2023;34(2):325-330

ORIGINAL ARTICLE

Retrospective evaluation of the effects of traditional interscalene block alone versus combined with superior truncus block-associated diaphragm paralysis during arthroscopic shoulder surgery

Irfan Gungor, MD[1], Gokcen Emmez, MD[1], A. Bengu Kaptan, MD[1], Berrin Gunaydin, MD[1], Ulunay Kanatli, MD[2]

[1]Department of Anesthesiology and Reanimation, Gazi University Faculty of Medicine, Ankara, Türkiye
[2]Department of Orthopedics and Traumatology, Gazi University Faculty of Medicine, Ankara, Türkiye

ABSTRACT

Objectives: The aim of this study was to investigate the effects of traditional interscalene block (ISB) alone and ISB combined with superior truncus block (STB)-associated diaphragm paralysis evaluated by ultrasound, duration of analgesia, and rate of complication in patients undergoing arthroscopic shoulder surgery.

Patients and methods: Between January 2020 and December 2022, a total of 285 patients (158 males, 127 females; mean age: 48.0±15.1 years; range, 18 to 80 years) who underwent arthroscopic shoulder surgery under ISB, either alone or combined with STB, were retrospectively analyzed. The patients were operated under ISB alone using 30 mL 0.5% bupivacaine (n=140) or ISB using 10 mL (n=67) or 5 mL 0.5% bupivacaine (n=78) combined with STB using 20 mL 0.5% bupivacaine. Ultrasound reports of all patients' diaphragm function were also retrieved. Duration of analgesia, need for additional analgesics, and the type of analgesic drugs, and evaluations of patient and surgeon satisfactions were evaluated. Degree of diaphragm paralysis considered as complete (≥75%), partial (25.1 to 74.9%) and no paralysis (≤25%) were evaluated for comparison between the block types.

Results: The patients underwent operation due to rotator cuff rupture (n=218) or Bankart (n=67). Duration of analgesia, need for additional analgesia, and the type of analgesic drugs used were comparable between the block types. The most common complication was Horner syndrome (n=96, 33.68%) which was significantly lower in ISB (5 mL) +STB (20 mL) than the others (17.9% *vs*. 41.4% and 37.3%, p=0.002). The ISB (5 mL bupivacaine 0.5%) + STB (20 mL bupivacaine 0.5%) resulted in less complete diaphragm paralysis with adequate surgical anesthesia not requiring general anesthesia.

Conclusion: The ISB using 5 mL of 0.5% bupivacaine + STB instead of traditional ISB alone can be preferred due to the low rate of complete hemi-diaphragm paralysis with adequate surgical anesthesia/analgesia and high patient and surgeon satisfaction.

Keywords: Diaphragm paralysis, interscalene block, shoulder surgery, superior truncus block.

Arthroscopic shoulder surgical procedures were performed under general anesthesia with the patient in the beach chair position.[1] However, the peripheral nerve block in arthroscopic shoulder surgery is advantageous in providing intra- and postoperative pain relief, as well as good recovery and rehabilitation.[1,2] Interscalene brachial plexus block which is performed by administering local anesthetics to the C5 and C6 nerve roots between the anterior and middle scalene muscles is among the regional techniques frequently used for anesthesia and/or analgesia for shoulder surgery.[2] During interscalene block (ISB) application, diaphragm

Received: December 07, 2022
Accepted: December 27, 2022
Published online: February 03, 2023

Correspondence: Berrin Günaydın, MD. Gazi Üniversitesi Tıp Fakültesi, Anestezi ve Reanimasyon Anabilim Dalı, 06810 Çankaya, Ankara, Türkiye

E-mail: gunaydin@gazi.edu.tr

Citation: Gungör I, Emmez G, Kaptan AB, Gunaydin B, Kanatli U. Retrospective evaluation of the effects of traditional interscalene block alone versus combined with superior truncus block-associated diaphragm paralysis during arthroscopic shoulder surgery. Jt Dis Relat Surg 2023;34(2):325-330. doi: 10.52312/jdrs.2023.977.

