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BOSPHORUS MEDICAL JOURNAL

Boğaziçi Tıp Dergisi

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	Word	Reference	Table/Figure	Author
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Case Report	2500	15	5	5
Editorial	2000	10	5	1
Letter to editor	500	5	2	2

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Acknowledgment of the individuals who contributed to the preparation of the manuscript but who do not fulfill authorship criteria.

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References

References are numbered and listed by their order of appearance in text; the text citation is followed by the appropriate reference number in parentheses. References should be restricted to closely pertinent material. Accuracy of citation is the author's responsibility. References should conform exactly to the original spelling, accents, punctuation, etc. All references should be cited inside the text. References must be listed in the Vancouver Style only. All references should be numbered sequentially as superscripted in the text and listed in the same numerical order in the reference section. The reference styles for different types of publications are presented in the following examples.

JOURNAL REFERENCE

Uruc F, Yildirim C, Aras B, Kivrak M, Sahin A, Akan S, et al. Infectious Complications of Transrectal Ultrasound-guided Prostate Needle Biopsy: A Retrospective Case-Control Study. Bosphorus Med J 2016; 3:5-8.

Journal Article:

Matsukawa Y, Kato K, Hatta Y, Iwamoto M, Mizuno S, Kurihara R, et al. Helicobacter pylori eradication reduces platelet count in patients without idiopathic thrombocytopenic purpura. Platelets 2007;18:52–5.

Book Chapter Reference

Author. Title. In: Editor, `Ed.`.^`Eds.`. Book Title. ed. Edition, Place Published: Publisher; Year: p. Pages. Lal G, Clark OH. Thyroid, parathyroid, and adrenal. In: Brunicardi FC, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Matthews JB, Eds. Schwartz's Principles of Surgery. ed.10th, New York; Mc-Graw Hill; 2015: p.1521-96.

Book Reference

Author. Title. ed. Edition, Place Published: Publisher; Year. Walsh P. Physiology and Pharmacology of the Bladder and Urethra. Campbell's Urology. ed. 10th, Philadelphia: Saunders; 2014.

Conference Proceedings:

Author. Title. In: Editor, `editor`.^`editors`. Conference Name; Year of Conference Date; Conference Location: Publisher; Year of Conference|. p. Pages.

Bengisson S. Sothemin BG. Enforcement of data protection, privacy and security in medical informatics. In: Lun KC, Degoulet P, Piemme TE, Rienhoff O, editors. MEDINFO 92. Proceedings of the 7th World Congress on Medical Informatics; 1992 Sept 6-10; Geneva, Switzerland. Amsterdam: North-Holland; 1992. pp.1561-5.

Scientific or Technical Report:

Author. Title. Type. Place Published: Institution; Year Date. Report No.: Report Number.

Cusick M, Chew EY, Hoogwerf B, Agrón E, Wu L, Lindley A, et al. Early Treatment Diabetic Retinopathy Study Research Group. Risk factors for renal replacement therapy in the Early Treatment Diabetic Retinopathy Study (ETDRS), Early Treatment Diabetic Retinopathy Study Kidney Int: 2004. Report No: 26.

Thesis:

Author. Title. Type. Place Published: Institution; Year Date. Report No.: Report Number.

Kaplan SI. Post-hospital home health care: elderly access and utilization (dissertation). St Louis (MO): Washington Univ; 1995.

Epub Ahead of Print Articles:

Author. Title. Alternate Title Year Date Accessed. doi: DOI. [Epub ahead of print].

Cai L, Yeh BM, Westphalen AC, Roberts JP, Wang ZJ. Adult living donor liver imaging. DiagnIntervRadiol. 2016 Feb 24.doi: 10.5152/dir.2016.15323. [Epub ahead of print].

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Author. Title. Available from: URL. Accessed Access Date, Access Year. Fox S. Pew Research Center. The social life of health information. 2014. Available from: http://www.pewresearch.

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Comparison of Functional and Pain Scores in The Early Period in Patients Undergoing Arthroscopic Rotator Cuff Repair Under General Anesthesia or Interscalene Block

Genel Anestezi veya İnterskalen Blok Altında Artroskopik Rotator Manşet Onarımı Yapılan Hastalarda Erken Dönemde Fonksiyonel ve Ağrı Skorlarının Karşılaştırılması

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ABSTRACT

Objectives: This study aimed to compare the effects of general anesthesia (GA) and interscalene brachial plexus block (ISB) on clinical outcomes following arthroscopic single-row or double-row repair of crescentic rotator cuff tears.

Methods: This retrospective cohort study included 80 patients (46 women, 34 men; mean age, 66.7 years) who underwent arthroscopic repair for crescent-shaped full-thickness rotator cuff tears. Patients were divided into GA (n=40) and ISB (n=40) groups. Tears were classified according to the Cofield classification. Functional outcomes were assessed using Constant-Murley, ASES, and UCLA scores, along with joint range of motion (JROM) and visual analog scale (VAS) pain scores. Evaluations were performed at 6 and 18 months postoperatively.

Results: At 6 months, Constant-Murley, ASES, and UCLA scores were significantly higher in the ISB group than in the GA group. No significant differences were observed between the groups at 18 months. Both groups showed significant improvement over time. JROM and VAS scores were similar between the groups. Demographic variables and repair type had no significant effect on outcomes.

Conclusion: ISB was associated with improved short-term functional outcomes following arthroscopic rotator cuff repair. Long-term clinical results were comparable to those achieved with general anesthesia.

Keywords: ASES; Constant-Murley score; Crescent-shaped rotator cuff tear; General anesthesia; Interscalene block; UCLA score.

ÖZET

Amaç: Bu çalışma, genel anestezi (GA) ve interskalen brakiyal pleksus bloğu (ISB) uygulamalarının, artroskopik tek sıra veya çift sıra hilal şeklindeki rotator manşet yırtıklarının onarımından sonraki klinik sonuçlar üzerindeki etkilerini karşılaştırmayı amaçlamıştır.

Yöntem: Bu retrospektif kohort çalışması, hilal şeklinde tam kat rotator manşet yırtıkları nedeniyle artroskopik onarım uygulanan 80 hastayı (46 kadın, 34 erkek; ortalama yaş 66,7) içermektedir. Hastalar GA (n=40) ve ISB (n=40) gruplarına ayrılmıştır. Yırtıklar Cofield sınıflandırmasına göre sınıflandırılmıştır. Fonksiyonel sonuçlar, Constant-Murley, ASES ve UCLA skorları ile eklem hareket açıklığı (JROM) ve görsel analog skala (VAS) ağrı skorları kullanılarak değerlendirilmiştir. Değerlendirmeler ameliyat sonrası 6. ve 18. aylarda yapılmıştır.

Bulgular: Altıncı ayda Constant-Murley, ASES ve UCLA skorları, GA grubuna kıyasla ISB grubunda anlamlı olarak daha yüksekti. On sekizinci ayda gruplar arasında anlamlı bir fark gözlenmedi. Her iki grup da zaman içinde anlamlı bir iyileşme gösterdi. JROM ve VAS skorları gruplar arasında benzerdi. Demografik değişkenler ve onarım tipi, sonuçlar üzerinde anlamlı bir etkiye sahip değildi.

Sonuç: ISB, artroskopik rotator manşet onarımı sonrası kısa dönem fonksiyonel sonuçlarda iyileşme ile ilişkiliydi. Uzun dönem klinik sonuçlar, genel anestezi ile elde edilen sonuçlarla karşılaştırılabilirdi.

Anahtar sözcükler: ASES; Constant Murley Skoru; Genel Anestezi; İnterskalen blok; Kresent tip rotator cuff yırtığı; UCLA skoru.

Conservative treatment is the first choice for rotator cuff injuries, especially in cases of partial tears and in patients who are not suitable for surgery. The aim is to control pain, improve function, and prevent progression of the tear. Response to treatment usually occurs within 6–12 weeks.[1-3] Surgical treatment involves open, mini-open, and arthroscopic repair techniques. In full-thickness tears, the tendon is completely detached from the humeral footprint, and repair is performed using one of these three methods.[4-6]

Arthroscopic rotator cuff repair is frequently preferred today because of both technical advances and its less invasive nature. High success rates have been reported, especially for small and medium-sized tears. The advantages of this method include minimal soft tissue damage, rapid functional recovery, and less postoperative pain.[6]

General anesthesia is the standard method in shoulder surgery because it ensures reliable airway control; however, it is more prone to hemodynamic fluctuations such as hypotension and bradycardia. While central blocks require caution in patients using anticoagulants, peripheral nerve blocks offer safe alternatives. The interscalene brachial plexus block (ISB) is the preferred regional anesthesia method in shoulder surgery because it provides effective motor and sensory blockade. However, ISB administration requires an experienced anesthesiologist and appropriate patient preparation.[7,8]

The aim of our study was to evaluate the use of general anesthesia and interscalene block anesthesia methods for the arthroscopic repair of crescentic (crescent-shaped) rotator cuff tears in patients undergoing single- or double-row repair and, additionally, to evaluate functional shoulder scores, shoulder joint range of motion, and pain scales according to tear size, repair method, affected shoulder, and sociodemographic characteristics (age, sex, and body mass index [BMI]).

There is insufficient information in the literature regarding functional differences between ISB and GA techniques in patients undergoing rotator cuff repair in the short and medium term. In our study, we expect better results in terms of functional and pain scales with the ISB technique in the short term, while we anticipate equivalent results in the medium term.

Methods

Ethical approval was obtained from the Scientific Research Ethics Committee of Balıkesir Atatürk City Hospital on June 19, 2025, with decision no. 2025/06/60. Informed consent was waived for this study, which was conducted in accordance with the Declaration of Helsinki.

This retrospective cohort study included a total of 80 patients who underwent single- or double-row rotator cuff repair using arthroscopic techniques. All cases were evaluated with preoperative magnetic resonance imaging (MRI) and plain radiographs; only patients with a crescentic full-thickness tear were included in the study. The morphology and size of the tears were defined intraoperatively by the surgeon and classified according to the Cofield classification as small (<1 cm), medium (1–3 cm), large (3–5 cm), and massive (>5 cm), based on the surgical reports. All surgical reports were retrospectively reviewed by two orthopedic surgeons.

Patients were divided into two groups with equal numbers (n=40).

Group A included patients operated on under general anesthesia, with 6 patients having small tears, 26 patients having medium tears, 7 patients having large tears, and 1 patient having a massive tear. Group B consisted of patients who underwent anesthesia with an interscalene brachial plexus block (ISB), including 6 patients with small tears, 26 patients with medium tears, 7 patients with large tears, and 1 patient with a massive tear.

In both groups, a single-row repair technique was applied to 20 patients and a double-row repair technique to 20 patients. Acromial spurs identified during arthroscopy were minimally shaved using a burr.

Patients with the following characteristics were excluded from the study: shoulder instability, degenerative arthritis of the glenohumeral joint, acromioclavicular joint pathology, tubercle fracture, previous shoulder surgery, revision surgery due to re-rupture, massive contracted and immobile tears, cases requiring subscapularis repair, and cases with Goutallier stage IV fatty degeneration.

Patients were followed for an average of 24.2 months (range, 18–32 months). During follow-up, all patients were re-evaluated at the 6- and 18-month follow-up visits, including assessments of functional status (ROM and functional shoulder scores) and pain (VAS score), along with any additional medical conditions and body mass index. Since the shortest follow-up period was 18 months, the 18-month follow-up was used for the final evaluation of all patients in the study.

The functional assessment scales applied included the Constant-Murley Score (CMS), American Shoulder and Elbow Surgeons (ASES) score, University of California at Los Angeles (UCLA) score, and range of motion (ROM) measurements. ROM values were measured using a goniometer in the directions of flexion, abduction, internal rotation, and external rotation. All measurements were performed in a standardized manner by two orthopedic surgeons during the patients' 6- and 18-month follow-up visits.

Surgical Technique

All procedures were performed with the patients in the supine position. First, arthroscopic examination of the glenohumeral joint was performed via the posterior portal. Subsequently, the subacromial space was accessed to visualize the rotator cuff tear. Next, the footprint was identified, and using the lateral portal, a sliding knot was tied with a 4.5-mm titanium anchor (Artrotek®) from SMC (Samsung Medical Center), compressing the rotator cuff and completing the single-row repair. Two medial anchors were used for tears that could not be completely closed. In addition, some cases were repaired in two rows using a 4.5-mm PushLock anchor with the tension-band method. Subacromial decompression was performed in all cases.

For the ultrasound-guided interscalene block, the linear probe was placed transversely in the supraclavicular fossa and advanced cranially to visualize the short axis of the brachial plexus, identifying the C5–C6 roots between the scalene muscles. The dorsal scapular and long thoracic nerves, which run within the middle scalene muscle, were identified and preserved. Using an in-plane technique, an 18-G Tuohy needle was directed laterally toward the plexus sheath with the aid of hydrodissection. After ruling out intravascular injection by negative aspiration, 20 mL of 0.25% bupivacaine was administered in fractional 5-mL injections. The procedure was completed with a sterile dressing containing chlorhexidine gluconate.

The postoperative follow-up protocol was the same for all groups. Passive shoulder movement was initiated 1 day after surgery in all patients. A shoulder-arm sling with abduction support was used for 6 weeks, and active shoulder movement was restricted during this period. After 6 weeks, the shoulder-arm sling was removed, and all patients underwent a 2-month physical therapy program for active shoulder movements. No complications were observed in any patient during postoperative follow-up.

Statistical Analyses

Data analysis was performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). Descriptive statistical methods (mean, standard deviation, minimum, and maximum) were used to evaluate the study data. The normality of quantitative data was tested using the Shapiro-Wilk test and graphical evaluations. For parametric data, the independent-samples t-test and paired t-test were used for intergroup comparisons, the mixed ANOVA test was used for repeated measures, and the chi-square test was used to compare categorical variables. The significance level was set at $p<0.05$.

Results

A retrospective cohort study was conducted, and 80 patients with complete crescentic rotator cuff tears who underwent single-row or double-row arthroscopic repair between January 2018 and January 2025 were randomly selected for inclusion according to the inclusion criteria. Sixty-one point two five percent (n=49) of the patients were female, and thirty-eight point seven five percent (n=31) were male, with a mean age of 64.29 years (range, 50–81 years) (Table 1).

Eighty patients were randomly assigned to two groups for evaluation. Group A received general anesthesia, while Group B received an interscalene brachial plexus block (ISB).

In Group A, there were 40 patients in total, 16 of whom were male and 24 were female. The youngest patient was 50 years old and the oldest was 81 years old, with a mean age of 64.29

Table 1. Demographic data of patients

	Group A (General Anesthesia)	Group B (Interscalenous Brachial Plexus Block)	Total
Number of patients	40	40	80
Gender (Male-Female)	16-24	15-25	80
Age	Mean: 64.29 (Range: 50–81 years)	Mean: 64.28 (Range: 50–81 years)	Mean: 64.29 (Range: 50–81 years)
Side			
Right	25	24	49
Left	15	16	31
Torn Type			
Small	6	6	12
Medium	26	26	52
Large	7	7	14
Massive	1	1	2
Follow-up period	Mean: 24.2 months (Range: 18–32 months)	Mean: 24.2 months (Range: 18–32 months)	Mean: 24.2 months (Range: 18–32 months)
Single row repair	20	20	40
Double row repair	20	20	40

years. Twenty-five patients had a crescent-type rotator cuff tear in the right shoulder, and 15 patients had one in the left shoulder.

At the 6-month follow-up, shoulder flexion was 150–162 degrees (mean, 157.3), abduction was 152–160 degrees (mean, 156.8), internal rotation was 52–59 degrees (mean, 55.6), and external rotation was 57–63 degrees (mean, 59.7). At the 18-month follow-up, shoulder flexion was 150–162 degrees (mean, 157.6), abduction was 152–159 degrees (mean, 156.4), internal rotation was 50–58 degrees (mean, 55.5), and external rotation was 57–63 degrees (mean, 59.6), as measured by goniometry (Table 2).

Repair was performed using a single-row technique in 20 patients and a double-row technique in 20 patients. Tear size was reported as small in 6 patients, medium in 26 patients, large in 7 patients, and massive in 1 patient.

Patients' functional scores at 6 months postoperatively showed a Constant-Murley score of 76–85 (mean, 80.23), an ASES score of 74–88 (mean, 80.45), a UCLA score of 24–32 (mean, 27.50), and a VAS score of 0–3 (mean, 1.14). At 18 months postoperatively, the Constant-Murley score was 77–86 (mean, 80.95), the ASES score was 76–89 (mean, 81.88), the UCLA score was 24–32 (mean, 27.67), and the VAS score was 0–3 (mean, 1.12) (Table 3).

Table 2. Joint range of motion values for patients in groups at 6 and 18 months

	Group A (General Anesthesia)		Group B (Interscalene Brachial Plexus Block)	
	6^{th} month Min-max (Mean) (SD)	18^{th} month Min-max (Mean) (SD)	6^{th} month Min-max (Mean) (SD)	18^{th} month Min-max (Mean) (SD)
Shoulder flexion degree	150-162 ° (Mean:157.3°) (3.5)	150-162 ° (Mean:157.6°) (3.3)	153-165 ° (Mean:158.1°) (3.3)	153-164 ° (Mean:157.9°) (3.3)
Shoulder abduction degree	152-160 ° (Mean:156.8°) (2.2)	152-159 ° (Mean:156.4°) (2.2)	152-160 ° (Mean:157.2°) (2.2)	151-158 ° (Mean:156.5°) (2.2)
Degree of shoulder internal rotation	52-59 ° (Mean:55.6°) (2.1)	50-58 ° (Mean:55.5°) (2.3)	52-60° (Mean:55.8°) (2.0)	51-59° (Mean:55.7°) (2.0)
Shoulder external rotation degree	57-63 ° (Mean:59.7) (2.1)	57-63 ° (Mean:59.6) (2.1)	56-63° (Mean:59.8°) (2.0)	55-63° (Mean:59.7°) (2.1)

SD: Standard deviation.

Table 3. Postoperative shoulder function scores in patients undergoing surgery under general anesthesia (GA)

Functional scores and pain scales	6th month Min-Max (Mean)	SD (6th month)	18th month Min-Max (Mean)	SD (18th month)
Constant Murley Score	76–85 (80.22)	5.3	77–86 (80.95)	5.4
ASES Score	74–88 (80.45)	4.8	76–89 (81.88)	4.9
UCLA Score	24–32 (27.50)	5.6	24–32 (27.67)	5.6
VAS Score	0-3 (1.15)	0.7	0-3 (1.12)	0.8

ASES: American Shoulder and Elbow Surgeons; UCLA: University of California at Los Angeles; VAS: Visual Analog Scale

The GA group showed a significant improvement in postoperative shoulder functional outcomes over time. The Constant-Murley score was 76–85 (mean, 80.23; SD, 5.3) at 6 months and 77–86 (mean, 80.95; SD, 5.4) at 18 months, showing a slight increase during follow-up. Similarly, ASES scores increased from 74–88 (mean, 80.45; SD, 4.8) at 6 months to 76–89 (mean, 81.88; SD, 4.9) at 18 months. UCLA scores remained stable at 24–32 (mean, 27.50; SD, 5.6) at 6 months and 24–32 (mean, 27.67; SD, 5.6) at 18 months. These findings indicate that functional shoulder scores in patients operated on under GA were generally preserved or tended to improve during the follow-up period.

