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Original Research

Early Outcomes of Cervical Interlaminar Epidural Steroid Injection Under Mild-to-Moderate Sedation: A Retrospective Cohort Study

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ABSTRACT

Objective: The role of sedation during cervical interlaminar epidural steroid injections remains controversial in terms of patient comfort and procedural safety. This study aimed to present the early clinical outcomes of cervical interlaminar epidural steroid injections performed under sedation in patients with cervical radiculopathy.

Methods: This retrospective observational study included 44 patients who underwent cervical interlaminar epidural steroid injections under sedation. Pain intensity was assessed before the procedure and at 4 hours after the procedure using the NRS-11, and post-procedural patient satisfaction was evaluated using a Likert scale. Cumulative radiation dose, fluoroscopy time, and intra-procedural complications were analyzed. Mild-to-moderate sedation was targeted, and the Modified Observer's Assessment of Alertness/Sedation Scale (MOAA/S) was used to assess the level of sedation.

Results: At 4 hours post-procedure, a significant decrease in NRS-11 scores was observed compared with pre-procedure scores. Most patients reported high post-procedure satisfaction. No major complications were observed during the study period, and the minor side effects were transient. However, due to the retrospective nature of the study and the absence of a comparison group without sedation, the findings cannot be considered to definitively reflect the effect of sedation.

Conclusion: Cervical interlaminar epidural steroid injections administered with mild-to-moderate sedation were associated with early pain reduction and high patient satisfaction. However, given the limitations of the present study, these findings should be interpreted with caution, and prospective, controlled studies are required to determine the true contribution of sedation.

Keywords: anesthesiology, cervical radiculopathy, epidural injection, mild-to-moderate sedation, pain

INTRODUCTION

Cervical radiculopathy (CR) is defined as "pain with a radicular distribution affecting the upper extremity, resulting from compression and/or irritation of one or more cervical nerve roots." Neurological symptoms such as pain, muscle weakness, and/or sensory loss may occur in these patients [1]. The incidence and prevalence of cervical radiculopathy vary because of broad diagnostic criteria. Although women may be more likely to develop CR than men, there is no definitive consensus on this issue [2]. Risk factors that have been identified include white ethnicity, smoking, and a past history of lumbar radiculopathy [3]. At present, there is no "gold standard" for diagnosing cervical radicular pain. The diagnosis is made by combining the patient's history, physical examination, and imaging studies [4]. When adequate pain control cannot be achieved with noninvasive treatments such as pharmacological therapy, physical therapy, and rehabilitation, interventional and surgical treatment options come to the forefront. Among these, the cervical interlaminar epidural procedure is frequently performed. Cervical epidural steroid injections (CESI) and pulsed radiofrequency applications to the dorsal root ganglion are commonly used interventional treatment modalities [5]. CESI, which is currently considered a minimally invasive procedure, is most preferred in pain management interventions. CESI can be done either under sedation or without sedation depending on the patient's co-morbid conditions, as well as patient and physician preferences. There are conflicting and limited data regarding the necessity of sedation in interventional pain procedures. The American Society of Interventional Pain Physicians (ASIPP) has developed guidelines for sedation use in this patient population. In interventional pain management, the risk of hypoxia due to respiratory depression, as well as psychiatric conditions such as anxiety and depression that commonly develop in patients with chronic pain, may complicate sedation management for anesthesiologists. However, close collaboration with anesthesiologists is essential in interventional pain procedures that carry risks such as vasovagal reactions, contrast allergy, intra-arterial injection, hypotension due to high spinal block, and local anesthetic toxicity. Furthermore, when sedation is deep, the patient may be unable to alert the physician to potential spinal cord injury or other neurological complications [6-9].

Main Points

- Cervical interlaminar epidural steroid injections performed under mild-to-moderate sedation resulted in significant early pain reduction in patients with cervical radiculopathy.
- High patient satisfaction was observed following sedated procedures, with no compromise in procedural safety.
- The use of moderate sedation was not associated with major neurological or cardiopulmonary complications, and only transient minor adverse effects were reported.
- Due to the retrospective design and lack of a non-sedated control group, prospective controlled studies are required to clarify the true impact of sedation on clinical outcomes.

The primary aim of this study was to evaluate the short-term clinical outcomes of cervical interlaminar epidural steroid injections performed under mild-to-moderate sedation. Specifically, we aimed to assess perioperative pain reduction, patient satisfaction, radiation exposure, peri-procedural monitoring findings, and procedure-related complications in this single-center cohort.