©2023 All right reserved by the Turkish Joint Diseases Foundation

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes (http://creativecommons.org/licenses/by-nc/4.0/).

paralysis may occur on the block side of the phrenic nerve due to exposure of either additional local anesthetic or cranial spread of the local anesthetic above the anterior scalene muscle, thereby leading to respiratory disturbances in patients with limited pulmonary function.[3-6] Choosing ISB instead of general anesthesia is uncommon, particularly in patients with coexisting pulmonary diseases.[7] To avoid phrenic nerve paralysis, using low volumes of local anesthetic for ISB or other alternative blocks can be considered for shoulder surgery.[2,8,9] Superior truncus block (STB) may be one of the blocks that has a diaphragm-protective effect by creating create almost a similar blocking effect to the ISB for shoulder surgery. The superior truncus of the brachial plexus is formed by the union of C5-C6 nerve roots and the nerves that descend the shoulder exiting from the distal part of the superior truncus. In the STB, since the injection site is far away from the phrenic nerve compared to the traditional ISB, the risk of diaphragmatic paralysis is reduced.[10]

In the present study, we aimed to investigate the effects of ISB types primarily on diaphragm functions evaluated by ultrasound, analgesia duration and complications/side effects in patients undergoing arthroscopic shoulder surgery.

PATIENTS AND METHODS

This single-center, retrospective study was conducted at Gazi University Faculty of Medicine, Department of Anesthesiology-Division of Orthopedics and Traumatology between January 1st, 2020 and December 31st, 2022. A total of 285 patients (158 males, 127 females; mean age: 48.0±15.1 years; range, 18 to 80 years) who underwent arthroscopic shoulder surgery under ISB (either alone or combined with STB) were screened. Data were collected from the patients who received ISB, regardless of the local anesthetic volume used (traditional ISB with volume of 30 mL or ISB with volume of 10 mL or 5 mL of 0.5% bupivacaine combined with STB (using 20 mL of 0.5% bupivacaine). Adequate surgical anesthesia and block quality which were evaluated using the pin prick and motor block 30 min after blocks in the study were checked. Later, retrospective records of patients' ultrasound reports of diaphragm function before and after all block types during normal and deep inspiration were retrieved. Then, complete and partial diaphragm paralysis on the block side (considered as hemi-diaphragm) were evaluated for comparison between the types of ISB (traditional ISB alone or ISB combined with STB). Degree of diaphragm paralysis on the block side which was considered as complete (≥75%), partial (25.1 to 74.9%) and no paralysis (≤25%) was evaluated for each block type.

Additionally, block-related complications/side effects, pain scores with an 11 point scale between 0 to 10 (Visual Analog Scale [VAS]; 10 point corresponding to worst pain imaginable where 0 point corresponds no pain at all), time to first analgesic requirement (analgesia duration), need for additional analgesia and the type of analgesic drugs used (paracetamol, tramadol, and/or non-steroidal anti-inflammatory drugs [NSAIDs]), and evaluations of patient and surgeon satisfactions (by a statement "I would definitely/maybe or not prefer") were reviewed.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 24.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean ± standard deviation (SD), median (min-max) or number and frequency, where applicable. Non-parametric tests were used for the data not showing normal distribution. The Mann-Whitney U test (Z-table value) was used to compare two independent groups and Kruskal-Wallis H test (χ^2-table value) was used to compare three or more independent groups. The Bonferroni correction was made for binary comparisons of variables in case of detecting significant differences among the groups. A p value of <0.05 was considered statistically significant.

TABLE I
Demographic data and surgery type

	n	%
Age (year)		
≤39	74	26.0
40-49	58	20.4
50-59	81	28.4
≥60	72	25.2
Sex		
Female	127	44.6
Male	158	55.4
Body mass index (kg/m²)		
Slim (<18.5)	4	1.4
Normal (18.5-24.9)	107	37.5
Overweight (25.0-29.9)	128	44.9
Obese (≥30)	46	16.2
Surgery type		
Rotator cuff rupture	218	76.5
Bankart	67	23.5

TABLE II
Distribution of ISB application, rate of complication/side effect and satisfaction (patient/surgeon)

	n	%
ISB type and volume of local anesthetic used		
Traditional ISB alone (30 mL)	140	49.1
ISB (5 mL) + STB (20 mL)	78	27.4
ISB (10 mL) + STB (20 mL)	67	23.5
Complication/side effect		
Horner syndrome	96	33.68
Hoarseness	1	0.35
Respiratory distress	1	0.35
Rate of surgeon satisfaction		
I would definitely prefer	279	97.9
Maybe I prefer	6	2.1
I do not prefer	0	0
Rate of patient satisfaction		
I would definitely prefer	221	77.5
Maybe I prefer	58	20.4
I do not prefer	6	2.1

ISB: Interscalene block; STB: Superior truncus block.