Patients had preoperative DM, HT, and CAD, and preoperative BMI ranged from 20 to 30 (mean, 24.1).

In Group B, 15 of the 40 patients were male and 25 were female. The youngest patient was 55 years old and the oldest was 80 years old, with a mean age of 64.28 years. Twenty-four patients had a crescent-type rotator cuff tear in the right shoulder, and 16 patients had one in the left shoulder.

At the 6-month postoperative follow-up, shoulder flexion ranged from 153 to 165 degrees (mean, 158.1), abduction from 152 to 160 degrees (mean, 157.2), internal rotation from 52 to 60 degrees (mean, 55.8), and external rotation from 56 to 63 degrees (mean, 59.8). At the 18-month postoperative follow-up, shoulder flexion ranged from 153 to 164 degrees (mean, 157.9), abduction from 151 to 158 degrees (mean, 156.5), internal rotation from 51 to 59 degrees (mean, 55.7), and external rotation from 55 to 63 degrees (mean, 59.7), as measured by goniometry (Table 2).

Repair was performed using a single-row technique in 20 patients and a double-row technique in 20 patients. Tear size was reported as small in 6 patients, medium in 26 patients, large in 7 patients, and massive in 1 patient.

Patients' functional scores at 6 months postoperatively showed a Constant-Murley score of 79–89 (mean, 83.25), an ASES score of 77–90 (mean, 83.08), a UCLA score of 27–34 (mean, 29.38), and a VAS score of 0–2 (mean, 1.1). At 18 months postoperatively, the Constant-Murley score was 78–85 (mean, 81.30), the ASES score was 76–89 (mean, 81.80), the UCLA score was 25–33 (mean, 27.93), and the VAS score was 0–2 (mean, 1.11) (Table 4).

In the ISB group, postoperative shoulder functional outcomes were better at 6 months but declined over time to values similar to those in the GA group. These findings indicate that functional shoulder scores in patients operated on under ISB were better during the early follow-up period at 6 months but tended to decline by 18 months.

Patients had preoperative DM, HT, and CAD, and preoperative BMI ranged from 20 to 30 (mean, 24.3).

According to the results of the independent-samples Welch t-test, Constant-Murley, ASES, and UCLA scores at 6 months were significantly higher in the interscalene brachial plex-

Table 4. Postoperative shoulder function scores in patients undergoing surgery under interscalene brachial plexus block (ISB)

Functional scores and pain scales	6th month Min-Max (Mean)	SD (6th month)	18th month Min-Max (Mean)	SD (18th month)
Constant Murley Score	79-89 (83.25)	5.7	78-85 (81.30)	5.5
ASES Score	77-90 (83.08)	5.1	76-89 (81.8)	5
UCLA Score	27-34 (29.38)	5.9	25-33 (27.93)	5.5
VAS Score	0-2 (1.1)	0.8	0-2 (1.11)	0.8

ASES: American Shoulder and Elbow Surgeons; UCLA: University of California at Los Angeles; VAS: Visual Analog Scale

us block (ISB) group than in the general anesthesia (GA) group (p<0.001 for all) (Fig. 1). However, at 18 months, no statistically significant differences were observed between the groups in these three scores (Constant-Murley, p=0.527; ASES, p=0.906; UCLA, p=0.528) (Fig. 2).

A paired t-test was used for within-group comparisons.

Accordingly, in the within-group evaluation of the GA group, a significant increase was found in Constant-Murley scores between 6 and 18 months (p<0.001).

Similarly, a significant difference was found between the ASES scores at 6 and 18 months (p<0.001).

However, no statistically significant change was observed between the UCLA scores at 6 and 18 months (p=0.051).

When the ISB group was evaluated using the paired t-test, a statistically significant difference was observed in Constant-Murley scores between 6 and 18 months (p<0.001).

Similarly, a significant difference was observed between the ASES scores at 6 and 18 months (p<0.001).

The UCLA scores at 6 and 18 months also showed a significant difference (p<0.001).

The effects of time (6 and 18 months) and type of anesthesia (GA and ISB) on repeated measures were evaluated using a mixed ANOVA.

In the mixed ANOVA performed for the Constant-Murley score, the results were as follows: time, p<0.001; anesthesia, p<0.001 (significant group difference); and time×anesthesia, p<0.001 (partial η^2=0.557, very strong) (Fig. 3).

In the mixed ANOVA performed for the ASES score, the results were as follows: time, p=0.559 (not significant); anesthesia, p<0.001 (significant group difference); and time×anesthesia, p<0.001 (partial η^2=0.589, very strong) (Fig. 4).

In the mixed ANOVA performed for the UCLA score, the results were as follows: time, p<0.001; anesthesia, p=0.068 (borderline); and time×anesthesia, p<0.001 (partial η^2=0.640, very strong) (Fig. 5).

All functional scores examined (Constant-Murley, ASES, and UCLA scores) were higher at 6 months; no difference was observed between the GA and ISB groups at 18 months. The interaction between time (6 and 18 months) and anesthesia was found to be statistically very strong.

Using the independent-samples t-test, no significant differences were observed between the groups (GA and ISB) in terms of age, sex, BMI, side, tear size, repair type, or anesthesia type (p>0.05).

When the ROM values of the GA and ISB groups were compared within each group at 6 and 18 months using a paired t-test, significant increases were observed in flexion, abduction, internal rotation, and external rotation in the GA group. In the ISB group, increases were observed in flexion and abduction, although these were more limited than those in the GA group, and significant increases were observed in

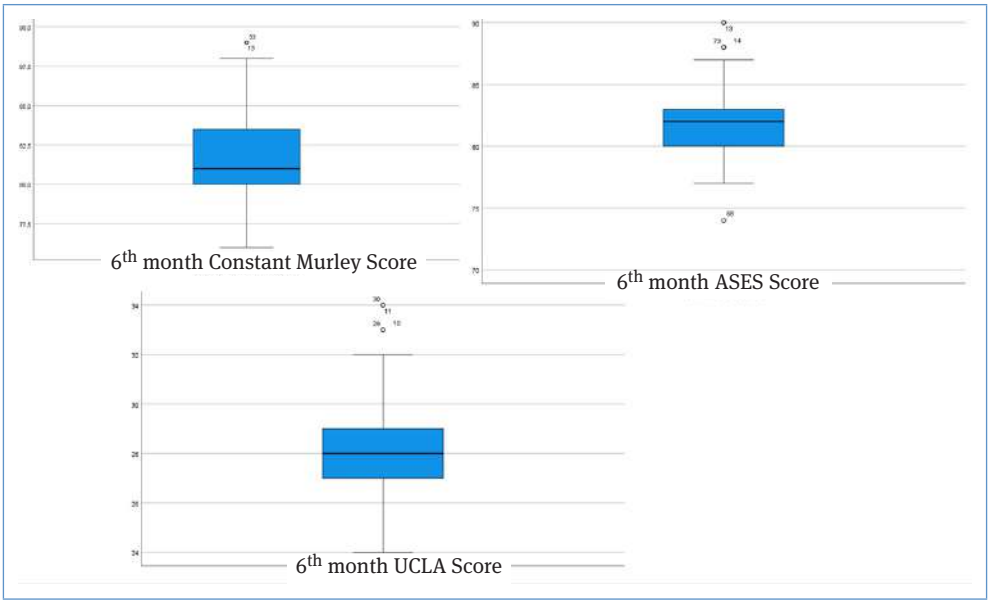

Figure 1. Distribution of Constant Murley, ASES, and UCLA scores at 6 months

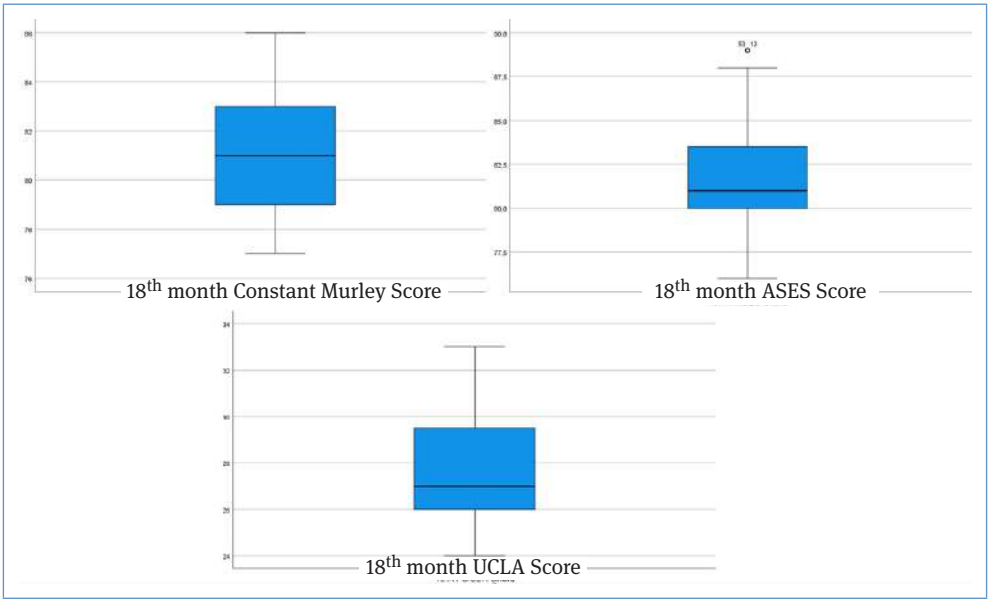

Figure 2. Distribution of Constant Murley, ASES, and UCLA scores at 18 months

internal and external rotation. The changes in both groups were statistically significant ($p<0.05$).

When ROM values were compared separately at 6 and 18 months using the independent-samples Welch t-test, flexion and abduction degrees at 6 months were higher in the ISB group than in the GA group, with statistically significant differences ($p<0.001$ for both). Internal and external rotation degrees were also higher in the ISB group than in the GA group, with statistically significant differences ($p<0.01$ for both).

At 18 months, all ROM degrees (flexion, abduction, internal rotation, and external rotation) were similar between the GA and ISB groups, with no statistically significant differences ($p>0.05$).

In the early period, at 6 months, ISB showed superiority in ROM scores, whereas in the medium term, at 18 months, no difference was observed between the ISB and GA groups.

When the VAS score was evaluated within each group using a paired t-test, it was found to have increased in both groups (GA and ISB) from 6 to 18 months, and this change was statistically significant ($p<0.001$). As the VAS score approaches 0, patient satisfaction is thought to increase; pa-

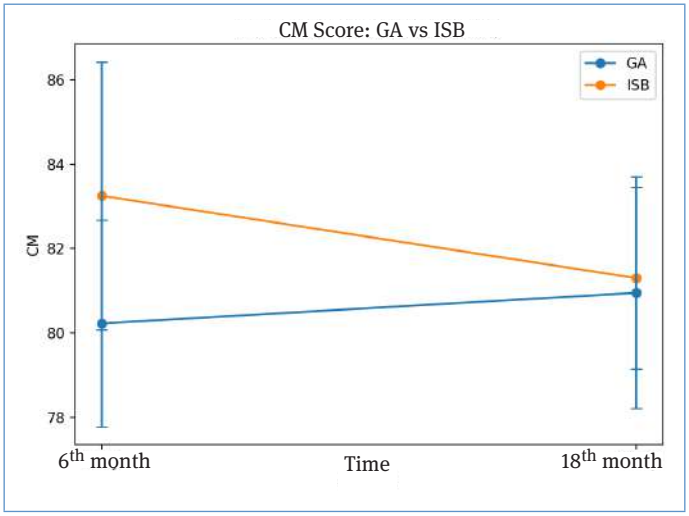

Figure 3. Line graph showing the relationship between Constant Murley score Time (6th and 18th month) and Anesthesia type (GA and ISB)

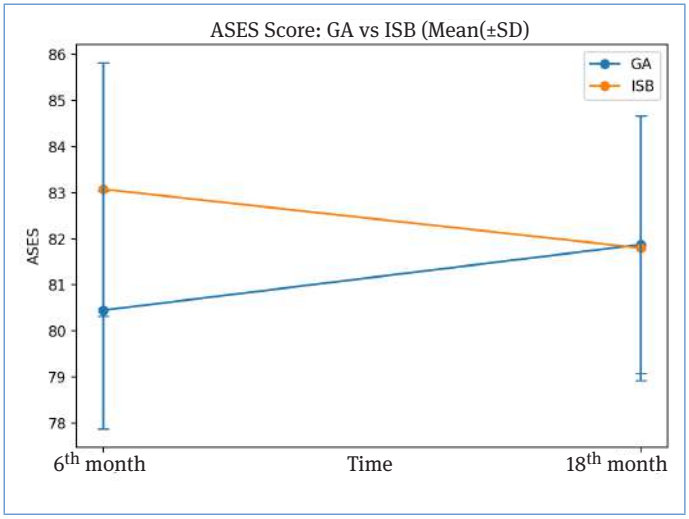

Figure 4. Line graph showing the relationship between ASES score Time (6th and 18th month) and Anesthesia type (GA and ISB)

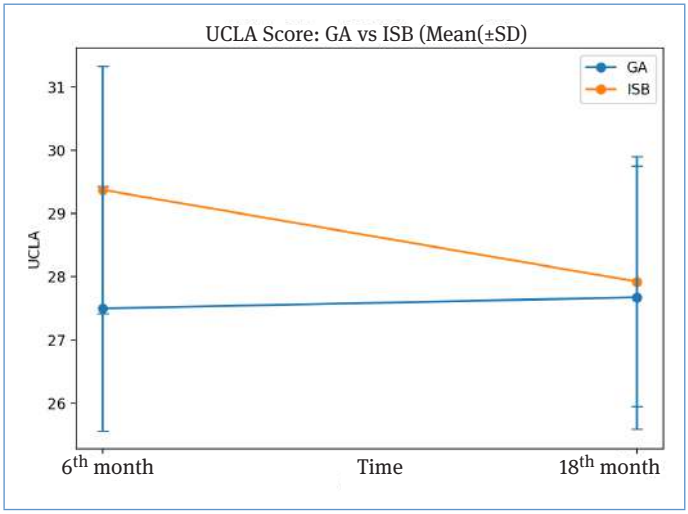

Figure 5. UCLA score Line graph showing the relationship between Time (6th and 18th month) and Anesthesia type (GA and ISB)

tient satisfaction was higher at 6 months postoperatively but decreased at 18 months.

When the VAS score was evaluated between the groups separately at 6 and 18 months using the independent-samples Welch t-test, the ISB group had a lower VAS score than the GA group at 6 months, and this difference was statistically significant ($p<0.001$). At 18 months, no significant difference was observed in VAS scores between the ISB and GA groups ($p>0.05$).

As the VAS score approaches 0, patient satisfaction is thought to increase. At 6 months postoperatively, patient satisfaction was higher in the ISB group than in the GA group, whereas at 18 months, there was no significant difference between the groups.

When a mixed ANOVA for repeated measures was performed, time (6 and 18 months) and anesthesia type (GA and ISB) were found to be significant for all ROM parameters and VAS scores ($p<0.001$), indicating that the effect of the anesthesia technique on functional recovery was mainly limited to the early postoperative period.

Discussion

Rotator cuff tears are a common problem in orthopedic surgery, and determining the type of tear is important for treatment.

Burkhart and Lo classified rotator cuff tears into four main groups: crescent-shaped, U-shaped, L-shaped, and massive tears. Crescent-shaped tears generally have sufficient medial-to-lateral mobility and can therefore be anatomically repaired directly onto the humeral tubercle under low tension.[9] If rotator cuff tears are classified geometrically, they can be categorized as Type 1, crescent-shaped tears;[10] Type 2, longitudinal (U- or L-shaped) tears;[10] Type 3, massive contracted tears; and Type 4, rotator cuff arthropathy tears associated with significant glenohumeral arthrosis and complete loss of the acromioclavicular space.[11]

Our study aimed to investigate the short- and medium-term functional changes in patients with crescent-shaped rotator cuff tears following single-row and double-row arthroscopic repairs according to the type of anesthesia.

Liu et al. [12] evaluated the analgesic effect of a single dose of interscalene block (SISB) in the early period following arthroscopic rotator cuff repair. In patients who received SISB, pain scores on the day of surgery and especially at 6 hours were significantly lower than those in the general anesthesia group. Furthermore, insulin levels were significantly reduced in the SISB group at 42 hours postoperatively. In contrast, no significant changes were observed in DHEA-S and fibrinogen levels. The study demonstrated that SISB could be administered without complications and effectively improved early postoperative pain control.[12]

In a study by Gurger and Ozer, [13] the effect of the combination of general anesthesia (GA) and continuous interscalene block (CISB) on postoperative outcomes in arthroscopic rotator cuff repair was evaluated. Patients who received CISB+GA showed lower pain scores and a reduced need for additional analgesics in the early postoperative period. Additionally, Constant scores at 6 weeks were higher in the CISB+GA group. However, functional outcomes at 6 months were similar between the two groups. These findings suggest that CISB supports early pain control and functional recovery but does not provide a significant advantage in long-term outcomes.[13]

Orhan et al. [14] evaluated postoperative pain intensity and time to pain onset in shoulder arthroscopies performed under interscalene block. In a retrospective review of 172 patients, the type of surgery (rotator cuff repair or instability surgery) and the duration of the operation (<30 min or ≥30 min) were found to have no significant effect on 24-hour VAS scores, pain onset, or the need for additional analgesics. The findings indicate that surgical and patient characteristics do not determine the postoperative pain pattern after interscalene block.[14]

Peripheral nerve blocks (PNBs) are an important component of multimodal analgesia and can be administered as a single-dose ISB or continuous ISB. Meta-analyses of randomized controlled trials have shown that PNBs provide better pain control and lower opioid consumption than intravenous opioids in patients undergoing upper- and lower-extremity surgeries. Single-dose ISB may shorten the time to readiness for discharge compared with continuous ISB. The main limitation of single-dose ISB is that its effect is limited to 12–24 hours.[15]

In our study, the intraoperative effects of peripheral nerve block methods and general anesthesia, postoperative vital signs, and biochemical marker monitoring were not evaluated, and only a single-dose interscalene block was applied among the peripheral nerve block methods. Evaluations were performed at the 6- and 18-month postoperative follow-ups; however, the duration of the nerve block and rebound pain effects were not examined.

Reyes-Peart et al. [16], in a cohort study of 30 patients, showed that shoulder function improved significantly over time after rotator cuff surgery. Constant scores increased significantly from the preoperative period to the 3rd and 6th months. There was no difference in functional outcomes between patients who initially underwent arthroscopy and subsequently converted to open surgery and those who underwent arthroscopy alone. These results support the view that the surgical technique is not decisive for functional improvement and that recovery is primarily dependent on time and the rehabilitation process.[16]

The most commonly used method today is arthroscopic repair, which was used in our study. All operations were completed arthroscopically, and patients were followed up in the short and medium term and underwent a standardized rehabilitation program.