MATERIALS AND METHODS

Following the approval of the ethics committee, the study was conducted retrospectively at the tertiary pain clinic (University of Health Sciences, Kanuni Sultan Süleyman Training and Research Hospital Ethics Committee, Approval number: 2026.01.342, Date: 2026-01-15). Throughout the study protocol, the principles of the Declaration of Helsinki were adhered to. The study was designed in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. Written informed consent for the use of clinical data was routinely obtained from all patients prior to the interventional procedure. The ethics committee did not consider it necessary to obtain new consent from patients, given the study's retrospective nature.

Study Population and Eligibility Criteria

Patients diagnosed with cervical radiculopathy between June 2023 and June 2025 who underwent cervical interlaminar epidural steroid injection (CESI) through the C7–T1 intervertebral level were included in the study. Forty-four patients aged 18–65 years with an American Society of Anesthesiologists (ASA) physical status score of 1–3 were included in the study (Figure 1).

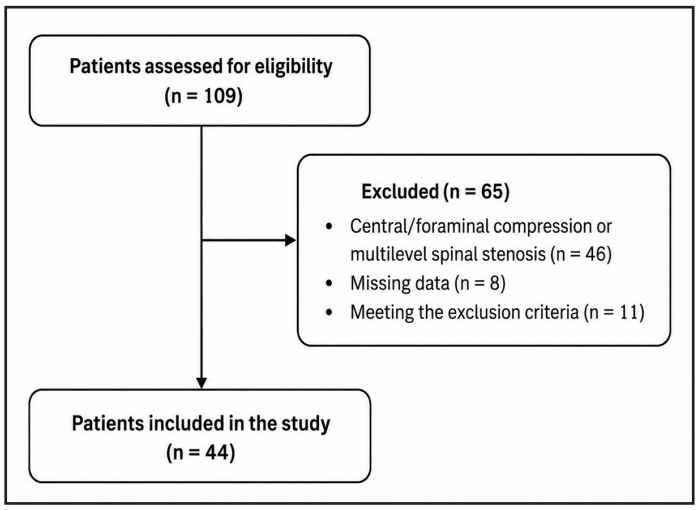

Figure 1. Flow diagram of the study.

Patients with an ASA score ≥4, inflammatory diseases (such as rheumatoid arthritis or ankylosing spondylitis), a history of cervical surgery, malignancy, psychosis, pregnancy, bleeding disorders, systemic or local infection at the injection site, allergy to any of the medications used, or those who had received a cervical injection within the previous 6 months were excluded from the study.

To prevent heterogeneity, intervertebral disc herniations were classified according to the joint consensus classification established by the American Society of Spine Radiology (ASSR), the American Society of Neuroradiology (ASNR), and the North American Spine Society (NASS). According to this classification, only patients with single-level disc protrusion were included in the study [10].

Clinical Parameters and Assessment Scales

The patients' age, sex, body mass index (BMI), procedure level, pain duration, ASA score, cumulative radiation dose, procedure duration, procedure side, and procedure-related complications were recorded. In addition, the Numeric Rating Scale (NRS-11) scores obtained before and 4 hours after the procedure, as well as the post-procedural Likert scale scores, were recorded. The total radiation dose during the procedure was recorded in mGy (milligray) by the fluoroscopy unit after the final image was acquired. Radiation-protective equipment was used throughout the procedure. Efforts were made to minimize exposure time and maximize the distance from the fluoroscopy unit. Pulsed fluoroscopy was used throughout the procedures. The ALARA (as low as reasonably achievable) principle was followed to minimize radiation exposure. Hemodynamic parameters including heart rate, systolic and diastolic blood pressure, and oxygen saturation were continuously monitored throughout the procedure. No clinically significant hemodynamic instability requiring intervention was recorded.

NRS-11: An 11-point numerical scale that allows patients to rate their pain on a scale from 0 points (no pain) to 10 points (the most severe pain they have ever experienced).

Likert scale: Post-procedural patient satisfaction was evaluated using a 5-point Likert scale. Patients were asked to rate their overall satisfaction with the procedure, where 1 indicated "not at all satisfied," 2 "slightly satisfied," 3 "moderately satisfied," 4 "satisfied," and 5 "very satisfied." Higher scores reflected greater levels of patient satisfaction [11].

Modified Observer's Assessment of Alertness/Sedation Scale (MOAA/S): This scoring system evaluates the patient's response to stimuli, verbal response, and eye and facial movements. Scores range from 0 (unresponsive) to 5 (fully alert) [12,13].