RESULTS

Demographic characteristics of the American Society of Anesthesiologists (ASA) I or II patients (n=285) and the indications for shoulder surgery (rotator cuff rupture n=218 and Bankart n=67) are presented in Table I.

The ISB type/characteristics are given in Table II. A total of 140 (49.1%) patients received traditional ISB alone, while 145 (50.9%) patients received ISB combined with STB. Thus, operation was performed under ISB alone using 30 mL 0.5% bupivacaine (n=140) or ISB using 10 mL (n=67) or 5 mL 0.5% bupivacaine (n=78) combined with STB using 20 mL 0.5% bupivacaine. The most common side effect/complication was Horner syndrome (n=96, 33.68%). Both patients (77.5%) and surgeons (97%) were highly satisfied by stating that they would definitely prefer the same anesthesia technique, if needed in the future (Table II).

The rate of complete diaphragm paralysis (when the decrease in the diaphragm excursion ≥75%) was significantly lower in the ISB (5 mL) + STB (20 mL)

TABLE III
Degree of diaphragm paralysis (complete ≥75%, partial 25.1 to 74.9% and no paralysis ≤25%) side effects/complication, need for analgesia and types of analgesics used

	Traditional ISB (30 mL) (n=140)		ISB (5 mL) + STB (20 mL) (n=78)		ISB (10 mL) + STB (20 mL) (n=67)		Probability	
	n	%	n	%	n	%	χ^2	*p*
During NI (%)							47.738	**0.000**
≤25	4	2.9	10	12.8	2	3.0		
25.1-74.9	65	46.4	63	80.8	38	56.7		
≥75	71	50.7	5*	6.4*	27	40.3		
During DI (%)							41.029	**0.000**
≤25	3	2.2	5	6.4	2	3.0		
25.1-74.9	72	51.4	68	87.2	33	49.2		
≥75	65	46.4	5*	6.4*	32	47.8		
SE/complication							12.720	**0.002**
Yes	58	41.4	14*	17.9*	25	37.3		
No	82	58.6	64	82.1	42	62.7		
Need for analgesic							4.405	0.111
Yes	85	60.7	47	60.3	50	74.6		
No	55	39.3	31	39.7	17	25.4		
Analgesic type							11.362	0.182
Tramodol	10	7.1	3	3.8	5	7.4		
Paracetamol	62	44.3	34	43.6	18	26.9		
NSAI	3	2.1	2	2.6	-	-		
Paracetamol + NSAI	20	14.4	17	21.8	16	23.9		
Paracetamol + tramadol	45	32.1	22	28.2	28	41.8		

ISB: Interscalene block; STB: Superior truncus block; NI: Normal inspiration; DI: Deep inspiration; SE: Side effect; NSAID: Non-steroidal anti-inflammatory drug; * p: Versus traditional ISB (30 mL) and ISB (10 mL) + STB (Pearson-χ^2 crosstabulations).

TABLE IV
Comparison of VAS and duration of analgesia

	Traditional ISB (30 mL) (n=140)			ISB (5 mL) + STB (20 mL) (n=78)			ISB (10 mL) + STB (20 mL) (n=67)			Probability	
	Mean±SD	Median	Min-Max	Mean±SD	Median	Min-Max	Mean±SD	Median	Min-Max	χ^2	*p*
VAS		2	0.0-4.0		3	0.0-4.0		1	0.0-3.0	1.942	0.379
Duration of analgesia	14.5±3.0			14.1±3.3			13.9±3.0			2.922	0.232

SD: Standard deviation; VAS: Visual Analog Scale; Kruskal-Wallis H test (χ^2-tabular value) was used to compare groups.

TABLE V
Duration of postoperative analgesia according to surgery type

	Rotator cuff rupture (n=218)	Bankart (n=67)		
	Mean±SD	Mean±SD	χ^2	*p*
Analgesia duration	14.4±3.2*	13.8±2.8	2.121	**0.034**

SD: Standard deviation; * p: Versus Bankart operation; Mann-Whitney U test (Z-table value) was used for comparison.

than that of the others during both normal (6.4% *vs.* 50.7% and 40.3%) and deep inspiration (6.4% *vs.* 46.4% and 47.8%) (Table III, p=0.000).