Chen et al. [17] conducted a meta-analysis comparing early and late rehabilitation protocols for improving shoulder function after rotator cuff repair. The study included randomized controlled trials (RCTs) selected from international and Chinese databases. According to the results of nine RCTs involving a total of 830 patients, there was no significant difference between the two approaches in terms of VAS, SST score, recovery rate, and re-tear rate at 6 and 12 months. ASES scores were similar at 6 months; the difference observed at 12 months was not clinically meaningful at the minimal clinically important difference (MCID) level. These results showed that early and late rehabilitation provided similar contributions to shoulder function. The authors concluded that when planning rehabilitation, the balance between tendon healing and range of motion should be considered, and the protocol should be flexibly adjusted according to the patient's clinical goals.[17]

Li et al. [18] investigated the early clinical value of enhanced recovery after surgery (ERAS) combined with an interscalene brachial plexus block (ISB) for arthroscopic rotator cuff repair (ARCR). They included 240 patients who underwent arthroscopic rotator cuff repair and randomly divided them into three groups. Groups A, B, and C were defined as surgery alone, surgery+ERAS, and ISB+surgery+ERAS, respectively. They analyzed the clinical data and postoperative indicators of the three patient groups and evaluated the early clinical effects of the ISB and ERAS protocols after ARCR. Baseline characteristics were similar between the groups. The ISB+ERAS group showed lower pain scores and shorter hospital stays during the first 24 hours after surgery. In addition, Constant-Murley and UCLA scores were higher at 6 weeks and 3 months in the groups receiving ERAS, and joint swelling was less pronounced. The incidence of postoperative stiffness did not differ between the groups. These results suggest that the ERAS protocol supports pain control and early functional recovery, while ISB provides additional benefits in pain management but does not offer additional advantages in terms of functional outcomes and complications.[18]

In our study, all patients received standard postoperative rehabilitation consisting of passive and active shoulder movements. No differences in rehabilitation protocols were applied between the groups; therefore, no rehabilitation-related differences were observed between the groups.

Sun et al. [19] evaluated whether acromioplasty provides additional clinical benefits in the arthroscopic repair of full-thickness rotator cuff tears in their meta-analysis. Five randomized studies involving a total of 465 patients were examined. No significant differences were found between the groups that underwent acromioplasty and those that did not in terms of ASES, Constant-Murley, and UCLA scores. Pain scores and reoperation rates were also similar between the two groups. These findings suggest that acromioplasty does not provide any additional advantage in terms of functional outcomes or pain in the short term.[19]

In our study, acromioplasty was routinely performed arthroscopically through the lateral portal in every patient.

Gu et al. [20] conducted a meta-analysis comparing the clinical outcomes of single-row (SR) and double-row (DR) repairs in rotator cuff injuries with different tear sizes. Data from 10 clinical studies showed that the DR technique generally provided better elevation ROM and a lower re-tear rate. There was no significant difference in clinical outcomes between SR and DR repairs for small tears (<3 cm). In contrast, for large tears (≥3 cm), DR repair was superior to SR repair in terms of ASES and UCLA scores. These findings suggest that the DR technique may be more advantageous in terms of functional outcomes and structural integrity, particularly for large tears.[20]

Núñez et al. [21] conducted a systematic review comparing the clinical outcomes of double-row and single-row techniques in arthroscopic rotator cuff repair. No demographic differences were found between the two groups in the 13 randomized studies included. The findings showed that the double-row technique was superior to the single-row technique in terms of UCLA scores. No significant differences were found in Constant-Murley and ASES scores. However, a higher tendon healing rate and a lower risk of re-tearing were observed with the double-row technique. These results support the notion that double-row repair may offer advantages in terms of structural healing and specific functional measurements.[21]

In our study, both single-row and double-row repair techniques were used, and no significant differences were observed between the techniques in terms of ROM values, VAS, CMS, ASES, and UCLA scores.

In our study, the intraoperative effects of peripheral nerve block methods and general anesthesia, postoperative vital signs, and biochemical marker monitoring were not evaluated. Only a single-dose interscalene block was used among the peripheral nerve block methods. This method was compared with general anesthesia during postoperative follow-up in terms of functional shoulder scores, pain scales, and joint range of motion in the short and medium term (at the 6- and 18-month follow-ups).

Limitation

The limitations of our study include the small number of patients, the limited follow-up period of 18 months, and the use of only a single-dose interscalene block among peripheral nerve block anesthesia techniques. It is anticipated that a larger number of patients and a longer postoperative follow-up period may reveal changes in functional scores, pain scores, and shoulder joint range of motion.

Conclusion

At 6 months postoperatively, functional shoulder scores (Constant-Murley, ASES, and UCLA scores) were better in the group that received interscalene block anesthesia than in the group that received general anesthesia, whereas at 18 months postoperatively, there was no difference between the two groups. There was no difference between the two groups in shoulder joint movements (flexion, abduction, internal rotation, and external rotation) or VAS scores at either 6 or 18 months postoperatively.

In patients who underwent ISB, the need for NSAIDs and opioid analgesics for postoperative pain management was lower, whereas it was higher in the GA group. Our study yielded results consistent with the literature, showing that peripheral nerve blocks contributed more to postoperative pain management and early rehabilitation.

Our study included only patients who underwent arthroscopic repair of crescent-shaped tears. Shoulder functional scores and range of motion were compared between general anesthesia and single-dose interscalene brachial plexus block anesthesia using different variables. It is anticipated that our results may differ when compared with those obtained using different peripheral nerve blocks, larger patient populations, different tear types and repair methods, and longer follow-up periods.

Disclosure

Ethics Committee Approval: This study was approved by The Scientific Research Ethics Committee of Balıkesir Atatürk City Hospital on 19.06.2025, with decision no. 2025/06/60.

Informed Consent: Written informed consents were obtained from patients who participated in this study.

Conflict of Interest: The authors declare that there is no conflict of interest.

Use of AI for Writing Assistance: The authors declared that artificial intelligence was not used in the study.

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Authorship Contributions: Concept – A.Ç., Ö.K., B.Y.; Design – A.Ç., Ö.K., B.Y.; Supervision – A.Ç., Ö.K., B.Y.; Resource – A.Ç., Ö.K., B.Y.; Materials – A.Ç., Ö.K., B.Y.; Data Collection and/or Processing – A.Ç., Ö.K., B.Y.; Analysis and/or Interpretation – A.Ç., Ö.K., B.Y.; Literature Search – A.Ç., Ö.K., B.Y.; Writing – A.Ç., Ö.K., B.Y.; Critical Reviews – A.Ç., Ö.K., B.Y.

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Assessment of Determinants Influencing Fall Risk Among Geriatric Patients

Geriatrik Hastalarda Düşme Riskini Etkileyen Faktörlerin Değerlendirilmesi

Elem Yorulmaz,[1] Berna Günay,[1] Nilgün Mesci,[1] Büşra Üstün,[2] Duygu Geler Külcü[1]

ABSTRACT

Objectives: Falls in geriatric populations may result in significant injury and subsequent functional decline, thereby diminishing overall quality of life. Therefore, accurate assessment of fall risk and comprehensive identification of contributing factors are of fundamental importance, particularly within geriatric populations.

Methods: Geriatric patients admitted to the inpatient Physical Therapy and Rehabilitation unit were enrolled in the study. Data were collected on patients' age, sex, height, weight, educational status, medications potentially associated with falls, and assistive devices used during ambulation. Cognitive function was evaluated using the Hodkinson Abbreviated Mental Test. All participants underwent assessment with the Functional Ambulation Category (FAC), the Berg Balance Scale (BBS), and the Falls Efficacy Scale (FES). Patients were additionally questioned regarding visual impairments, urinary symptoms, nutrition-related risk factors, psychological complaints, and environmental hazards in the home that might elevate fall risk. Observations were also made to identify risky behaviors during mobility and transfers. Participants were subsequently categorized into two groups based on their fall history, and differences in these variables were analyzed between the groups.

Results: A total of 54 patients aged 65 years and older were included in the study. Patients were categorized into two groups: fallers and non-fallers. A significant difference in the female-to-male ratio was observed between the two groups (p=0.002). While no significant differences were observed between the two groups in terms of age, height, weight, cognitive status, FAC, or FES scores, the faller group demonstrated significantly lower BBS scores and a higher frequency of mobility- and transfer-related risky behaviors (p=0.013, p=0.012).

Conclusion: This study found that fall risk in geriatric patients was significantly associated with reduced balance and risky behaviors during mobility and transfers. The results underscore the need for systematic fall-risk assessment, close supervision, and balance-focused interventions in inpatient rehabilitation to reduce falls and support prevention strategies after discharge.

Keywords: Aged; fall risk; postural balance.

ÖZET

Amaç: Geriatrik popülasyonda görülen düşmeler, ciddi yaralanmalara ve buna bağlı fonksiyonel kayba yol açarak yaşam kalitesini belirgin biçimde azaltabilir. Bu nedenle, düşme riskinin doğru şekilde değerlendirilmesi ve katkıda bulunan faktörlerin kapsamlı biçimde belirlenmesi, özellikle geriatrik hastalarda temel bir gerekliliktir.

Yöntem: Fizik Tedavi ve Rehabilitasyon servisine yatırılan geriatri hastaları çalışmaya dâhil edildi. Hastaların yaşı, cinsiyeti, boyu, kilosu, eğitim durumu, düşme ile ilişkili olabilecek ilaç kullanımı ve yürüme sırasında kullanılan yardımcı cihazlara ilişkin veriler kaydedildi. Kognitif durum, Hodkinson Kısaltılmış Mental Testi ile değerlendirildi. Tüm katılımcılara Fonksiyonel Ambulasyon Skalası (FAS), Berg Denge Ölçeği (BDÖ) ve Düşme Etkililiği Ölçeği (DEÖ) uygulandı. Ayrıca hastalarda görme problemleri, üriner semptomlar, beslenmeye dayalı risk faktörleri, psikolojik yakınmalar ve ev içi çevresel tehlikeler sorgulandı. Mobilite ve transfer sırasında gözlemlenen riskli davranışlar da kaydedildi. Hastalar düşme öyküsü varlığına göre iki gruba ayrıldı ve değişkenler arasındaki farklar gruplar arasında karşılaştırıldı.

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Bulgular: Çalışmaya 65 yaş ve üzeri toplam 54 hasta dâhil edildi. Hastalar düşen ve düşmeyen olmak üzere iki gruba ayrıldı. Cinsiyet dağılımı açısından gruplar arasında anlamlı bir fark bulundu (p=0,002). Yaş, boy, kilo, kognitif durum, FAS ve DEÖ skorları açısından gruplar arasında anlamlı bir fark bulunmazken, düşen grupta BDÖ skorlarının belirgin şekilde daha düşük olduğu ve mobilite ile transfer sırasında riskli davranışların daha sık görüldüğü saptandı (p=0,013, p=0,012).

Sonuç: Çalışmada, geriatri hastalarında düşme riskinin azalmış denge ile mobilite ve transfer sırasında ortaya çıkan riskli davranışlarla anlamlı düzeyde ilişkili olduğu gösterilmiştir. Bulgular, yatırılarak rehabilitasyon uygulanan hastalarda sistematik düşme risk değerlendirmesinin, yakın gözlemin ve denge odaklı müdahalelerin düşme riskinin azaltılmasında ve taburculuk sonrası korunma stratejilerinin desteklenmesinde kritik önem taşıdığını ortaya koymaktadır.

Anahtar sözcükler: Düşme riski; postural denge; yaşlı.

Falls are among the most common and preventable causes of morbidity, mortality, and loss of independence in older adults, and with increasing life expectancy worldwide, the incidence of falls has risen in the population aged 65 years and older.[1,2] Epidemiological studies report that 25–35% of individuals over the age of 65 experience at least one fall each year, and approximately 10% of these falls result in injury.[3] Serious consequences of falls include fractures, traumatic brain injuries, hip fractures, prolonged bed rest, functional decline, and mortality.[4] It has been reported that one in every five falls in older adults results in a fracture or head trauma.[1] Furthermore, fall-related mortality rates have increased dramatically over the years, and the Centers for Disease Control and Prevention (CDC) reports that in the United States, an older adult dies from a fall every 20 minutes.[1,5] In addition to these severe health consequences, healthcare costs associated with falls are also rising globally.[6]

An increase in fall risk is multifactorial, and individual factors such as balance impairments, visual and vestibular system problems, reduced proprioceptive sensitivity, decreased muscle strength, neuropathy, and cognitive slowing contribute to heightened susceptibility to falls.[2,7] Among environmental factors, the home setting constitutes the most critical component. Approximately 79% of falls occur within the home environment, with bedrooms, staircases, and bathrooms reported as the most frequent locations.[6] The WHO report emphasizes that slippery floors, inadequate lighting, cluttered household arrangements, loose rug edges, and structural inadequacies in stairways all increase fall risk.[2] In older adults, delayed motor responses further impair the postural corrective actions required to prevent a fall, thereby increasing the likelihood of falling.[1]

Recent systematic reviews and meta-analyses have shown that factors such as sarcopenia, mobility limitations, depression, polypharmacy, the use of antihypertensive or psychotropic medications, sleep disorders, and reduced gait speed significantly increase fall risk.[3,6] Sarcopenia, in particular, has been reported to both elevate fall risk and influence the severity of fall-related injuries.[8] Weight loss, fatigue, low physical activity, slow walking speed, and reduced grip strength have also been defined as high-risk conditions for falls, disability, hospitalization, and mortality in older adults.[9] Risky behaviors during mobility and transfers—such as rushing, failing to use necessary assistive devices, incorrect use of equipment, or wearing inappropriate footwear—have likewise been associated with an increased likelihood of falling.[2,10]

Urinary incontinence and urgency symptoms are additional factors that heighten fall risk in older adults and have been linked to increased fall incidence in multiple studies.[11,12]

In addition to its physical consequences, fall-related psychosocial problems are also common among older adults. Fear of falling, social isolation, and activity restriction can lead to muscle strength loss, reduced physical activity, decreased quality of life, and depression, collectively creating a vicious cycle that further increases fall risk.[8,13] Community-based data indicate that among individuals aged 60 years and older, the prevalence of fear of falling is 69.2%, while fall-related activity restriction occurs in 38.4% of adults in this age group.[1]

Taken together, these findings indicate that falls represent a common, multifactorial, yet preventable public health concern among older adults. Therefore, accurate assessment of fall risk, comprehensive evaluation of multiple contributing factors, and the development of individualized, evidence-based interventions are critical to reducing fall frequency and minimizing fall-related adverse outcomes.[3] In this context, it is essential to identify the clinical, functional, psychosocial, and environmental factors that contribute to fall risk among community-dwelling older adults and to evaluate these factors within an integrated and holistic framework.[6]

This study aims to contribute to this field by evaluating the clinical, functional, psychosocial, and environmental risk factors described in the literature among older patients hospitalized in a physical medicine and rehabilitation (PM&R) clinic and by identifying the factors that increase fall risk in this population.

Methods

This study was conducted as a single-center, cross-sectional study in the PM&R inpatient unit of a tertiary care hospital. The study protocol was approved by the Haydarpaşa Numune Training and Research Hospital Clinical Research Ethics Committee (ethics approval number: HNEAH-KAEK 2021/97, date: March 15, 2021), and all procedures were carried out in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants.

The inclusion criteria were being over 65 years of age, having received the diagnosis that led to hospitalization in the PM&R clinic at least one year prior, having a Functional Ambulation Category (FAC) level of at least 3, being able to ambulate independently despite the need for an assistive device, being able to follow commands, communicate verbally, and having no language or speech impairments that would interfere with understanding or responding to the assessment questions. Exclusion criteria included impaired speech or comprehension, the presence of limb amputation, and being classified as FAC level 1 or 2.

A total of 54 patients aged 65 years and older who were hospitalized with various diagnoses in the PM&R clinic between May 15 and August 15, 2021, were included in the study. All assessments were performed by the same clinician.

Demographic data, including age, sex, height, weight, and educational status, as well as the diagnosis leading to hospitalization and the use of assistive devices for ambulation, were recorded. In addition, medical treatments that could potentially be related to fall risk (hypnotic–sedative medications, drugs used for Parkinson's disease, diuretics, antihypertensives, and antidepressants) were reviewed, and the number of medications used from this group was documented.

Conditions known to be part of the fall etiology in the literature, as well as those considered potentially related to falls based on our clinical experience, were questioned in each patient, and responses were recorded as "present/absent." These included visual impairments that may cause difficulty in seeing objects or navigating the environment, nutrition-related risks such as weight loss and loss of appetite, the presence of urgency, nocturia, or urinary incontinence, and environmental hazards in the home or living area that may contribute to falls, such as inappropriate rugs, inadequate lighting, or slippery floors.

In addition, the presence of depressive or anxious psychological complaints was assessed in each patient and recorded as "none/mild/moderate/severe" in terms of their impact on activities of daily living.

Patients were evaluated by the clinician for the presence or absence of risky behaviors during mobility and transfers. For the assessment of transfers, patients were asked to perform actions such as moving from the bed to a chair and from the chair back to the bed, involving coordinated movements between surfaces of different heights. Mobility was assessed by asking the patient to walk a predetermined distance within the clinic corridor. During these activities, behaviors such as rushing, not using the assistive device required for ambulation, or wearing shoes improperly were recorded as the presence of a risky behavior during the corresponding activity.

Patients' ambulation status was assessed using the FAC, which is an ordinal clinical tool used to classify ambulatory capacity on a 0–5 scale, where higher scores indicate greater independence. The scale reflects the level of assistance required during ambulation, ranging from non-functional walking (score 0) to fully independent community ambulation (score 5).[14]

Balance was assessed using the Berg Balance Scale (BBS),[15] a 14-item performance-based measure evaluating static and dynamic balance. Each item is scored on a 0–4 scale, yielding a total score ranging from 0 to 56, with higher scores indicating better balance performance. The Turkish version of the BBS has been culturally adapted and shown to be valid and reliable in patients with stroke.[16]

Fear of falling was assessed using the Falls Efficacy Scale (FES), developed by Tinetti and colleagues.[17] The FES consists of 10 items, each scored on a 1–10 scale, yielding a total score ranging from 10 to 100, with higher scores indicating greater fear of falling.

Cognitive status was assessed using the Hodkinson Abbreviated Mental Test Score (AMTS).[18] The AMTS consists of

10 items evaluating orientation, short-term memory, and attention. Each correct answer is scored as 1 point, yielding a total score between 0 and 10, with lower scores indicating greater cognitive impairment. Patients with AMTS scores of 9–10 were considered cognitively intact, scores of 7–8 were classified as mildly impaired, scores of 5–6 as moderately impaired, and scores of 4 or below as severely impaired.

Patients were divided into two groups—fallers (n=27) and non-fallers (n=27)—based on their history of falls within the past year, and differences between the groups regarding these factors were evaluated. Demographic data, diagnoses, and functional assessment results were recorded.

Statistical Analysis

The statistical analysis of the study data was performed using SPSS Statistics version 21 software (IBM Corp., NY, USA). The normality of data distribution was assessed with the Shapiro–Wilk test. Since the data did not follow a normal distribution, descriptive statistics were presented as median (minimum–maximum) values for continuous variables and as numbers and percentages (%) for categorical variables. For comparisons between groups, the Chi-square (χ^2) test was used for categorical variables, and the Mann–Whitney U test was used for continuous variables. Correlation analysis was conducted using Spearman's rank correlation coefficient (Spearman's rho) to evaluate the relationships between variables. A p-value of <0.05 was considered statistically significant.

Results

A total of 54 patients aged over 65 years were included in the study. While half of the patients (n=27) had no previous history of falling, the other half had experienced at least one fall. Study data were analyzed by comparing the non-faller and faller groups.

Demographic Findings

There were no statistically significant differences between the two groups in terms of age, height, weight, or educational status (p>0.05). However, gender distribution differed significantly; whereas all patients in the non-faller group were women, the proportion of men in the faller group was 29.6% (p=0.002) (Table 1).

Clinical and Functional Assessment Findings

The comparison of clinical and functional variables between the groups is presented in Table 2. No significant differences were found between the faller and non-faller groups regarding assistive device use, presence of neurological diagnosis, medication use, psychological status, cognitive status (AMTS), FAC scores, FES scores, visual status, environmental risk factors, nutrition-related risks, or urinary incontinence (p>0.05). In contrast, BBS scores were significantly lower in the faller group (p=0.003). Risky behaviors during mobility and transfers were also observed significantly more frequently in the faller group (p=0.013 and p=0.012, respectively).

Relationships Between Variables

When the relationships between variables were examined (Table 3), a moderate and negative correlation was found between assistive device use and balance performance (r=−0.458, p<0.001). Balance scores (BBS) showed a strong negative correlation with fear of falling (FES) (r=−0.495, p<0.001) and a positive correlation with functional am-bulation level (FAC) (r=0.307, p=0.024). BBS also demonstrated a weak but significant correlation with nutrition-re-lated risks (r=0.304, p=0.025) and with gender (r=−0.298, p=0.028). Assistive device use was additionally correlated with FAC (r=−0.395, p=0.003)

Table 1. Demographic characteristics according to fall status

Variable	Non-fallers (n=27)	Fallers (n=27)	p
Age (years)	(62-81) (71)	(60-85) (73)	0.972*
Sex n (%)	Female: 27 (100%) Male: 0 (0%)	Female: 19 (70.4%) Male: 8 (29.6%)	**0.002****
height (cm)	(146-166) (155)	(148-185) (158)	0.111*
weight (kg)	(58-100) (79)	(52-130) (80)	0.782*
Educational status n(%)	Illiterate: 3 (11.1%) Primary school: 22 (81.5%) Secondary school: 2 (7.4%)	Illiterate: 4 (14.8%) Primary school: 18 (66.7%) Secondary school: 2 (7.4%) University: 3 (11.1%)	0.315**

*:Mann–Whitney U test **: Chi-square (χ^2) test

Table 2. Clinical and functional assessments

Variable	Non-fallers n (%)	Fallers n (%)	p
Assistive device use	None: 20 (74.1%) / Single: 7 (25.9%)	None: 15 (55.6%) / Single: 9 (33.3%) / Double: 1 (3.7%) / Walker: 2 (7.4%)	0.265**
Neurological diagnosis	Yes: 2 / No: 25	Yes: 7 / No: 20	0.068**
Medication use	None: 4 (14.8%) / 1 medication: 11 (40.7%) / 2 medications: 12 (44.4%)	None: 6 (22.2%) / 1 medication: 10 (37.0%) / 2 medications: 10 (37.0%) / ≥2 medications: 1 (3.7%)	0.653**
Psychological status	None: 13 (48.1%) / Mild: 14 (51.9%)	None: 11 (40.7%) / Mild: 14 (51.9%) / Moderate: 2 (7.4%)	0.338**
Cognitive status (AMTS)	Intact: 13 (48.1%) / Mild: 10 (37.0%) / Moderate: 4 (14.8%)	Intact: 16 (59.3%) / Mild: 7 (25.9%) / Moderate: 4 (14.8%)	0.657**
FAC	(4–5) (5)	(3–5) (5)	0.123*
FES	(10–69) (31)	(6–81) (39)	0.386*
BBS	(27–51) (44)	(24–49) (39)	**0.003***
Vision	Present: 4 (14.8%) / Absent: 23 (85.2%)	Present: 4 (14.8%) / Absent: 23 (85.2%)	1.000**
Mobility	Risky: 7 (25.9%) / Safe: 20 (74.1%)	Risky: 16 (59.3%) / Safe: 11 (40.7%)	**0.013****
Transfers	Risky: 6 (22.2%) / Safe: 21 (77.8%)	Risky: 15 (55.6%) / Safe: 12 (44.4%)	**0.012****
Environment	Risky: 3 (11.1%) / Safe: 24 (88.9%)	Risky: 1 (3.7%) / Safe: 26 (96.3%)	0.299**
Nutrition risk	No risk: 27 (100%)	Risk: 3 (11.1%) / No risk: 24 (88.9%)	0.075**
Incontinence	Present: 23 (85.2%) / Absent: 4 (14.8%)	Present: 22 (81.5%) / Absent: 5 (18.5%)	0.715**

*:Mann–Whitney U test **: Chi-square (χ^2) test, AMTS: Hodkinson Abbreviated Mental Test Score; FAC: Functional Ambulation category; FES: Falls Efficacy scale; BBS: Berg Balance scale.

A strong positive correlation was found between risky behavior during transfers and risky behavior during mobility (r=0.696, p<0.001). Cognitive status showed a weak negative correlation with risky behavior during transfers (r=−0.303, p=0.026), while the presence of a neurological diagnosis was positively correlated with risky behavior during mobility (r=0.273, p=0.046).

When variables associated with falls were examined, gender was positively correlated with falling (r=0.417, p=0.002). In addition, a history of falling was significantly negatively correlated with balance scores (r=−0.404, p=0.002) and positively correlated with risky behavior during transfers (r=0.342, p=0.011) and mobility (r=0.337, p=0.013). Gender was also negatively correlated with medication use (r=−0.332, p=0.014). Finally, there was a weak but significant negative correlation between BMI and incontinence (r=−0.312, p=0.021).

Distribution of Diagnoses

The distribution of PM&R diagnoses according to fall history is presented in Table 4. The most common diagnosis in both groups was lumbar disc herniation (LDH), observed in equal numbers in the non-faller and faller groups (n=9 each). Gonarthrosis was present in 4 patients in the non-faller group and 3 patients in the faller group. Hemiplegia was more frequently observed in the faller group (n=4 vs. n=1). Impingement was identified only in the non-faller group (n=3), whereas brachial plexus injury and radius fracture were found exclusively in the faller group (n=1 each). Lumbar spondylosis was detected in five non-fallers and three fallers, while operated LDH occurred only in the faller group (n=2). Less common diagnoses in the non-faller and faller groups, respectively, were paraplegia (n=1, n=2), subdural hematoma (SDH) (n=1, n=1), and spinal stenosis (n=1, n=1).

Regarding the distribution of PM&R diagnoses by sex, LDH was observed in 16 women, lumbar spondylosis in 8, gonarthrosis in 5, hemiplegia in 4, and impingement in 3 patients. Additionally, paraplegia and spinal stenosis were each present in 2 women, and 1 patient each had knee arthroplasty, hip arthroplasty, brachial plexus injury, operated LDH, SDH, and radius fracture. Among men (n=8), the distribution was as follows: gonarthrosis (n=2), LDH (n=2), hemiplegia (n=1), operated LDH (n=1), paraplegia (n=1), and SDH (n=1).

The distribution of neurological diagnoses by sex is presented in Table 5. Neurological diagnoses were present in 15.2% of women and 25% of men.

Table 3. Correlation table (only statistically significant variables are listed)

Variable 1	Variable 2	R	p***
Assistive device use	BBS	−0.458	**<0.0001**
BBS	FES	−0.495	**<0.0001**
Risky behavior during transfers	Risky behavior during mobility	0.696	**<0.0001**
Sex	Falls	0.417	**0.002**
BBS	Falls	−0.404	**0.002**
Assistive device use	FAC	−0.395	**0.003**
Assistive device use	FES	0.368	**0.006**
Falls	Risky behavior during transfers	0.342	**0.011**
Falls	Risky behavior during mobility	0.337	**0.013**
Sex	Medication use	−0.332	**0.014**
BMI	Incontinence	−0.312	**0.021**
FAC	BBS	0.307	**0.024**
BBS	Nutrition risk	0.304	**0.025**
Cognitive status	Transfers	-0.303	**0.026**
Sex	BBS	−0.298	**0.028**
Neurological diagnosis	Mobility	0.273	**0.046**

***: Spearman's rank correlation test. BBS: Berg Balance scale; FES: Falls Efficacy scale; FAC: Functional Ambulation category; BMI: body mass index.

Table 4. Distribution of rehabilitation-related diagnoses according to fall history

Diagnosis	Non-fallers (n=27)	Fallers (n=27)	Total
Knee arthroplasty	1	0	1
Hip arthroplasty	1	0	1
Brachial plexus injury	0	1	1
Gonarthrosis	4	3	7
Hemiplegia	1	4	5
Impingement syndrome	3	0	3
Lumbar disc herniation	9	9	18
Lumbar spondylosis	5	3	8
Operated LDH	0	2	2
Paraplegia	1	2	3
Radius fracture	0	1	1
Subdural hematoma	1	1	2
Spinal stenosis	1	1	2
Total	27	27	54

Table 5. Distribution of neurological diagnoses by gender

Neurological diagnosis	Female (n=46)	Male (n=8)	Total
Absent	39	6	45
Present	7	2	9
Total	46	8	54

Discussion

This study examined clinical, functional, cognitive, and behavioral variables that may contribute to fall risk in geriatric patients, identifying several distinctions between fallers and non-fallers. The principal finding of this study is that individuals classified as fallers—those who experienced at least one fall within the past year—demonstrated significantly poorer balance, as evidenced by lower balance assessment scores. This outcome underscores the central role of postural control in fall risk. In addition, unsafe mobility patterns and high-risk behaviors during transfers were more frequently observed among fallers compared with non-fallers. Collectively, these findings imply reduced self-efficacy, impaired gait stability, and deficits in executive functioning, all of which are critical components of fall mechanisms.

Recent systematic reviews emphasize that fall risk cannot be attributed to a single determinant; rather, it reflects the interplay of multiple factors, including musculoskeletal impairments, visual–vestibular dysfunctions, medication-related effects, and environmental conditions.[1,3,19] Nevertheless, numerous studies highlight the particularly crucial contribution of balance and gait disturbances with-

in the broader spectrum of fall-related risk factors. Postural control, a core physiological function that progressively declines with advancing age, has consistently been identified as a robust predictor of fall risk.[20] In alignment with this evidence, Colón and Emeric[1] identified balance deficits, impaired proprioception, and mobility limitations as critical intrinsic contributors to fall susceptibility. Furthermore, meta-analytic findings indicate that balance-focused exercise interventions substantially reduce fall risk, demonstrating more pronounced effects than other exercise modalities.[3,19,21] These findings indicate that, despite the multifactorial etiology of falls, balance impairments constitute a central target for intervention. Consistent with the prevailing evidence in the literature, the results of the present study suggest that the factors most strongly associated with fall risk are balance dysfunction, risky behaviors during mobility, and transfers.

Our study differs from most investigations of fall risk factors in geriatric populations by including a heterogeneous cohort of patients with both neurological and musculoskeletal diagnoses. We observed that patients with neurological disorders and those with a history of vertebral surgery were more likely to belong to the faller group. The increased fall risk in these patients is likely attributable to balance and gait disturbances. Consistent with our findings, the literature reports that the incidence of falls is approximately three times higher in patients with mild to moderate neurological disorders compared with those without any neurological symptoms or signs.[22] Factors contributing to falls in this population have been reported to include behavioral determinants, such as inattention, fear of falling, and improper use of assistive devices, and environmental factors, as well as biological determinants, including impaired balance, muscle weakness, spasticity, and muscle spasms.[23] The absence of a significant relationship between environmental factors and fall risk in our study may be attributable to the reliance on patient self-reports. Participants may have had difficulty recalling or recognizing the relevance of environmental hazards, such as slippery carpets, inadequate lighting, or wet floors.

Contrary to most reports in the literature, our study did not identify significant associations between age, female gender, or body mass index and fall risk.[21,24–26] Conversely, male gender has been reported as a factor associated with increased fall risk. This discrepancy may be attributable to the relatively small sample size of our study, almost similar values in mean age and weight between study groups, and the proportionally higher prevalence of diagnoses potentially linked to falls within the male subgroup. Although limited, similar patterns regarding the relationship between fall risk and gender have been documented in previous research. For instance, Jehu et al.[27] reported that men experience falls more frequently than women in their prospective cohort study, attributing this difference to factors such as reduced cognitive function, impaired judgment during movement, or slower decision-making processes in men. Additionally, Gale et al.[28] reported that pain and balance impairments are more potent predictors of fall risk in men compared with women. The higher prevalence of male participants and balance deficits within the faller group in our study aligns with this observation. Furthermore, correlation analyses revealed that male gender was associated with polypharmacy and lower balance scores, which may help to explain the elevated fall risk observed among men in our study population.

Functional mobility assessments and gait parameters represent key determinants of fall risk in older adults. In their meta-analysis, Lusardi et al.[29] recommended the integrated use of performance-based measures evaluating both balance and mobility to more accurately assess fall risk. Furthermore, they noted that the inclusion of self-reported indicators of depression and fear of falling alongside objective performance measures offers a more thorough and reliable method for predicting fall risk. More recently, Intaruk et al.[30] evaluated the reliability and minimal detectable change of four commonly used functional assessments—the 10-meter walk test, the timed up-and-go test, the five-times sit-to-stand test, and the 6-minute walk test—in community-dwelling older adults at high risk of falling. They concluded that each of these assessments reflects different aspects of fall risk, providing clinicians with valuable information for evaluating and monitoring the efficacy of fall prevention interventions. Although our study did not employ these specific tests, significant correlations observed between the Functional Ambulation Scale, Berg Balance Scale scores, and the use of assistive devices further support the essential role of functional mobility in fall risk determination.

Cognitive impairment has also emerged as a significant factor associated with fall risk. It has been shown that older adults with cognitive deficits experience a higher incidence of falls compared with their cognitively intact peers, often accompanied by balance impairments and depressive symptoms.[31,32]

Furthermore, Liu et al.'s[33] meta-analysis highlighted that cognitive vulnerability substantially increases fall risk, particularly among individuals with diminished cognitive and physical reserves. The absence of a significant association between cognitive function and fall history in our study may be attributable to the fact that the cognitive status of the majority of participants was either intact or only mildly impaired. Nevertheless, the observed relationship between cognitive status and risky behaviors during mobility and transfers suggests that a more comprehensive and detailed assessment of cognitive function may be warranted.

Fear of falling has been recognized in the literature as an independent risk factor among older adults and has been reported to be as significant as a prior fall history in restricting activities of daily living.[25,34] Although no direct association between Falls Efficacy Scale scores and fall history was observed in our study, the significant correlations observed between Falls Efficacy Scale scores, assistive device use, and balance performance indicate that fear of falling is closely linked to functional mobility and postural control.

Another factor associated with fall risk in geriatric patients is nutritional status. Previous studies have reported an increased risk of falls among individuals who are malnourished or at nutritional risk.[35,36] Since the nutritional status of participants in our study was not assessed in detail, the relationship between nutrition and fall risk could not be established. Nevertheless, the observed associations between symptoms, such as loss of appetite and weight loss, and balance performance underscore the importance of comprehensive nutritional assessment in studies evaluating fall risk.

Other factors commonly associated with fall risk in geriatric populations, including polypharmacy, psychological status, visual impairments, and incontinence, were also assessed in our study; however, no significant differences were observed between fallers and non-fallers.[1,28] This finding may be attributable to the fact that psychological status, visual impairments, and incontinence were evaluated based on patient self-reports rather than objective measures. Our limitations related to medication use are that we only investigated medications associated with falls and that we evaluated patients using more than one medication together.

Our study is valuable in that it assessed fall-related factors in a heterogeneous cohort of patients with diverse diagnoses who were receiving inpatient care in the physical therapy and rehabilitation unit of a tertiary health center. Nevertheless, it has several limitations. Although a history of falls was assessed, the frequency of falls was not recorded. The cross-sectional design makes it difficult to establish a causal relationship between variables. The relatively small sample size and single-center setting may limit the generalizability of the findings. Certain important aspects, such as detailed strength assessments and gait analysis, were not directly measured. Additionally, the exclusive reliance on self-report measures to evaluate depression and other psychosocial factors may be considered another limitation.

Future studies with larger sample sizes and multicenter designs are warranted to longitudinally monitor the incidence of falls and associated risk factors, as well as to evaluate these factors using objective measures. Such research, in conjunction with findings from intervention studies targeting specific risk factors, will generate stronger evidence to inform clinical practice and contribute to the reduction of fall-related morbidity and mortality in older adults.

Conclusion

In our study, fall risk in geriatric patients was significantly associated with balance scores, risky behaviors observed during mobility, and transfers. Conducted in an inpatient physical therapy and rehabilitation unit, this study underscores the importance of systematically assessing fall risk in patients with diverse neuromusculoskeletal diagnoses. The findings highlight the need for close monitoring during ambulation and transfers, the provision of tailored recommendations to mitigate fall risk, and the incorporation of balance and coordination exercises as integral components of the treatment plan. Such an approach not only reduces the risk of falls during hospitalization but also offers a valuable opportunity to develop strategies aimed at preventing falls in daily life after discharge.

Disclosure

Ethics Committee Approval: This study was approved by the Haydarpaşa Numune Training and Research Hospital Clinical Research Ethics Committee (Decision no: HNEAH-KAEK 2021/97, date: 15.03.2021).

Informed Consent: Informed consent was obtained from all patients.

Conflict of Interest: The authors declare that they have no conflicts of interest.

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Performance of the 'Turkish Triage System' During the Covid-19 Pandemic

COVID-19 Pandemisinde 'Türk Triaj Sistemi'nin Performansı

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ABSTRACT

Objectives: In Türkiye, a triage system based on a 3-color code (red: very urgent, yellow: urgent, green: non-urgent) is mandatory in all public hospitals. This study aimed to analyze the triage codes assigned to confirmed COVID-19 patients according to their outcomes to test the reliability of the triage system. Our study provides data on our triage system, whose reliability has not been tested before.

Methods: Patients with positive PCR tests who were admitted to the emergency department between March 15 and December 31, 2020, were included in the study. Assigned triage codes and outcomes were analyzed retrospectively.

Results: Of the 7040 patients, 4176 (59.3%) were coded as 'green' and 333 (4.7%) were coded as 'red' at triage. The sensitivity of green triage for recovery was 60.29%, and the specificity was 78.78%. The sensitivity of red triage for critical outcomes and mortality was 57.14%, and the specificity was 96.59%. Being over 58 years old, regardless of gender, was a predictive factor for critical outcomes and mortality.

Conclusion: Based on this study, it is possible to state that the 'Turkish Triage System' is successful in recognizing patients in critical situations, but its performance in distinguishing cases with recovery is moderate in the COVID-19 patient group.

Keywords: COVID-19; emergency department; patient outcomes; triage; Turkish triage system.

ÖZET

Amaç: Türkiye'de, 3 renkli kodlamaya dayalı bir triaj sistemi (kırmızı: çok acil, sarı: acil, yeşil: acil değil) tüm kamu hastanelerinde zorunlu olarak kullanılmaktadır. Bu çalışma, triaj sisteminin güvenilirliğini test etmek amacıyla doğrulanmış COVID-19 hastalarına verilen triaj kodlarını hasta sonuçlarına göre analiz etmeyi hedeflemektedir. Çalışmamız, daha önce güvenilirliği değerlendirilmemiş olan triaj sistemimize ilişkin veriler sunmaktadır.