Regarding the incidence of side effect/complication, it was significantly lower in ISB (5 mL) +STB (20 mL) than the others (17.9% *vs.* 41.4% and 37.3%) (Table 3, p=0.002). Additionally, there was no statistically significant difference in the amount of analgesics used among the block types (p>0.05) (Table III).

There was no statistically significant difference in the VAS scores and analgesia duration among the block types (p>0.05) (Table IV). However, time to first analgesic requirement (duration of analgesia) in patients with rotator cuff rupture was significantly higher than that of Bankart operation (Z=-2.121, p=0.034) (Table V).

DISCUSSION

In the present study, we evaluated the rate of complete/partial hemi-diaphragm paralysis and patient-surgeon satisfaction, analgesia duration, need for intravenous analgesics and side effects/complications in patients who underwent arthroscopic shoulder surgery under traditional ISB alone or combined with STB. Currently, diaphragm functions were affected at different degrees after either ISB alone or ISB combined with STB. Traditional ISB with 30 mL revealed a significantly higher rate of complete hemi-diaphragm paralysis during both normal and deep inspiration and Horner syndrome was documented as a more common side effect/complication. However, ISB using low volume (5 mL) of local anesthetic (bupivacaine 0.5%) combined with STB as a sole anesthetic technique resulted in less complete hemi-diaphragm paralysis with adequate surgical anesthesia not requiring general anesthesia in patients who underwent arthroscopy shoulder surgery.

Kang et al.[10] evaluated the pain scores of patients who underwent either STB or ISB using 15 mL of local anesthetic after postoperative 6, 12, 18, and 24 h, the severity of hemi-diaphragm paralysis during deep inspiration, changes in pulmonary function measured by spirometer and the duration of analgesia. The incidence of complete (≥75%) plus partial (25.1 to 74.9%) hemi-diaphragm paralysis was higher in the ISB group alone (97.5%) than that of the STB alone (76.3%); however, the analgesia duration was not significantly different between these blocks. The rates of complete paralysis alone for ISB and STB were 72.5% and 5.3%, respectively.[10] The hemi-diaphragm paralysis in our traditional ISB group was 97.1%, which is very much similar to Kang's et al.'s[10] study. Meanwhile, the rates of complete paralysis alone was 50.7% and 46.4% during normal and deep inspiration, respectively in our traditional ISB alone, which are lower than that of Kang et al.'s[10] study. The individual rate of complete hemi-diaphragm paralysis during both normal and deep inspiration was 6.4% in the ISB (5 mL) combined with STB, which is one of the main findings of the present study. When ISB (10 mL) plus STB was evaluated, the complete

diaphragm paralysis increased to 40.3% without change in analgesia duration. Thus, the greater the local anesthetic volume and dose used for ISB, the higher the degree of diaphragm paralysis. However, ISB using 5 mL of local anesthetic combined with STB (20 mL) was associated with lower side effects than both traditional ISB and ISB using 10 mL combined with STB (20 mL). There was no significant difference in terms of postoperative analgesic need and analgesia duration between the ISB application types.

When Lee et al.[11] used 20 mL of local anesthetic mixture (10 mL of ropivacaine 0.75% plus 10 mL of lidocaine 2%) for STB and ISB, resulting surgical anesthesia in STB was less than that of ISB without a significant difference in the rate of hemi-diaphragm complete paralysis for STB (12.5%) and ISB (25%). Due to inadequate surgical anesthesia in STB, conversion to general anesthesia was required in five of these 22 patients. This could be attributed to the inadequate block of suprascapular nerve that provides 70% of the innervation of the shoulder joint. Therefore, studies recommend to apply blocks from a proximal level before the suprascapular nerve leaves the superior truncus.[12,13] Fortunately, since STB was not used alone for shoulder surgery and, particularly, it was combined with ISB in this study, no inadequate surgical anesthesia or need for conversion to general anesthesia was encountered. Additionally, to avoid phrenic nerve paralysis, cutaneous local anesthetic infiltration anesthesia was used instead of the superficial cervical plexus block in our unit.