Yöntem: 15 Mart–31 Aralık 2020 tarihleri arasında acil servise başvuran ve PCR testi pozitif olan hastalar çalışmaya dâhil edildi. Verilen triaj kodları ve hasta sonuçları retrospektif olarak analiz edildi.

Bulgular: Toplam 7040 hastanın 4176'sı (%59,3) triajda "yeşil", 333'ü (%4,7) ise "kırmızı" olarak kodlandı. İyileşmeyi öngörmede yeşil triajın duyarlılığı %60,29, özgüllüğü ise %78,78 idi. Kritik sonuçları ve mortaliteyi öngörmede kırmızı triajın duyarlılığı %57,14, özgüllüğü ise %96,59 olarak bulundu. Cinsiyetten bağımsız olarak 58 yaşın üzerinde olmak, kritik sonuçlar ve mortalite için prediktif bir faktör olarak saptandı.

Sonuç: Bu çalışma ile "Türk Triaj Sistemi"nin kritik durumdaki hastaları tanımada başarılı olduğu; ancak COVID-19 hasta grubunda iyileşmeyle sonuçlanan olguları ayırt etmedeki performansının orta düzeyde olduğu söylenebilir.

Anahtar sözcükler: Acil Servis; COVID-19; hasta sonuçları; triaj; Türk triaj sistemi.

*This study was a thesis for graduation from Emergency Medicine Residency Program in University of Health Sciences Fatih Sultan Mehmet Training and Research Hospital.

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In emergency departments (EDs), different triage systems are used in different countries to determine the urgency of patients' conditions and their priority for examination. The Emergency Severity Index (ESI), Canadian Triage System, Manchester Triage System (MTS), and Australian Triage System (ATS) are examples of triage systems used worldwide.[1,2] Most of these systems determine the triage category using parameters such as the patient's symptoms and vital signs (blood pressure, temperature, heart rate, oxygen saturation, and respiratory rate [RR]) and the resources required to manage the patient.

In our country, triage practice became mandatory in EDs with the publication of the 'Communiqué on Implementation Procedures and Principles of Emergency Departments in Inpatient Health Facilities' by the Ministry of Health of the Turkish Government in 2009. In the specified triage system, patients are classified using three colour codes: red (very urgent), yellow (urgent), and green (less urgent), and each colour contains two subcategories.[3] This colour-coded triage system applied in our country is similar to the MTS in terms of the urgency represented by the colours and the ATS in terms of its categories.[4-6] The triage system that we use has not yet been named, so we will call it the 'Turkish Triage System' (TTS). We know of no published study on the reliability and validity of the triage system used in our country before or during the pandemic. Therefore, our study presents new data.

Due to the COVID-19 pandemic, EDs had to be physically reorganized to manage the burden of cases and isolate patients at risk of infection. The infection prevention and control recommendations of the World Health Organization emphasized that effective triage and isolation were needed to prevent unnecessary exposure of those at risk of contracting COVID-19.[7] In Türkiye, a guideline containing recommendations from the Scientific Advisory Board of our Ministry of Health is used for the management and treatment of COVID-19 patients, and it has been updated periodically with new scientific evidence. Unfortunately, while there was agreement on the isolation procedures, no specific system or procedure for the triage of patients was defined, even in the latest updates.[8,9]

During the pandemic, we applied a two-step triage system in the ED of our hospital. Suspected COVID-19 patients (based on respiratory symptoms, fever, and close contact with a person with confirmed COVID-19) were separated from other patients and later evaluated in an isolated area of the ED. Patients in both groups were then subjected to secondary triage and classified according to the standard colours (green, yellow, or red) of the TTS.

In this study, we conducted a retrospective analysis of the triage codes of patients with confirmed COVID-19 to evaluate the performance of the TTS in distinguishing COVID-19 patients at high risk of death from those who could be treated as outpatients. We investigated disease-related mortality, intubation, intensive care hospitalization within 30 days, and recovery from the disease. Additionally, the relationship between vital signs at admission and patient outcomes was evaluated.

Methods

Study Design

We conducted a retrospective cross-sectional data analysis. Triage is conducted by two experienced nurses in the ED. One obtains information about the patient's symptoms and medical history and enters the data electronically, while the other measures the patient's vital signs. Triage nurses are selected from among nurses with at least two years of ED experience and are trained annually using simulation scenarios.

During the pandemic, patients with possible COVID-19 were isolated from other patients, and secondary triage was applied to both groups. The Glasgow Coma Score (GCS), blood pressure (BP), pulse, oxygen saturation, respiratory rate (RR), and temperature of each patient with possible COVID-19 were recorded. Patients with possible COVID-19 who had a history of COVID-19 contact and/or symptoms highly suggestive of COVID-19 infection, such as cough, shortness of breath, and fever, and who had stable vital signs were classified at the 'green' triage level and evaluated in the pandemic outpatient clinic. The remaining patients were coded as 'yellow' or 'red' triage levels according to the triage system criteria and were examined and treated separately in the appropriate areas.[5] The triage forms recorded in the hospital's automated system were examined retrospectively.

Settings and Participants

Our hospital is a training and research hospital located in Istanbul, the city with the highest number of COVID-19 cases in Türkiye. The hospital has a tertiary ED with an average of 270,000 patient admissions annually before the pandemic. During the pandemic, the number of emergency department admissions sometimes increased three- or four-fold.

Patients who were admitted to the ED of Fatih Sultan Mehmet Training and Research Hospital between 15 March and 31 December 2020 were identified through the General Directorate of Public Health Laboratory Information Management System, in which nationwide COVID-19 polymerase chain reaction (PCR) results were recorded.

COVID-19 PCR-positive patients were evaluated retrospectively in the study. Patients who visited the ED for screening tests only and were not admitted through the emergency triage department, as well as those who underwent repeated tests during hospitalization, were excluded from the study.

Outcome Measurements

Intubation and intensive care admission were considered critical outcomes. Triage systems are primarily designed to identify or safely exclude patients with critical illness rather than to predict recovery. At times when there are excessive numbers of patient admissions, it is important to identify patients who will not require immediate ED evaluation, as well as critically ill patients and those at risk of mortality. Therefore, we focused on red and green codes. Patient outcomes were also obtained from digital records. Each patient was counted once, even if the patient died after being intubated and hospitalized in the intensive care unit because of COVID-19 within 30 days. Information that was not available in hospital records was obtained from the patients or their relatives by phone.

Mortality information was obtained using the Death Notification System or by phone. The relationship between the triage codes assigned to patients and the outcomes was statistically analysed.

Statistical Analysis

IBM SPSS Statistics 22 (IBM SPSS, Türkiye) and MedCalc version 23.5.2 (MedCalc Software Ltd) were used for statistical analysis. The Shapiro–Wilk test indicated that the data did not conform to a normal distribution ($p<0.05$). In addition to descriptive statistical methods (mean, standard deviation, and frequency), the Mann–Whitney U test was used to compare quantitative data between the two groups. The chi-square test was used to compare qualitative data. We considered $p<0.05$ to indicate statistical significance. In addition, specificity and sensitivity analyses were conducted using cross-tabulation. Receiver operating characteristic (ROC) curve analyses were performed to determine the efficacy of age and vital signs in predicting critical outcomes and mortality.

This study was conducted in accordance with the principles of the Declaration of Helsinki. The study was approved by the Istanbul Fatih Sultan Mehmet Training and Research Hospital Clinical Research Ethics Committee (Date: 11.06.2020, Decision no: 2020/11). Owing to the retrospective design of the study, the requirement for informed consent was waived by the Ethics Committee.

Results

A total of 7040 patients with positive COVID-19 PCR tests were included in the study. Of them, 3784 (53.8%) were male and 3256 (46.2%) were female. The patients' ages ranged from 1 to 99 years (median age, 41 years), with a mean age of 41.94±15.28 years. Figure 1 depicts a flowchart of the study.

There was a statistically significant difference between the mean ages of patients with different outcomes; the mean

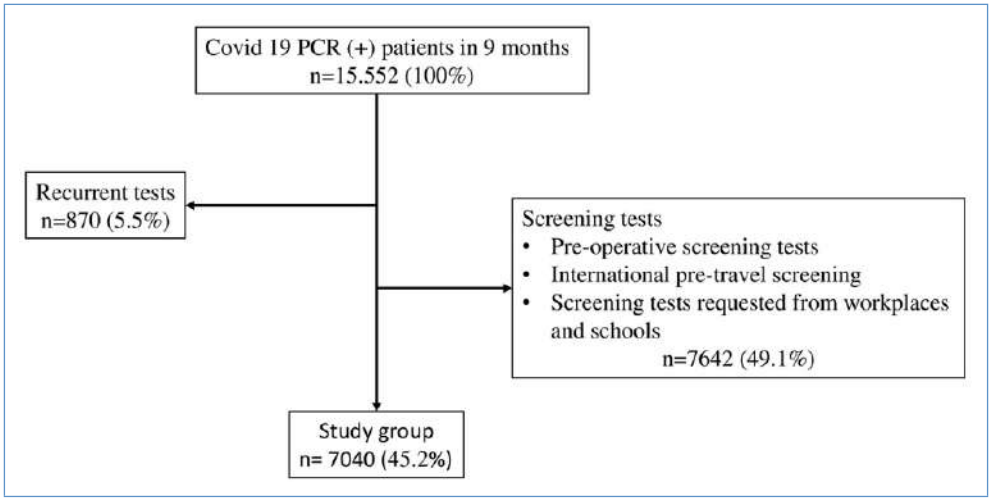

Figure 1. Flow chart of the study.

Table 1. ROC Curve Analyses of Vital Parameters

Parameter	Area Under Curve (%95 CI)	Cut-off Value	Sensitivity	Specificity	p
Age (year)	0.922 (0.916–0.929)	>58	82.9	87.7	<0.0001
Temperature (^{0}C)	0.642 (0.631-0.653)	>36,6	50.3	72.7	<0.0001
Heart Rate (beats/min)	0.540 (0.528–0.552)	>88	68.6	40.9	0.067
SBP (mmHg)	0.634 (0.622–0.645)	>135	44	81.5	<0.0001
DBP (mmHg)	0.504 (0.492–0.516)	≤60	15.4	91.7	0.8651
Oxygen Saturation (%)	0.824 (0.815–0.833)	≤96	74.2	76.1	<0.0001
Respiratory Rate (breaths/min)	0.626 (0.615–0.638)	>20	28.6	99.1	<0.0001

age of patients who died (73.61±13.12 years) was significantly higher than that of those who were discharged and recovered (41.36±14.69 years) (p<0.001). No statistically significant effect of gender on outcome was found (p=0.886).

We also investigated vital signs at the time of triage. Fever, systolic blood pressure (SBP), and RR were significantly higher in patients with critical outcomes and mortality than in those who were discharged and recovered (p<0.001), whereas GCS and oxygen saturation were significantly lower (p<0.001). The cut-off values calculated for age and oxygen saturation were statistically significant. However, the cut-off determined for oxygen saturation, ≤96%, was not considered clinically significant. The cut-off for age, >58 years, might be both clinically and statistically significant. Table 1 shows the results of the ROC curve analyses performed to determine the efficacy of age and vital signs in predicting critical outcomes and mortality.

Of the 7040 patients, 4176 (59.3%) were coded as 'green' and 333 (4.7%) were coded as 'red' at the time of triage. Patients were evaluated according to their final outcomes. The distributions of the patients and the final outcomes evaluated are summarized in Table 2. Table 3 shows comparisons of outcomes according to triage codes.

The sensitivity of the green triage code for recovery was 60.29% (95% CI: 59.12–61.45%), and the specificity was 78.78% (95% CI: 72.05–84.66%). Importantly, the negative predictive value of the green triage code for 'critical outcomes and mortality' was 0.95 (95% CI: 0.947–0.954), indicating that the green code was effective in safely excluding critical illness. The positive predictive value of the green triage code for recovery was 0.975 (95% CI: 0.971–0.978), and the positive likelihood ratio was 2.85 (95% CI: 2.14–3.80). The negative likelihood ratio was 1.99 (95% CI: 1.83–2.16).

Table 2. Distribution of the patients and final outcomes

	n	%
Triage		
Green	4176	59.3
Yellow	2531	36.0
Red	333	4.7
Ward admission		
Yes	798	11.3
No	6242	88.7
ICU admission		
Yes	152	2.2
No	6888	97.8
Intubation		
Yes	100	1.4
No	6940	98.6
Exitus		
Yes	127	1.8
No	6913	98.2
Outcome		
Critical outcome and mortality	175	2.4
Recovery	6865	97.5
Total	7040	100.0

Table 3. Comparison of the outcome against triage

Triage Code		Outcome: Critical outcome and mortality (n=175)	Outcome: Recovery (n=6865)	Total	p
Green	n (%)	37 (0.8)	4139 (99.1)	4176 (100)	<0.0001
Yellow	n (%)	39 (1.5)	2492 (98.4)	2531 (100)	
Red	n (%)	99 (29.7)	234 (70.2)	333 (100)	
Total	n (%)	175 (2.4)	6865 (97.5)	7040 (100)	

The sensitivity of the red triage code for 'critical outcomes and mortality' was 56.57% (95% CI: 48.88–64.03%), and the specificity was 96.59% (95% CI: 96.14–97.01%). The positive likelihood ratio was 16.60 (95% CI: 13.85–19.89).

The sensitivity of the red triage code for 'critical outcomes and mortality' in the ED was 92.00% (95% CI: 73.97–99.02%), and the specificity was 95.57% (95% CI: 95.06–96.04%). The positive likelihood ratio was 20.75 (95% CI: 17.71–24.32) (Table 1).

Discussion

The increase in the number of COVID-19 cases placed a significant strain on healthcare systems worldwide. One of the most important issues was the management of COVID-19 patients who were admitted to the ED. Experts from many different healthcare centres have shared their experiences with ED organization.[10-12] However, to our knowledge, no published studies have validated the performance of various pre-pandemic ED triage systems used during the pandemic. Additionally, the TTS had not been validated, even before the pandemic, although it has been used nationwide since 2009. We compared our results with those of performance studies of other triage systems conducted before the pandemic. Therefore, our study presents new data.

As a result of the healthcare system implemented in our country, daily ED admissions are approximately 1000 patients in almost every hospital, and this number occasionally reaches 1500–2000 in many hospitals. In Türkiye, patients who are not experiencing an emergency can easily be admitted to any level of ED, even in university hospitals, without any outpatient qualification. There is no legal obstacle to this; in fact, it is forbidden to refuse these patients. We are very uncomfortable with this situation because it is generally abused. It is ironic that we, as emergency physicians in Türkiye, had the advantage of working under such a burden as part of our daily routine during the pandemic. We think that the TTS is a beneficial tool for managing crowds in EDs.

Of the patients included in our study, 4176 (59.3%) were assigned green triage codes, 2531 (36%) yellow, and 333 (4.7%) red. Wuerz et al.[2] evaluated the accuracy and reliability of the ESI triage system; patients were classified as very urgent (13%), urgent (52%), or not urgent (34%). They reported that this scoring was reliable in estimating the length of hospital stay compared with hospitalization, resource use, and triage scoring. Zachariasse et al.[13] studied 288,633 patients at three hospitals for one year and evaluated the validity of the MTS. The sensitivity of the MTS was 0.47–0.87 among the three hospitals, and the specificity was 0.84–0.94; the validity of the system was moderate to good. In our study, the sensitivity of the green triage code for recovery was 60.29%, and the specificity was 78.78%. Notably, the negative predictive value of the green code for critical outcomes and mortality was 0.95, suggesting that the green code was effective in safely ruling out critical illness. The sensitivity of red triage for critical outcomes and mortality was 56.57%, and the specificity was 96.59%; the positive likelihood ratio was 16.60. When we calculated the sensitivity of red triage for critical outcomes and mortality in the ED, the sensitivity increased to 92%, and the specificity was 95.57%.

In comparison with related studies, the triage system used in our hospital performed well in identifying critical cases. However, it is important to note that triage systems are primarily designed to identify or safely exclude patients with critical illness rather than to predict recovery. The moderate sensitivity of the green code for recovery is therefore expected and does not diminish the clinical utility of the system.[2,13] This is probably due to the nature of the specific disease. Nearly half of the patients were assigned yellow triage codes. These results suggest that triage nurses may also have been reluctant to assign the green triage code because of uncertainty about the disease. We suggest that a study conducted during a non-pandemic period would be more demonstrative and realistic.

Our study, with its large number of patients, also contributes epidemiological data regarding the COVID-19 pandemic. The mean age of the patients included in our study was 41.94±15.28 years, and 53.8% were male. İlhan Alp et al.[14] studied patients with a mean age of 40.4±15.67 years, similar to our study, and 57.4% of the participants were male. Ankaralı et al.[15] reported a significant relationship between age and death due to COVID-19: the death rate increased significantly with increasing age. Ek et al.[16] investigated the effects of COVID-19 on older people, and their sample included 85 countries with more than 5000 cases. They reported that the older population constituted a significant proportion of deaths due to COVID-19. Our study found that the mean age of patients who died (73.61±13.12 years) was significantly higher than that of those who were discharged and recovered (41.36±14.69 years), which was consistent with findings reported in the literature. Fifty-eight years

of age was determined to be a cut-off value for critical outcomes and mortality.

In this study, no statistically significant difference in outcomes was found between genders. The rates of 'critical outcomes and mortality' and recovery were similar in patients of both genders. Although some studies have reported a gender difference in terms of mortality and outcomes in patients with COVID-19, other studies have reported results similar to those of our study. Mohamed et al.[17] found that death rates due to COVID-19 were similar in men and women and that there was no significant difference between the groups. However, in a study conducted in Türkiye, 66.1% of those who died were men and 33.9% were women, and the incidence of cases was 9% higher in men than in women.[18]

In our study, temperature, systolic BP, and RR were significantly higher in COVID-19 patients whose outcomes were critical and/or fatal than in those who were discharged and recovered, whereas GCS and oxygen saturation were significantly lower. Choron et al.[19] reported that fever was one of the parameters that could be used to estimate mortality in mechanically ventilated COVID-19 patients. Caillon et al.[20] reported that high systolic BP at the time of hospital admission was an important risk factor in models predicting the outcomes of COVID-19 patients. Knight et al.[21] reported that a high RR was an important parameter in predicting COVID-19-related deaths.

Of the patients evaluated in our study, 2.2% (*n*=152) were admitted to the intensive care unit, and 31.6% of them were discharged and recovered. Korkmaz reported that 10% of COVID-19 patients were admitted to the intensive care unit.[22] Of the 1.3 million patients with COVID-19 reported to the United States Centers for Disease Control and Prevention by the end of May 2020, 2% were hospitalized in intensive care, and 5% died.[23] Kim et al.[24] studied 2491 COVID-19 patients and reported that the rate of hospitalization in the intensive care unit was 32%, and the rate of requiring mechanical ventilation was 19%. During the pandemic, many countries attempted to intervene using the resources available for patient care. In addition, mean age, gender distributions, and population densities vary among countries. Such factors may have affected intensive care hospitalization rates. We found that 1.4% (*n*=100) of patients were intubated, of whom 92 (92%) died and 8 (8%) were discharged and recovered. The weekly COVID-19 status reports published by our Ministry of Health reported that 8.8% of patients were intubated as of October 4, 2020, while the intubation rate between October 19 and October 25, 2020, was 3.8%.[25,26] Ertürk reported that the intubation rate was 8.9%.[27] Intubation rates in our study were lower than those reported in the literature. We suggest that one reason for this was the establishment of an 'ED critical care unit' in our hospital during the pandemic; in this unit, non-invasive mechanical ventilation was used. Additionally, patients who might otherwise have required intubation because of transfers to distant hospitals could be treated here without being intubated. Another reason might have been the advocacy of early intubation at the beginning of the pandemic. Since our study was conducted toward the middle of the pandemic, intubation rates may have been lower during this period.

Limitations

Our study is a retrospective cross-sectional study conducted at a single centre. Although single-centre studies provide detailed institutional data, they may limit the generalizability of the findings to other settings with different patient populations, triage practices, and healthcare infrastructure. Additionally, although triage is performed primarily by experienced ED nurses trained in triage, differences in their levels of experience and interpersonal dynamics may potentially affect the accuracy and consistency of triage decisions. Unfortunately, inter-rater and intra-rater agreement analyses could not be performed because of the retrospective nature of the study and the pandemic.

It is important to consider contextual factors when interpreting the results. Changes in healthcare policies and guidelines, as well as fluctuations in the number and severity of COVID-19 cases, can affect the number of patient admissions and the clinical profiles of patients seen in EDs. Similarly, the number of patients and their clinical profiles may have varied according to the virus variant circulating in the population at a given time.

In our study, only the triage of patients with PCR positivity on the relevant date was examined. However, it is now known that there are many cases in which PCR positivity is not detected at admission. Therefore, it is possible that, during the study period, many more COVID-19 patients were admitted to the ED but were excluded from the study because they were PCR-negative.

Patients with clinical findings of COVID-19 but negative PCR tests and patients with negative PCR tests but typical COVID-19 findings on thoracic CT were not included in this study.

Conclusion

Our study suggests that the TTS is successful in identifying critical outcomes and mortality in patients with COVID-19 and in safely excluding critical illness among patients assigned the green triage code. As triage systems are primarily designed to identify or safely exclude critical illness rather than to predict recovery, the moderate sensitivity of the green code for recovery does not diminish the clinical value of the system.

Our study provides valuable insight into the system's ability to identify critical illness and predict outcomes in COVID-19 patients. Further validation studies are needed after the pandemic to confirm the system's usefulness in the triage of general ED patients.

Although it has not yet been scientifically proven, based on our clinical experience, we believe that this triage system, which we have been using safely in EDs since 2009, can be a useful tool for managing patient loads during extraordinarily busy periods in EDs beyond the COVID-19 pandemic.

Disclosures

Ethics Committee Approval: This study was approved by the Istanbul Fatih Sultan Mehmet Training and Research Hospital Clinical Research Ethics Committee (Date: 11.06.2020, Decision no: 2020/11).

Informed Consent: Owing to the retrospective design of the study, the requirement for informed consent was waived by the Ethics Committee.

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Comparison of the Efficacy of Low-Level Laser Therapy and Ultrasound Treatment in Patients with Shoulder Pain

Omuz Ağrılı Hastalarda Düşük Yoğunluklu Lazer ve Ultrason Tedavisinin Etkinliğinin Karşılaştırılması

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*This study is derived from specialist thesis completed at Fatih Sultan Mehmet Training and Research Hospital in 2010.

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ABSTRACT

Objectives: Shoulder pain is the most common cause of upper extremity pain. This study aimed to comparatively investigate the effects of low-intensity laser and ultrasound therapy on pain and functionality.

Methods: Our study included 60 patients who presented to our outpatient clinic with shoulder pain and limited range of motion. The study was designed as a randomized, prospective, single-blind trial. Patients were randomly assigned to two groups. Both groups received TENS (transcutaneous electrical nerve stimulation), a hot pack, and medical treatment (diclofenac sodium 75 mg once daily). Ultrasound (US) treatment was administered at a dose of 1.5 W/cm^2 for 5 minutes, and laser therapy was applied at 2000 Hz, 0.6 J/cm^2, and 905 nm for 6 minutes. The treatment consisted of 10 sessions over 2 weeks. Evaluations were conducted before treatment, immediately after treatment, and at 3 months. During assessments, VAS (visual analog scale) scores during sleep, movement, and rest and active-passive range of motion (ROM) measurements were used. The Constant and UCLA scoring systems were used for shoulder function assessment.

Results: Both groups demonstrated significant improvements in pain, ROM, and functional scores compared with baseline ($p<0.05$), with effects maintained at 3 months. No significant between-group differences were observed in VAS pain scores or ROM values ($p>0.05$). However, the US group showed significantly greater improvement in the Constant score compared with the LLLT group ($p<0.05$).

Conclusion: This study found that both low-level laser therapy and therapeutic ultrasound were effective in reducing pain and improving range of motion in patients with shoulder pain. Therapeutic ultrasound demonstrated superior efficacy compared with laser therapy in restoring shoulder function. Ultrasound therapy can also be considered an effective and reliable treatment method for shoulder pain.

Keywords: Low-level laser therapy; shoulder pain; ultrasound therapy.

ÖZET

Amaç: Omuz ağrısı, üst ekstremite ağrılarının en yaygın nedenidir. Bu çalışma, son yıllarda kas-iskelet sistemi ağrılarının tedavisinde sıklıkla kullanılan düşük yoğunluklu lazer ve ultrasonun omuz ağrısının tedavisindeki etkinliğini araştırmayı amaçlamıştır.

Yöntem: Çalışmamıza, polikliniğimize omuz ağrısı ve hareket kısıtlılığı şikâyetiyle başvuran 60 hasta dâhil edildi. Çalışma, randomize, prospektif, tek kör bir çalışma olarak tasarlandı. Hastalar randomize olarak iki gruba ayrıldı. Her iki grup da TENS (Transkutanöz Elektriksel Sinir Stimülasyonu), sıcak kompres ve tıbbi tedavi (günde bir kez 75 mg diklofenak sodyum) aldı. Ultrason (US) tedavisi 5 dakika boyunca 1,5 W/cm^2 dozunda, lazer tedavisi ise 6 dakika boyunca 2000 Hz, 0,6 J/cm^2 ve 905 nm'de uygulandı. Tedavi, 2 hafta boyunca 10 seanstan oluştu. Değerlendirmeler tedavi öncesinde, hemen sonrasında ve 3 ay sonra yapıldı. Değerlendirmeler sırasında uyku, hareket ve dinlenme hâllerinde VAS (Görsel Analog Skala) ile aktif-pasif hareket açıklığı (ROM) ölçümleri kullanıldı. Omuz fonksiyonunun değerlendirilmesi için Constant ve UCLA skorlama sistemleri kullanıldı.

Bulgular: Her iki grup da başlangıç değerlerine kıyasla ağrı, hareket açıklığı (ROM) ve fonksiyonel skorlarda anlamlı iyileşmeler gösterdi (p<0,05) ve bu etkiler 3 ay boyunca devam etti. VAS ağrı skorlarında veya ROM değerlerinde gruplar arasında anlamlı bir fark gözlenmedi (p>0.05). Bununla birlikte, US grubu, LLLT grubuna kıyasla Constant skorunda anlamlı derecede daha fazla iyileşme gösterdi (p<0,05).

Sonuç: Bu çalışma, hem düşük seviyeli lazer tedavisinin hem de terapötik ultrasonun omuz ağrısı olan hastalarda ağrıyı azaltmada ve hareket açıklığını iyileştirmede etkili olduğunu göstermiştir. Terapötik ultrason, omuz fonksiyonunu geri kazandırmada lazer tedavisine göre üstün etkinlik göstermiştir. Ultrason, lazer tedavisine kıyasla omuz ağrısında etkili ve güvenilir bir tedavi yöntemi olarak düşünülebilir.

Anahtar sözcükler: Düşük yoğunluklu lazer tedavisi; omuz ağrısı; ultrason tedavisi.

Shoulder pain is the most common cause of upper extremity pain and ranks third among musculoskeletal disorders, following low back and neck pain.[1] The prevalence in the general population ranges from 7% to 26%, with lifetime prevalence reported to reach up to 67%. The annual incidence of new cases is estimated to be 0.9–2.5%, peaking in the middle-aged group (45–64 years). Approximately 50% of patients presenting with shoulder pain in primary care settings continue to report symptoms six months later.[2] Shoulder pain significantly impairs occupational, social, and athletic activities, adversely affecting the quality of daily life and work performance.

The anatomical structure of the shoulder reveals that the glenohumeral joint, while allowing a wide range of motion, is susceptible to injury due to its inherent compromise between mobility and stability. The rotator cuff consists of the supraspinatus, infraspinatus, teres minor, and subscapularis muscles, which together provide dynamic stability to the shoulder joint. When the tendons of these muscles are subjected to repetitive overhead movements and loading, pathologies such as tendinitis, impingement syndrome, and adhesive capsulitis may develop.[3] Supraspinatus tendinitis is the most frequently reported pathology among the etiologies of shoulder pain, accounting for approximately 65–70% of all shoulder pain cases.[4]

Treatment options for shoulder pain include medical therapy, physical therapy modalities, exercise, and surgical intervention when necessary. Conservative approaches—including steroid injections, exercise, manual therapy, and physical therapy modalities—have been reported to achieve 40–80% pain reduction and functional improvement.[5] Among physical therapy modalities, transcutaneous electrical nerve stimulation (TENS), hot/cold packs, therapeutic ultrasound (US), and low-level laser therapy (LLLT) are the most commonly employed.[6]

Therapeutic ultrasound is a modality that transmits mechanical energy waves at a frequency of 0.5–3 MHz, producing analgesia, increased tissue elasticity, and accelerated healing through thermal and mechanical tissue effects. Given its ability to reach deeper tissues, it is frequently preferred in chronic conditions such as fibrosis, contracture, and tendinitis.[7] LLLT, with its analgesic, biostimulant, and anti-inflammatory properties, has gained increasing use in musculoskeletal disorders. Although its mechanism of action is not fully elucidated, it is understood to promote tissue stimulation through cellular and subcellular mechanisms.[8]

Both modalities are widely used in the treatment of shoulder pathologies; however, the number of randomized controlled trials comparing their efficacy remains limited. The aim of this study was to compare the short- and mid-term effects of LLLT and US—applied in addition to TENS, hot packs, medical treatment, and exercise—on pain, range of motion (ROM), and functionality in patients with shoulder pain.

Methods

This study included a total of 60 patients aged 30–75 years who presented to the Physical Medicine and Rehabilitation outpatient clinic of Fatih Sultan Mehmet Training and Research Hospital with shoulder pain and restricted motion lasting at least three weeks.

The exclusion criteria were malignancy; systemic diseases (pulmonary fibrotic changes, diabetes mellitus, rheumatological conditions); a history of shoulder fracture or reflex sympathetic dystrophy; and advanced cervical spondylosis or restricted cervical motion.

The study was designed as a randomized, prospective, single-blind trial. Patients were randomized into two groups using the sealed-envelope method. Group 1 received therapeutic US (n=30) at 1.5 W/cm² for 5 minutes per session. Group 2 received LLLT (n=30) at 2000 Hz, 0.6 J/cm², 5 mW, and 905 nm (Endolaser 422, 905 nm) for 6 minutes per session (2 minutes each over the anterior shoulder, posterior shoulder, and greater tubercle). Both groups concurrently received TENS, hot packs, and exercise therapy. The exercise program—consisting of Codman pendulum exercises, passive-active ROM

exercises, posterior capsule stretching, and strengthening exercises—was provided as a home program. Medical treatment (diclofenac sodium, 75 mg tablet, once daily) was recommended for pain control. The total treatment duration was 10 sessions over two weeks. Patients were evaluated at baseline, post-treatment, and at the 3-month follow-up.

Outcome measures included VAS pain scores at rest, during movement, and at night; active and passive ROM measurements in all planes; and specific shoulder examination tests (Hawkins, Neer, supraspinatus, Speed, and Yergason tests). Functional assessment was performed using the Constant shoulder scoring system and the UCLA (University of California–Los Angeles) shoulder rating scale.

The Constant score is widely used to evaluate shoulder function before and after both conservative and surgical interventions and was first described by Constant and Murley in 1986.[9] The UCLA scale was developed by Ellman in 1986 and is favored for its ease of application.[10]

Ethical Approval

This study was based on a specialist thesis completed in 2010. At the time the study was initiated, Fatih Sultan Mehmet Training and Research Hospital did not have an institutional ethics committee. Therefore, the study protocol was submitted to and approved by the Fatih Sultan Mehmet Training and Research Hospital Thesis Committee under the petition dated August 26, 2009, and numbered 7653. The study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment.

Statistical Analysis

Statistical analyses were performed using SPSS version 17.0. The chi-square test was used for categorical variables, and the independent-samples t-test was used for continuous variables. Within- and between-group comparisons of pre- and post-treatment measurements were conducted using repeated-measures two-way analysis of variance and Cochran's Q test. Statistical significance was set at $p \leq 0.05$.

Results

Sixty patients were included in the study; 66.7% (n=40) were female, and 33.3% (n=20) were male. The mean age was 53.4 years. No statistically significant differences were found between the US and LLLT groups in terms of age, sex, symptom duration, or baseline measurement values ($p>0.05$) (Table 1). Right-hand dominance was present in 93.3% of patients; however, no significant association was observed between hand dominance and the side of the painful shoulder (Table 2). The groups were statistically comparable at baseline.

Regarding diagnosis distribution, 68.3% (n=41) had supraspinatus tendinitis, 8.3% (n=5) had biceps tendinitis, 20% (n=12) had adhesive capsulitis, and 3.3% (n=2) had acromioclavicular joint degeneration. Supraspinatus tendinitis was the most common diagnosis in this study, consistent with the existing literature on shoulder pain etiology.[3,4] (Table 3).

VAS pain scores (at rest, during movement, and at night) showed statistically significant decreases in both groups compared with baseline following treatment ($p=0.00<0.05$). Improvements observed at the 3-month follow-up also remained significant compared with baseline in both groups. Between-group comparisons revealed no statistically significant differences in VAS rest, movement, or night pain scores between the LLLT and US groups ($p>0.05$), suggesting comparable analgesic efficacy of both modalities.[11] (Table 4).

Active and passive ROM measurements—including flexion, abduction, internal rotation, and external rotation—showed significant improvements from baseline in both

Table 1. Comparison of baseline continuous demographic characteristics between groups

Variable	All patients (n=60)		Ultrasound group (n=30)		Laser group (n=30)		p
	Mean	SD	Mean	SD	Mean	SD	
Age (Years)	53.4	11.3	54.2	10.6	52.6	12.1	0.60
Duration (month)	8.6	8.8	8.1	9.3	9.2	8.3	0.64
Weight (kg)	75.0	14.4	72.4	12.9	77.5	15.7	0.17
Height (cm)	162.7	8.9	160.8	8.3	164.6	9.2	0.99

Independent samples t-test

Table 2. Comparison of baseline categorical demographic characteristics between groups

Variable		All patients		Ultrasound group		Laser group		p
		n	%	n	%	n	%	
Gender	Female	40	66.7	23	76.7	17	56.7	0.10
	Male	20	33.3	7	23.3	13	43.3	
Dominant side	Right	56	93.3	29	96.7	27	90	0.10
	Left	4	6.7	1	3.3	3	10	
Affected shoulder	Right	29	48.3	15	50.0	14	46.7	0.80
	Left	31	51.7	15	50.0	16	53.3	
Marital status	Single	5	8.3	1	3.3	4	13.3	0.37
	Married	51	85.0	27	90.0	24	80.0	
	Widowed	4	6.7	2	6.7	2	6.7	
Education level	Illiterate	13	21.7	7	23.3	6	20	0.79
	Primary school	33	55	17	56.7	16	53.3	
	Middle school	4	6.7	2	6.7	2	6.7	
	High school	7	11.7	2	6.7	5	16.7	
	Unıversıty	3	5	2	6.72	1	3.3	
Employment status	Housewife	34	56.7	19	63.3	15	50	0.48
	Retired	15	25	6	20	9	30	
	Employed	10	16.7	4	13.3	6	20	
	Desk job	1	1.7	1	3.3	0	0	

Chi-square test

Table 3. Distribution of clinical diagnoses between groups

Diagnosis	Ultrasound group n / %	Laser group n / %	Total n / %
Supraspinatus tendinitis	23/76.7%	18/60.0%	41/68.3%
Biceps tendinitis	3/10.0%	2/6.7%	5/8.3%
Adhesive capsulitis	4/13.3%	8/26.7%	12/20.0%
Akromioclavicular joint degeneration	0/0.0%	2/6.7%	2/3.3%
Total	30/100%	30/100%	60/100%

groups ($p<0.05$). ROM gains achieved after treatment were maintained at the 3-month follow-up. No statistically significant between-group differences were found in active or passive ROM values ($p>0.05$). Ultrasound's capacity to heat deep tissues is known to increase collagen elasticity and reduce capsular restriction; this biomechanical mechanism is thought to contribute to ROM recovery, particularly in adhesive capsulitis.[7] (Table 4).

Functional outcomes were assessed using the Constant score and the UCLA shoulder rating scale. UCLA scores showed significant improvement in both groups following treatment; however, the between-group difference was not statistically significant ($p>0.05$). In contrast, the Constant score demonstrated statistically significantly greater functional recovery in the US group compared with the LLLT group ($p<0.05$) (Table 4). This finding indicates that while pain reduction and ROM improvement were comparable between groups, therapeutic US showed a relative advantage in functional recovery. The tissue-heating and fibrolytic properties of ultrasound may play a key role in this effect.[6]

Discussion

The shoulder is a complex joint that relies on soft-tissue stabilizers—including the rotator cuff muscles, joint capsule,

Table 4. Comparison of VAS, range of motion, and functional scores over time

Outcome	Ultrasound group			Laser group			p
	Pre treatment	Post treatment	3. months	Pre treatment	Post treatment	3. months	
VAS Rest	4.2	2.2	1.2	3.6	2.2	1.6	0.55
VAS Movement	7.6	4.2	3.2	7.1	4.2	2.1	0.31
VAS Sleep	6.3	3.2	2.7	7.9	3.7	2.4	0.16
Abduction (Abd) AROM (°)	125.6	145.0	154.3	127.7	144.6	143.0	0.17
Abd. PROM (°)	132.9	156.3	160.3	132.6	149.7	144.3	0.14
Flexion AROM (°)	145.5	166.1	170.0	150.0	157.7	161.3	0.07
Flexion PROM (°)	153.4	169.5	172.0	153.9	160.8	162.6	0.17
Internal rotation (IR) AROM (°)	61.5	73.2	78.2	64.4	75.2	77.8	0.81
IR PROM (°)	65.3	74.8	79.3	65.2	75.4	77.8	0.87
External rotation (ER) AROM (°)	55.7	67.4	73.0	58.6	65.3	71.2	0.54
ER PROM (°)	61.7	70.7	75.1	60.0	66.6	71.4	0.80
Constant Score	42.4	64.0	71.0	50.5	65.4	67.1	0.01*
UCLA Score	14.7	24.4	27.3	15.6	24.8	25.7	0.23

Two-way ANOVA and Cochran's Q test. AROM: Active range of motion; PROM: Passive range of motion; VAS: Visual analog scale

and ligaments—to achieve its wide range of motion, making it susceptible to injury due to limited bony stabilization. Shoulder pain is the most common cause of upper extremity disorders, with a lifetime prevalence of approximately 70%, leading to significant functional impairment and loss of work capacity.[12]

Multiple factors contribute to the etiology of shoulder pain. Higher rates are observed in individuals performing frequent overhead activities, such as athletes, swimmers, and weightlifters.[13] Age is a factor in etiology: glenohumeral instability and rotator cuff tendinitis are more prevalent in individuals under 40 years of age, while rotator cuff tendinitis, adhesive capsulitis, and glenohumeral osteoarthritis are more common after the age of 40.[14]

The most common causes of shoulder pain include subacromial impingement syndrome, rotator cuff tendinopathy, biceps tendon pathologies, adhesive capsulitis, and acromioclavicular joint disorders.[15] In this study, 68.3% of patients had supraspinatus tendinitis, 20% had adhesive capsulitis, 8.3% had biceps tendinitis, and 3.3% had acromioclavicular joint degeneration.