The ISB-associated diaphragm paralysis was observed with different radiological studies (X-ray or ultrasound). Less hemi-diaphragm paralysis was detected by lung X-ray after ISB using 5 mL local anesthetic than that of using 10 mL with similar analgesic quality.[14] While Oliver-Fornies et al.[15] evaluated the diaphragm paralysis with ultrasound and spirometer after ISB using 10 mL and 20 mL local anesthetics, Riazi et al.[16] compared 5 mL and 20 mL of local anesthetics for ISB with ultrasound. In both studies, the incidence of hemi-diaphragm paralysis was lower in groups using low-volume (5 or 10 mL) local anesthetic as expected, but the analgesic quality was as adequate as with 20 mL.[15,16] On the contrary to our study, general anesthesia was applied to all of the patients in addition to ISB which was performed only for postoperative analgesia purpose.[14-16] Therefore, our study may be considered as a benchmark study due to not requiring general anesthesia, and it is more likely that our surgeon's preference of lateral decubitus position for operation which is very comfortable for an awake patient could have contributed.[17]

Hartrick et al.[18] performed ISB with a concentration of 0.75% of ropivacaine (5, 10 or 20 mL) for perioperative anesthesia-analgesia under intravenous propofol infusion throughout the entire operation. The conversion/need for general anesthesia was similar in the groups due to insufficient block. The incidence of dyspnea was higher when a volume of 20 mL used, and postoperative pain scores were higher when a volume of 5 mL was used.[17] In our study, the incidence of side effect/complication was least (17.9%) in 5 mL ISB + 20 mL STB, while it was the highest (41.4%) in the traditional ISB alone. Of note, Horner syndrome was the most common side effect and no need for general anesthesia was documented.

Compared to previous studies,[14-16,18] ISB using low volume (5 mL of bupivacaine 0.5%) combined with STB seems to be the most optimal approach as a sole anesthetic technique owing to the lowest complete hemi-diaphragm paralysis with adequate surgical anesthesia not requiring general anesthesia in patients undergoing arthroscopy shoulder surgery in the lateral decubitus position.

Despite retrospective nature of the study as a limitation, which is lack of randomization and unblind data collection, ISB using low volume/dose of local anesthetic combined with STB instead of traditional ISB alone can be preferred to reduce the incidence of complete hemi-diaphragm paralysis. In addition, if the surgeons interfered with postoperative pain management after the block was over, the results of the study could have been affected. However, we, anesthesiologist-surgeon as a team, collaboratively manage multimodal postoperative analgesia protocol, particularly in patients undergoing surgery under not only after upper, but also lower extremity blocks in our unit.

In conclusion, ISB using a relatively low local anesthetic volume combined with STB as a sole anesthetic technique not only provides effective surgical anesthesia and analgesia compared to the traditional ISB alone, but also leads to less hemi-diaphragm paralysis which may be considered in patients with limited pulmonary function to avoid general anesthesia.

Acknowledgements: We thank Selin Erel for her valuable assistance in initial editing of the manuscript.

Ethics Committee Approval: The study protocol was approved by the Medicine Faculty of Gazi University Ethics Committee (date: 09.03.2022, no: 2022-328). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept, design: I.G.; Control/supervision: B.G., I.G.; Data collection and/or processing, literature review: A.B.K., G.E.; Analysis and/or interpretation: I.G., A.B.K.; Writing the article: B.G., A.B.K.; Critical review: U.K., I.G., B.G.; References and fundings: A.B.K.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Chen Q, Shen P, Zhang B, Chen Y, Zheng C. Treatment outcomes of tendinitis of long head of the biceps brachii tendon by different surgeries based on the concept of enhanced recovery after surgery. Jt Dis Relat Surg 2023;34:24-31. doi: 10.52312/jdrs.2022.796.
2. Singelyn FJ, Lhotel L, Fabre B. Pain relief after arthroscopic shoulder surgery: A comparison of intraarticular analgesia, suprascapular nerve block, and interscalene brachial plexus block. Anesth Analg 2004;99:589-92, table of contents. doi: 10.1213/01.ANE.0000125112.83117.49.
3. Neal JM, Gerancher JC, Hebl JR, Ilfeld BM, McCartney CJ, Franco CD, et al. Upper extremity regional anesthesia: Essentials of our current understanding, 2008. Reg Anesth Pain Med 2009;34:134-70. doi: 10.1097/AAP.0b013e31819624eb.
4. 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;33:545-50.
5. Urmey WF, McDonald M. Hemidiaphragmatic paresis during interscalene brachial plexus block: Effects on pulmonary function and chest wall mechanics. Anesth Analg 1992;74:352-7. doi: 10.1213/00000539-199203000-00006.
6. Lenters TR, Davies J, Matsen FA 3rd. The types and severity of complications associated with interscalene brachial plexus block anesthesia: Local and national evidence. J Shoulder Elbow Surg 2007;16:379-87. doi: 10.1016/j.jse.2006.10.007.
7. Aliste J, Bravo D, Layera S, Fernández D, Jara Á, Maccioni C, et al. Randomized comparison between interscalene and costoclavicular blocks for arthroscopic shoulder surgery. Reg Anesth Pain Med 2019:rapm-2018-100055. doi: 10.1136/rapm-2018-100055.
8. Bharti N, Bhardawaj N, Wig J. Comparison of ultrasound-guided supraclavicular, infraclavicular and below-C6 interscalene brachial plexus block for upper limb surgery: A randomised, observer-blinded study. Anaesth Intensive Care 2015;43:468-72. doi: 10.1177/0310057X1504300408.
9. Lim JA, Lim H, Lee JH, Kwak SG, Kim JH, Song SY, et al. Local anesthetic volume in ultrasound-guided interscalene block and opioid consumption during shoulder arthroscopic surgery: A retrospective comparative study. Medicine (Baltimore) 2021;100:e26527. doi: 10.1097/MD.0000000000026527.
10. Kang R, Jeong JS, Chin KJ, Yoo JC, Lee JH, Choi SJ, et al. Superior trunk block provides noninferior analgesia compared with interscalene brachial plexus block in arthroscopic shoulder surgery. Anesthesiology 2019;131:1316-26. doi: 10.1097/ALN.0000000000002919.
11. Lee MG, Shin YJ, You HS, Lim CH, Chang YJ, Shin HJ. A comparison of anesthetic quality between interscalene block and superior trunk block for arthroscopic shoulder surgery: A randomized controlled trial. Pain Physician 2021;24:235-42.
12. Kim DH, Lin Y, Beathe JC, Liu J, Oxendine JA, Haskins SC, et al. Superior trunk block: A phrenic-sparing alternative to the interscalene block: A randomized controlled trial. Anesthesiology 2019;131:521-33. doi: 10.1097/ALN.0000000000002841.
13. Burckett-St Laurent D, Chan V, Chin KJ. Refining the ultrasound-guided interscalene brachial plexus block: The superior trunk approach. Can J Anaesth 2014;61:1098-102. doi: 10.1007/s12630-014-0237-3.
14. Lee JH, Cho SH, Kim SH, Chae WS, Jin HC, Lee JS, 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;58:1001-6. doi: 10.1007/s12630-011-9568-5.
15. Oliver-Fornies P, Ortega Lahuerta JP, Gomez Gomez R, Gonzalo Pellicer I, Oliden Gutierrez L, Viñuales Cabeza J, et al. Diaphragmatic paralysis, respiratory function, and postoperative pain after interscalene brachial plexus block with a reduced dose of 10 ml levobupivacaine 0.25% versus a 20 ml dose in patients undergoing arthroscopic shoulder surgery: Study protocol for the randomized controlled double-blind REDOLEV study. Trials 2021;22:287. doi: 10.1186/s13063-021-05216-6.
16. Riazi S, Carmichael N, Awad I, Holtby RM, McCartney CJ. Effect of local anaesthetic volume (20 vs 5 ml) on the efficacy and respiratory consequences of ultrasound-guided interscalene brachial plexus block. Br J Anaesth 2008;101:549-56. doi: 10.1093/bja/aen229.
17. Atik OŞ. Which articles do the editors prefer to publish? Jt Dis Relat Surg 2022;33:1-2. doi: 10.52312/jdrs.2022.57903.
18. Hartrick CT, Tang YS, Siwek D, Murray R, Hunstad D, Smith G. The effect of initial local anesthetic dose with continuous interscalene analgesia on postoperative pain and diaphragmatic function in patients undergoing arthroscopic shoulder surgery: A double-blind, randomized controlled trial. BMC Anesthesiol 2012;12:6. doi: 10.1186/1471-2253-12-6.