The mean age of patients in our study was 53.4 years, with comparable age distributions in both groups, and age-related shoulder pathologies were consistent with the literature. Female patients predominated (66.7%), which is in accordance with studies on the epidemiology of shoulder pain, supporting the role of hormonal factors and occupational loading in increasing the risk of shoulder pathology in women.[2] No significant association was observed between hand dominance and the side of the symptomatic shoulder, which is consistent with previous studies reporting inconsistent findings regarding the relationship between shoulder pain and hand dominance, with several demonstrating no significant association between symptom side and the dominant extremity.[1,16]

Conservative approaches are the first-line treatment for shoulder pain, including steroid injections, exercise, manual therapy, and physical therapy modalities. Given the paucity of studies directly comparing LLLT and therapeutic US in shoulder pain, this study was designed to evaluate and compare the effects of these two modalities on pain, ROM, and functionality. Both modalities produced clinically meaningful improvements; therapeutic US demonstrated statistically significant superiority over LLLT in shoulder functionality (p=0.01). Treatment efficacy was maintained at the 3-month follow-up.

A systematic review evaluating the efficacy of LLLT in shoulder pain confirmed that conservative treatment remains the primary approach; however, it emphasized that the level of evidence for the use of passive treatment modalities independently of exercise remains insufficient.[17] In this context, it is noteworthy that more clinically meaningful im-

provements can be achieved when both modalities are used in conjunction with active exercise. In the present study, exercise therapy was administered concurrently to both groups.

When systematic reviews evaluating the efficacy of LLLT in shoulder pain are examined, it is evident that LLLT applied at appropriate doses provides clinically significant pain relief and that its efficacy increases when combined with physiotherapy.[17,18] The analgesic mechanism of LLLT is thought to occur through neuronal inhibition, mitochondrial activation, suppression of prostaglandin synthesis, and enhancement of endorphin release.[8] In light of these mechanisms, the similar degree of pain reduction observed in both treatment groups in our study is consistent with expectations.

A 2024 systematic review and meta-analysis on the efficacy of ultrasound in shoulder pain reported that ultrasound reduces shoulder pain.[19] One study with controversial findings reported that US therapy, when applied as an adjunct to other physical therapy modalities, provided no significant additional benefit over placebo; however, it was emphasized that, when used alone, it supports tissue healing through thermal and mechanical effects.[20] We believe that the application of ultrasound within a multimodal regimen alongside TENS and hot packs in our study may have contributed to the superior effect of this combination on functionality. The significant functional superiority observed in US-treated patients at follow-up (third month) compared with those receiving LLLT may be explained by therapeutic ultrasound's capacity to more directly affect the capsular structures of the shoulder joint. The deep tissue heating effect of US softens collagen fibers, increases capsular flexibility, and facilitates synovial fluid production. These mechanisms make important contributions to the restoration of joint function, particularly in adhesive capsulitis and rotator cuff tendinitis.[21]

A review of the literature revealed that studies directly comparing laser and ultrasound in shoulder pain are limited in number. In a randomized controlled study, LLLT and US therapy were compared in combination with a home exercise program in patients with subacromial impingement syndrome; both modalities yielded effective outcomes regarding pain and functionality, but no statistically significant difference was detected between the groups.[12] In another study involving patients diagnosed with rotator cuff tendinopathy, similar findings were reported; both the LLLT and US groups demonstrated marked improvement in pain, function, sleep quality, and emotional status following treatment.[5]

One of the most important findings of our study is that, while pain reduction and increased range of motion were achieved with both modalities, no significant difference was detected between the groups. This result suggests that the analgesic and kinetic efficacy of LLLT and US in shoulder pain are comparable. Similarly, in a randomized controlled study conducted by Sen et al.[12] in patients with subacromial impingement syndrome, no significant difference was found between the LLLT and US groups in terms of VAS and ROM values, and both treatments were reported to yield effective outcomes when combined with home exercise.

The mean symptom duration of 8.6 months in our study indicates that the patient population had characteristics of chronic shoulder pain. Based on these findings, both LLLT and therapeutic US can be considered effective interventions for chronic shoulder pain and dysfunction. Current evidence indicates that exercise-based physical therapy approaches have positive effects on pain and function in chronic shoulder pain; combined therapies have been shown to be more effective, while passive modalities alone offer limited benefit.[22] The results of this study further demonstrate that LLLT or US can be added to the existing treatment regimen in shoulder pain management.

Strengths of this study include its randomized, prospective, single-blind design and the simultaneous use of two validated functional scoring systems. Limitations include a relatively small sample size, the delivery of exercise as a home program rather than a supervised protocol, and the evaluation of treatment efficacy across a heterogeneous group of shoulder pathologies. Future research is recommended with larger sample sizes, active exercise control groups, and investigation of more specific shoulder pathology subgroups.

Conclusion

This study demonstrated that both low-level laser therapy and therapeutic ultrasound are effective in reducing pain and improving the range of motion in patients with shoulder pain. Therapeutic ultrasound showed superior efficacy over laser therapy in restoring shoulder functionality.

These findings indicate that therapeutic ultrasound can be used as a reliable and effective alternative to laser therapy

in the conservative management of shoulder pain. In particular, ultrasound therapy represents a viable option when laser therapy is contraindicated or when cost constraints are a consideration in clinical settings.

Disclosure

Ethics Committee Approval: The study protocol was approved by the Fatih Sultan Mehmet Training and Research Hospital Thesis Committee under the petition dated August 26, 2009, and numbered 7653.

Informed Consent: Written informed consent was obtained from all participants included in this study.

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Effects of Greater Occipital Nerve Block on Headache Frequency and Sleep Disturbance in Medication Overuse Headache

Büyük Oksipital Sinir Bloğunun İlaç Aşırı Kullanım Baş Ağrısında Baş Ağrısı Sıklığı ve Uyku Bozukluğu Üzerine Etkileri

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ABSTRACT

Objectives: Medication Overuse Headache (MOH) is a secondary headache that develops due to the use of analgesic treatment for more than three months, exceeding 10–15 days per month, depending on the medication used. Patients with MOH are more likely to experience sleep disorders, such as chronic insomnia, compared with those without such disorders, which negatively impacts their quality of life.

Methods: This study was a retrospective, single-center observational study conducted at the Neurology Clinic involving 23 patients diagnosed with MOH and treated with a greater occipital nerve (GON) block. Patients over 18 years of age who met the ICHD-3 criteria for MOH were included in the study. For each patient, the average monthly headache frequency over the three months following the injection, Epworth Sleepiness Scale (ESS) scores, and subjective sleep quality assessments were recorded.

Results: Among the participants, the number of days with pain decreased in 18, increased in 1, and remained the same in 4. A statistically significant difference was found when comparing the number of painful days before and after the procedure. In 7 participants, the ESS score decreased after the procedure, while in 16, it remained the same. A statistically significant difference was found when comparing the ESS scores before and after the procedure.

Conclusion: GON block is an effective, low-cost, accessible, and safe procedure that can be used in the treatment of MOH. Our findings demonstrate a reduction in the number of headache days and daytime sleepiness.

Keywords: GON block; headache; insomnia; medication overuse headache.

ÖZET

Amaç: İlaç Aşırı Kullanım Baş Ağrısı (İAKBA), kullanılan ilaca bağlı olarak ayda 10–15 günü aşacak şekilde, üç aydan uzun süre analjezik tedavi kullanımına bağlı olarak gelişen sekonder bir baş ağrısıdır. İAKBA'lı hastalar, bu tür bozuklukları olmayan kişilere kıyasla kronik uykusuzluk gibi uyku bozukluklarını daha sık yaşamakta olup bu durum yaşam kalitelerini olumsuz yönde etkilemektedir.

Yöntem: Bu çalışma, Nöroloji Kliniği'nde yürütülen, İAKBA tanısı almış ve büyük oksipital sinir (GON) bloğu uygulanmış 23 hastayı kapsayan retrospektif, tek merkezli, gözlemsel bir çalışmadır. İAKBA için ICHD-3 kriterlerini karşılayan 18 yaş üstü hastalar çalışmaya dahil edilmiştir. Her hasta için enjeksiyonu izleyen üç ay boyunca ortalama aylık baş ağrısı sıklığı, Epworth Uykululuk Ölçeği (EUÖ) skorları ve subjektif uyku kalitesi değerlendirmeleri kaydedilmiştir.

Bulgular: Katılımcılar arasında ağrılı gün sayısı 18 hastada azalmış, 1 hastada artmış ve 4 hastada aynı kalmıştır. İşlem öncesi ve sonrası ağrılı gün sayıları karşılaştırıldığında istatistiksel olarak anlamlı bir fark bulunmuştur.

Katılımcıların 7'sinde EUÖ skoru işlem sonrası azalırken, 16'sında aynı kalmıştır. İşlem öncesi ve sonrası EUÖ skorları karşılaştırıldığında istatistiksel olarak anlamlı bir fark bulunmuştur.

Sonuç: GON bloğu, İAKBA tedavisinde kullanılabilen etkili, düşük maliyetli, erişilebilir ve güvenli bir işlemdir. Bulgularımız, baş ağrısı gün sayısında ve gündüz uykululuğunda azalma olduğunu göstermektedir.

Anahtar sözcükler: Baş ağrısı; GON bloğu; ilaç aşırı kullanım baş ağrısı; uykusuzluk.

Medication Overuse Headache (MOH) is a secondary headache that develops due to the use of analgesic treatment for more than three months, exceeding 10–15 days per month, depending on the medication used.[1] Affecting approximately 60 million people worldwide, MOH is among the top 20 causes of disability globally.[2] A study conducted in Türkiye in 2012 determined its prevalence to be 2.1% in the general population and 8.2% among migraine patients.[3] Patients with MOH are more likely to experience sleep disorders, such as chronic insomnia, compared with those without such disorders, which negatively impacts their quality of life. Early identification and treatment of psychiatric comorbidities and sleep disorders in these patients contribute to improved quality of life and functionality.[4,5]

Greater occipital nerve (GON) block is a frequently preferred procedure among clinicians for primary and secondary headaches due to its simple technique and high efficacy. It is also used in the treatment of MOH.[6,7] However, there is no established consensus regarding the injection site, the medication used, or the dosage. Typically, the procedure involves injecting bupivacaine or lidocaine into the nerve on the sensitive side.[8]

In this study, we aimed to evaluate the effects of GON block application on headache frequency and sleep quality in patients with MOH.

Methods

This study was a retrospective, single-center observational study conducted at the Neurology Clinic of Kulu Regional State Hospital between April 1, 2024, and September 1, 2024, involving 23 patients diagnosed with medication overuse headache (MOH) and treated with a greater occipital nerve (GON) block. The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice Guidelines and was approved by the Ethics Committee of Konya City Hospital.

Patients over 18 years of age who met the ICHD-3 criteria for MOH were included in the study. A 0.5% bupivacaine injection was administered to the nerve on the side of the patient's tenderness, targeting a point 2 cm lateral and 2 cm inferior to the external occipital protuberance. Patients who continued follow-up received up to four GON block injections at one-week intervals. Additionally, patients who could not continue the injections for reasons such as relocating to another city or voluntarily discontinuing treatment were also included in the study, and the effects of the number of injections were analyzed.

For each patient, the average monthly headache frequency over the three months following the injection, Epworth Sleepiness Scale (ESS) scores, and subjective sleep quality assessments were recorded and compared with the average values from the three months prior to the injection. During this period, patients were advised to restrict their analgesic use.

Exclusion Criteria:

1. Patients under 18 years of age
2. Patients with a history of another secondary headache
3. Patients receiving psychiatric treatment
4. Patients who did not adhere to analgesic restriction

Statistical Analyses

To describe the distribution of individuals in terms of demographic and clinical characteristics, numbers (n) and percentages (%) were used. The normality of continuous variables in the study was assessed graphically and using the Shapiro–Wilk test. Descriptive statistics for the variables were presented as median (minimum–maximum) values. Cross-tabulations were created to compare subjective sleep quality assessments among individuals experiencing >50% improvement, and numbers (n), percentages (%), and Fisher's exact test statistics were provided. The Mann–Whitney U test was used to compare age and the number of applications according to the change in benefit (>50%) and ESS score. To investigate whether there were differences in the number of painful days and ESS scores between different measurement times (pre-procedure and post-procedure), the Wilcoxon signed-rank test was used. Among individuals experiencing >50% improvement, correlation analyses

Table 1. Demographic and clinical characteristics of study participants

		All cases (n=23)
Age	Median (Min-Max)	48.87±16.87 47.0 (27-88)
Gender, n (%)		
Female		20 (87)
Male		3 (13)
More than 50% benefit, n (%)		
Yes		14 (60,9)
No		9 (39,1)
Adverse effect, n (%)		
Yes		1 (4.3)
No		22 (95.7)
Subjective Sleep Quality Assessment, n (%)		
No change		18 (78.3)
İmproved		5 (21.7)

between the change in ESS score and age and number of applications were conducted, and point-biserial correlation coefficients were provided. IBM SPSS Statistics 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) and MS Excel 2007 were used for statistical analyses and calculations. A statistical significance level of $p<0.05$ was accepted.

Results

The average age of the participants in the study was 48.87±16.87 years. Of the participants, 87.0% (n=20) were women. Among the participants, 60.9% (n=14) reported experiencing >50% improvement. One participant (4.3%) experienced an adverse effect, with vasovagal syncope observed. According to the subjective sleep quality assessment, there was no change in 78.3% of the participants (n=18) (Table 1).

Table 3. Relationship between more than 50% benefit and number of applications

	More Than 50% Benefit	
	r_{pb}	p
Number of Applications	0.558	**0.006**

rpb: Point Biserial Correlation Coefficient

Among the participants, the number of days with pain decreased in 18, increased in 1, and remained the same in 4. A statistically significant difference was found when comparing the number of painful days before and after the procedure ($z=3.787$, $p<0.001$). Additionally, the median number of painful days was 13 before the procedure and 5 after the procedure (Table 2).

According to the point-biserial correlation analysis, there was a positive and statistically significant relationship between experiencing >50% improvement and the number of applications ($p<0.05$). As the number of applications increased, the likelihood of experiencing >50% improvement also increased (Table 3).

In 7 participants, the ESS score decreased after the procedure, while in 16, it remained the same. A statistically significant difference was found when comparing the ESS scores before and after the procedure ($z=2.375$, $p=0.018$). Additionally, the median ESS score was 6.0 before the procedure and 5 after the procedure (Table 5).

Among individuals who benefited by more than 50%, sleep quality improved in 28.6% (n=4), while among those who did not benefit, sleep quality improved in 11.1% (n=1). No statistically significant difference was found in the subjective sleep quality assessment according to whether participants experienced >50% improvement ($p=0.327$). In 7 participants, the ESS score decreased after the procedure, while in 16, it remained the same. A statistically significant difference was found when comparing the ESS scores before

Table 2. Comparison of painful days before and after the procedure

Painful days		n	Pre-Procedure Median (Min-Max)	Post-Procedure Median (Min-Max)	z	p
Pre-Procedure - Post-Procedure Change	Increase	1	13 (10-20)	5 (1-20)	z=3.787	**<0.001**
	Decrease	18				
	No change	4				

z:Wilcoxon Signed Rank Test

Table 4. The status of more than 50% benefit based on patients' age

	More Than 50% Benefit			
	Yes (n=14)	No (n=9)	Test statistic	
	Median (Min-Max)	Median (Min-Max)	z	p
Age	53 (27-88)	36 (29-75)	z=1.609	0.109

z: Mann Whitney U Test

and after the procedure (z=2.375, p=0.018). Additionally, the median ESS score was 6 before the procedure and 5 after the procedure (Table 6).

No statistically significant difference was found in the age or number of applications of the participants according to the change in their ESS scores (p>0.05) (Table 7).

Discussion

In this observational study, the effects of greater occipital nerve (GON) block on the number of painful days and sleep quality in patients diagnosed with medication overuse headache (MOH) were evaluated, and whether increasing the frequency of application improves its effectiveness was investigated.

Tablo 7. Comparison of age and number of applications based on epworth sleppiness scale

	Epworth Sleepiness Scale			
	No Change (n=16)	Decrease (n=7)	Test statistic	
	Median (Min-Max)	Median (Min-Max)	z	p
Age	48.0 (27-88)	37.0 (34-58)	z=0.937	0.376
Number of Applications	2.5 (1-4)	4.0 (1-4)	z=0.932	0.413

z:Mann Whitney U Test

After the procedure, a statistically significant and notable reduction was observed in the number of painful days. In a study by Karadaş et al.[9], GON block application using lidocaine three times at weekly intervals was compared with a single application, and both methods were found to be effective. In another study by Arab et al.[10], GON block was

Table 5. Comparison of epworth sleepiness scale before and after the procedure

Epworth Sleepiness Scale		n	Pre-procedure median (Min-Max)	Post-procedure median (Min-Max)	z	p
Pre-Procedure - Post-Procedure Change	Increase	0	6 (0-12)	5 (0-12)	z=2.375	**0.018**
	Decrease	7				
	No change	16				

z:Wilcoxon Signed Rank Test

Tablo 6. Comparison of subjective sleep quality assessment according to the status of more than 50% benefit and comparison of epworth sleepiness scale before and after the procedure

		More Than %50 Benefit		
		Yes (n=14) n (%)	No (n=9) n (%)	p*
Subjective Sleep Quality Assessment				
No Change		10 (71.4)	8 (88.9)	0.327
Improve		4 (28.6)	1 (11.1)	

Epworth Sleepiness Scale		n	Pre-procedure median (Min-Max)	Post-procedure median (Min-Max)	z	p
Pre-Procedure Post-Procedure Change	Increase	0	6 (0-12)	5 (0-12)	z=2.375	**0.018**
	Decrease	7				
	No change	16				

Fisher Exact test results are provided. z: Wilcoxon Signed Rank Test

also found to be effective in addition to analgesic restriction. In the study by Ünsal et al.[7], the benefit of GON block application was also demonstrated. Our findings are consistent with the literature in this regard.

There is no standardized procedure regarding the number and frequency of GON blocks. In the study by Karadaş et al.[9], patients who received a single injection were compared with those who received injections three times at weekly intervals, and repeated injections were shown to be superior. Another study evaluating the effectiveness of repeated GON blocks in cervicogenic headaches also showed the superiority of repeated injections over a single application.[11] In our study, similar to the literature, it was observed that the number of painful days decreased more with repeated injections. Although a standardized procedure cannot be established based on these findings, repeated applications may be more effective.

In our study, no relationship was found between benefiting from the application and patient age. In a study by Allen et al.[12], patients were divided into groups based on age (under and over 65 years), and both groups were shown to benefit equally. In another study by Ökmen et al.[13], no difference in effectiveness was observed between different age groups. These results indicate that our findings are consistent with the literature.

The ESS was used to assess daytime sleepiness in our study, and subjective evaluations of sleep quality were obtained from the patients themselves. A statistically significant decrease in ESS scores was observed after the procedure, but no significant difference was found in subjective sleep quality. Additionally, in patients with a >50% reduction in pain frequency after the injection, a greater decrease in ESS scores was observed, but no changes were observed with an increasing number of injections. In a study by Saçmacı et al.[14], the sleep quality of the included patients was shown to improve, and psychiatric symptoms regressed. Similar positive effects on sleep quality have been demonstrated in other studies in the literature conducted in patients with chronic migraine.[15,16] These results suggest that GON block may improve sleep quality and reduce insomnia symptoms.

Limitations

The limitations of this study include its retrospective nature, the subjective assessment of sleep quality, its single-center design, and the small number of patients. The strengths of the study include directly assessing sleep quality in patients with MOH and evaluating sleep-related issues from the patients' own perspective.

Conclusion

In conclusion, GON block is an effective, low-cost, accessible, and safe procedure that can be used in the treatment of MOH. Our findings demonstrate a reduction in the number of headache days and daytime sleepiness. Although less robust, the findings also suggest an improvement in patients' subjective sleep quality. Prospective, randomized controlled trials with larger sample sizes are needed to expand the available evidence.

Disclosure

Ethics Committee Approval: This study was approved by The Ethics Committee of Konya City Hospital (2025/09 -08.09.2025)

Informed Consent: Written informed consents were obtained from patients who participated in this study.

Conflict of Interest: The authors declare that there is no conflict of interest.

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Case Report

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An Early-Stage Neuroborreliosis Case with Atypical Findings

Atipik Bulgularıyla Erken Dönem Nöroborreliyoz Olgusu

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ABSTRACT

Lyme disease is a zoonotic infection caused by the spirochete *Borrelia burgdorferi*, which can affect multiple organs, including the skin, joints, heart, and central nervous system. Neurological involvement that typically appears within the first few months after a tick bite is referred to as neuroborreliosis. In this paper, we present a case of neuroborreliosis with concurrent involvement of the trigeminal nerve, peripheral facial nerve, and partial cauda equina. A 32-year-old male patient presented with complaints of facial numbness, difficulty walking, and loss of sensation in the perianal region. Brain and spinal magnetic resonance imaging (MRI) revealed no pathological findings. Cerebrospinal fluid (CSF) analysis showed elevated protein levels, and Borrelia burgdorferi IgM antibodies were positive. After the patient was treated with intravenous ceftriaxone, significant improvement in clinical symptoms was observed. This case is important because it demonstrates that neuroborreliosis can present with rare neurological findings, such as cranial neuropathy and cauda equina syndrome.

Keywords: Cauda equina syndrome; cranial neuropathy; Lyme disease; neuroborreliosis.

ÖZET

Lyme hastalığı, *Borrelia burgdorferi* isimli spiroket tarafından oluşturulan ve deri, eklem, kalp ile sinir sistemi başta olmak üzere birçok organı etkileyebilen zoonotik bir enfeksiyondur. Kene ısırığından sonra genellikle ilk birkaç ay içinde ortaya çıkan sinir sistemi tutulumu nöroborreliyoz olarak adlandırılır. Bu yazıda, trigeminal sinir, periferik fasiyal sinir ve parsiyel kauda equina tutulumunun birlikte görüldüğü bir nöroborreliyoz olgusu sunulmuştur. Otuz iki yaşında erkek hasta, yüzde uyuşma, yürüme güçlüğü ve perianal bölgede his kaybı şikâyetleri ile başvurmuştur. Beyin ve spinal manyetik rezonans görüntüleme incelemelerinde patolojik bulgu saptanmamıştır. Beyin omurilik sıvısı incelemesinde protein yüksekliği saptanmış, Borrelia burgdorferi IgM antikorları pozitif bulunmuştur. Hastaya uygulanan intravenöz seftriakson tedavisi sonrasında klinik bulgularda belirgin düzelme izlenmiştir. Bu olgu, nöroborreliyozun kraniyal nöropati ve kauda equina sendromu gibi nadir nörolojik bulgular ile prezente olabileceğini göstermesi açısından önem taşımaktadır.

Anahtar sözcükler: Kauda equina sendromu; kraniyal nöropati; Lyme hastalığı; nöroborreliyoz.

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Lyme disease is a multisystemic zoonotic infection transmitted by ticks and caused by the spirochete *Borrelia burgdorferi* sensu lato complex. The primary vectors are *Ixodes* species ticks, and the disease is mainly characterized by skin, joint, cardiac, and nervous system involvement.[1] The earliest and most typical clinical manifestation is erythema migrans; in later stages, the disease may lead to neurological, cardiac, and rheumatological complications.[1]

Nervous system involvement in Lyme disease is termed neuroborreliosis and occurs in approximately 3–12% of cases.[2] Lyme neuroborreliosis encompasses a broad clinical spectrum that can affect both the central and peripheral nervous systems. The most frequent neurological man-

ifestations include meningoradiculitis, cranial neuropathies, and lymphocytic meningitis.[3,4]

In this paper, we present a rare case of a patient presenting with facial numbness, facial paralysis, and gait difficulty who was diagnosed with Lyme neuroborreliosis after a thorough evaluation, demonstrating concomitant involvement of cranial nerves V and VII along with partial cauda equina involvement.

Case Report

A 32-year-old male patient presented to the emergency department with left-sided facial numbness, nausea, difficulty walking, perianal numbness, and fecal incontinence. No history of a tick bite could be elicited, although he had a history of recent travel to Georgia. His medical history was unremarkable except for residual visual loss in the right eye. He had no history of smoking, alcohol, or substance use. On neurological examination, cranial nerve assessment was intact except for residual limitation of right eye abduction (impaired lateral gaze), sensory loss on the left half of the face, and left-sided peripheral facial paralysis. The patient reported no pain. Muscle strength was 4/5 in the proximal lower extremities bilaterally; deep tendon reflexes revealed brisk patellar reflexes bilaterally, normoactive Achilles reflexes, and mute plantar responses. Saddle hypoesthesia starting from the L3 level and encompassing the sacral dermatomes was present. His gait was spastic-ataxic and required support. Routine biochemistry and complete blood count parameters were within normal limits. Serum VDRL and HIV tests were negative. Contrast-enhanced brain, cervical, thoracic, and lumbar spinal magnetic resonance imaging (MRI) studies were nor-

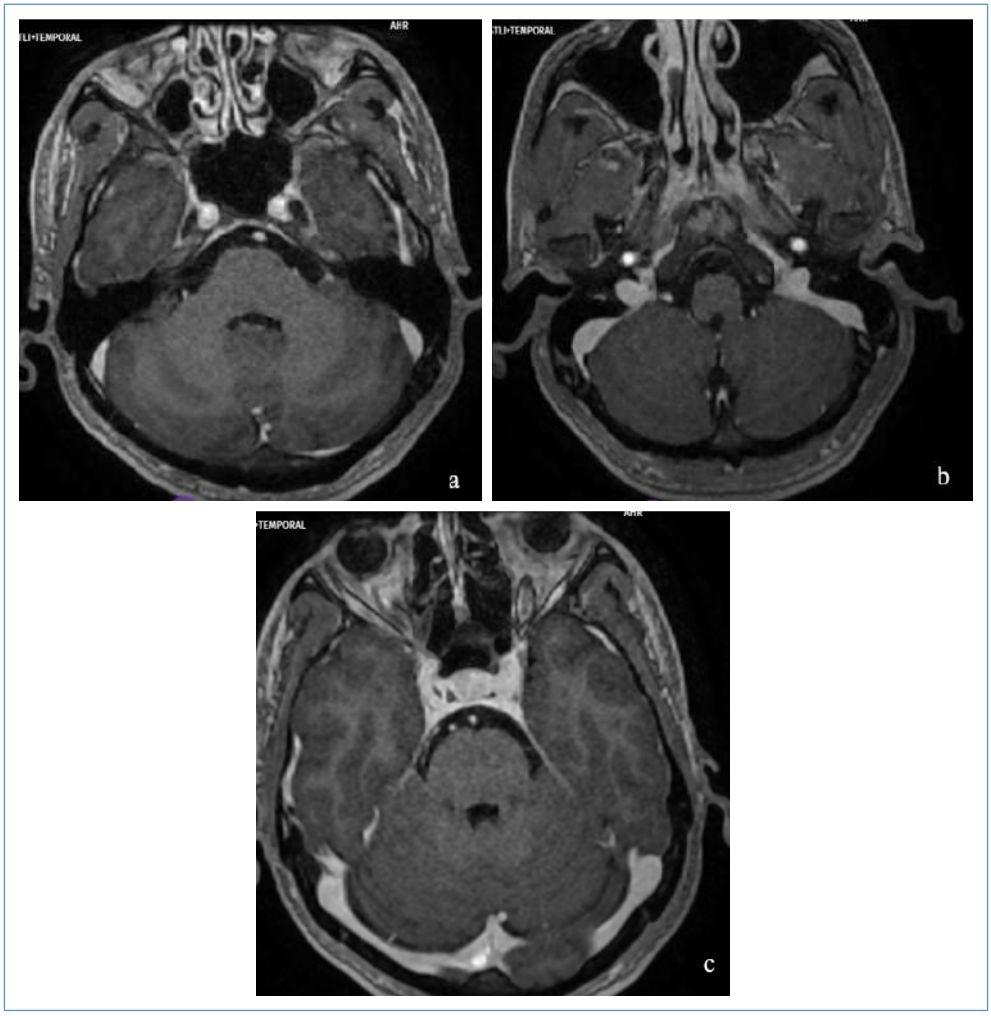

Figure 1. **a, b, c.** Contrast-enhanced axial T1-weighted images show no evidence of pathological signal intensity involving the brainstem structures. Furthermore, axial FLAIR sequences at the level of the lateral ventricles demonstrate no pathological signal changes within the brain parenchyma.

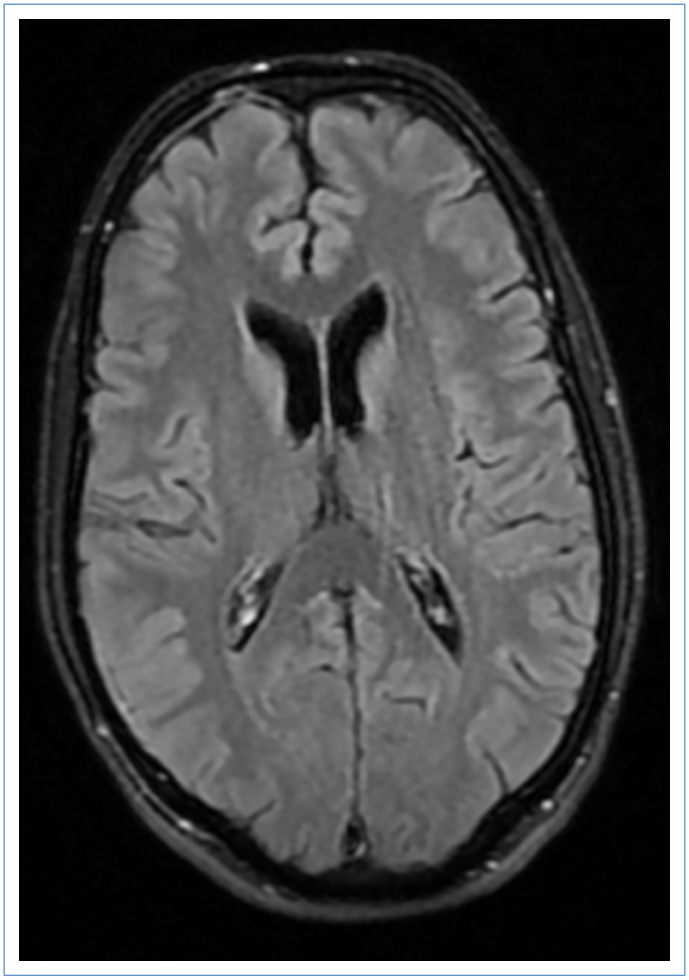

Figure 2. Contrast-enhanced axial T1-weighted images show no evidence of pathological signal intensity involving the brainstem structures. Furthermore, axial FLAIR sequences at the level of the lateral ventricles demonstrate no pathological signal changes within the brain parenchyma.

mal (Fig.1-4). On electrophysiological evaluation, median and tibial somatosensory evoked potentials (SEPs) were within normal limits. Cerebrospinal fluid (CSF) analysis demonstrated elevated protein levels (1.27 g/L) and normal glucose levels (75.5 mg/dL, with a simultaneous blood glucose level of 116 mg/dL); no cells were detected. CSF meningitis panel, CSF culture, tuberculosis polymerase chain reaction (PCR), fungal culture, herpes PCR, *Brucella* IgM and IgG (ELISA), and cytomegalovirus PCR were all negative. CSF oligoclonal band Type 1 was negative. CSF *B. burgdorferi* IgG (Western blot) was negative, whereas CSF *B. burgdorferi* IgM was positive (36.8 Positive U/mL).

During clinical follow-up, his neurological condition progressed: proximal muscle strength in the right lower extremity declined to 3/5, sensory deficits became more prominent,

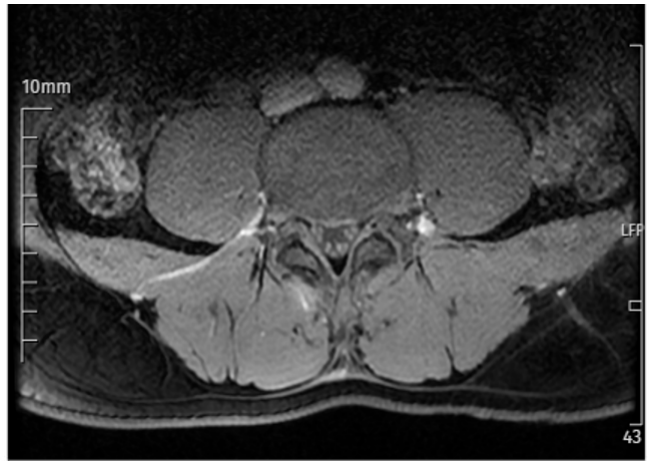

Figure 3. Axial contrast-enhanced T1-weighted lumbar MRI shows no evidence of pathological signal intensity changes.

Figure 4. Sagittal T2-weighted lumbar MRI sections demonstrate no pathological signal intensity changes.

and fecal incontinence developed. Intravenous ceftriaxone, 2 g once daily, was administered for 3 weeks. The patient's clinical condition gradually improved, and his neurological examination was completely normal upon discharge.

Discussion

In this patient presenting with acute conus-cauda involvement and isolated cranial neuropathy symptoms, a diagnosis of neuroborreliosis was established following comprehensive evaluations. Lyme disease is a multisystemic and multistage infectious disease.[1]

The clinical features of the disease vary depending on the stage of infection. While cutaneous involvement is most commonly observed in the early stage, systemic organ involvement emerges in later stages. The early objective skin lesion is erythema migrans, whereas chronic cutaneous changes may develop in the late stages.[1]

Neurological involvement occurs in approximately 3–12% of patients.[2] Lyme neuroborreliosis can affect both the central and peripheral nervous systems.[3] In the vast majority of early-stage European neuroborreliosis cases, the clinical presentation manifests as painful meningoradiculitis (Bannwarth syndrome), characterized by severe radicular pain, cranial neuropathy, and CSF pleocytosis.[4]

Cranial nerve involvement is one of the most common manifestations of Lyme neuroborreliosis, with peripheral facial palsy being particularly frequently reported.[3,5] Less commonly, the trigeminal nerve and other cranial nerves may also be affected.[3] Furthermore, lymphocytic meningitis is a common finding in neuroborreliosis, whereas encephalitis or myelitis is observed less frequently.[3,5]

Cerebral vasculitis is a rare but important complication of Lyme disease and should be considered in the differential diagnosis, especially in young patients presenting with unexplained stroke.[6] Polyneuropathy, a late-stage manifestation, typically presents as predominantly sensory axonal neuropathy.[7]

Our patient presented with peripheral facial palsy, trigeminal nerve involvement, and partial cauda equina syndrome. Although cranial nerve involvement is common in neuroborreliosis, the development of a cauda equina-like syndrome concomitant with trigeminal and facial nerve involvement is a clinical combination rarely reported in the literature.[8]

Inquiring about a history of tick bite is essential for diagnosis; however, only a minority of patients recall prior tick exposure.[9]

CSF analysis plays a critical role in the diagnostic workup. Protein elevation and inflammatory changes in the CSF can be observed in cases of neuroborreliosis.[3] However, culturing the pathogen from CSF is extremely challenging. The sensitivity of PCR testing in CSF is also limited, yielding positive results in only a small subset of cases.[10]

The current standard approach for the serological diagnosis of Lyme borreliosis is a two-tiered testing algorithm. The first step involves screening with an enzyme immunoassay or immunofluorescence antibody test; positive or equivocal results must be confirmed using immunoblotting.[10,11] The most specific diagnostic method is the demonstration of intrathecal antibody production specific to *Borrelia burgdorferi* in CSF.[12]

In our case, although CSF pleocytosis was not detected, elevated protein levels and *B. burgdorferi* IgM positivity were demonstrated by Western blot. While lymphocytic pleocytosis in CSF is observed in the majority of neuroborreliosis cases, cellular expansion may not be detected in early-stage or rare cases. The acute onset of symptoms and the marked clinical response to antibiotic therapy suggested that the detected serological finding was consistent with an active infection.

In the treatment of neuroborreliosis, a 14-day course of antibiotic therapy is considered sufficient for early-stage and isolated neurological involvement, whereas the duration may be extended to 21 days in late-stage or severe central nervous system involvement. First-line treatment frequently involves intravenous ceftriaxone; however, oral doxycycline is known to yield clinical efficacy equivalent to that of intravenous regimens.[13,14]

Antibiotic therapy leads to complete clinical recovery in the majority of patients; nevertheless, post-treatment Lyme disease syndrome (PTLDS) or persistent symptoms—characterized by ongoing fatigue, widespread musculoskeletal pain, and cognitive dysfunction persisting for months after treatment—may be observed in a subset of patients.[15]

Conclusion

In conclusion, this case demonstrates that neuroborreliosis can present with atypical neurological features, such as cranial nerve involvement combined with partial cauda equina syndrome. In the presence of clinical suspicion, early serological evaluation and appropriate antibiotic treatment are paramount to the prognosis of the disease.

Disclosure

Informed Consent: Written informed consents were obtained from patients who participated in this study.

Conflict of Interest: The authors declare that there is no conflict of interest.

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