The primary outcome of this study was the perioperative change in patients' NRS scores. Secondary outcomes included patient satisfaction, radiation exposure, and procedure-related complications.

Sedation Protocol

Sedation was administered by an anesthesiologist with at least 5 years of experience. Mild-to-moderate sedation was targeted according to the Modified Observer's Assessment of Alertness/Sedation Scale (MOAA/S). For sedation, an intravenous bolus of midazolam (0.03 mg/kg) and fentanyl (1 μg/kg) was administered. In patients who did not achieve an adequate depth of sedation within 5 minutes after the initial dose, an additional bolus of midazolam (0.01 mg/kg) and fentanyl (0.5 μg/kg) was administered. Deep sedation was intentionally avoided to minimize the potential masking of neurological symptoms and reduce the risk of respiratory depression. Maintaining patient communication and responsiveness throughout the procedure was considered important for maximizing procedural safety and efficacy.

Procedure

All procedures were performed using a standardized protocol by the same experienced pain specialist under fluoroscopic guidance. The patient was placed in the prone position in the

operating room, and an intravenous (IV) line was established. Standard monitoring was applied, including electrocardiography, pulse oximetry, and noninvasive blood pressure monitoring. The procedural site was prepared with povidone–iodine and draped in accordance with standard procedural protocols.

After obtaining an anteroposterior (AP) fluoroscopic image, the C7–T1 intervertebral space was visualized at the optimal angle. Using a midline interlaminar approach, an 18-gauge Tuohy needle was advanced into the C7–T1 epidural space using the loss-of-resistance technique. The needle entry point was identified just below the C7 spinous process, and 2 mL of 1% lidocaine was administered for local anesthesia. The Tuohy needle was advanced sequentially through the skin, subcutaneous tissue, spinal ligaments, and ligamentum flavum. After loss of resistance was achieved, 0.5 mL of nonionic contrast medium was injected. Fluoroscopic images were obtained in the AP and contralateral oblique projections (Figure 2). Proper epidural spread of the contrast agent was confirmed, with no evidence of intravascular uptake.

Subsequently, a mixture of dexamethasone (8 mg/2 mL), 2% lidocaine (1 mL), and saline (2 mL) was slowly injected into the epidural space. After needle withdrawal, the patient was instructed to slowly rotate the head to the right and left shoulders three times to facilitate drug distribution through the neural foramen and to prevent possible neural compression or localization. The patient was then monitored for 4 hours after the procedure.

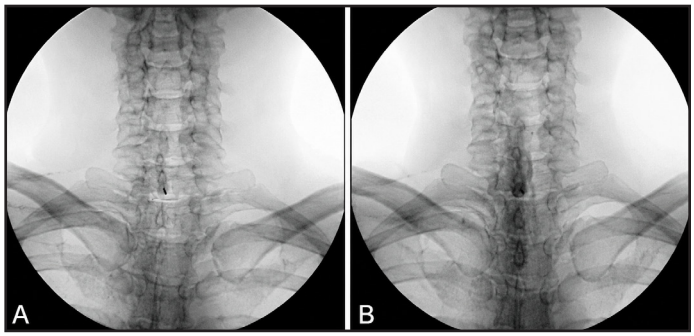

Figure 2. Cervical interlaminar epidural steroid injection under fluoroscopic guidance

(A) Anteroposterior (AP) fluoroscopic image demonstrating appropriate epidural needle positioning. (B) Anteroposterior fluoroscopic image obtained after contrast medium injection, confirming correct epidural space localization and adequate epidural contrast dispersion.

The 4-hour post-procedural time point was chosen to assess the immediate short-term analgesic response while controlling for confounding factors such as residual sedative effects and procedural discomfort. In our institution, patients remain under standardized clinical observation for approximately 4 hours following the intervention. Evaluating pain at this time ensured that measurements were obtained after recovery from mild-to-moderate sedation, yet before discharge-related environmental variability could influence patient-reported outcomes. Thus, the 4-hour assessment provided a uniform and clinically relevant early efficacy endpoint.

Statistical Analysis

The statistical analysis was performed using IBM SPSS Statistics for Windows, version 27.0 (IBM Corp., Armonk, NY, USA). Data normality was assessed using the Shapiro–Wilk test, which indicated that the data were not normally distributed. Therefore, non-parametric tests were applied. Results were reported as frequency, percentage, mean, and standard deviation. Categorical variables were expressed as number (n) and percentage (%). The Wilcoxon signed-rank test was used to compare pre- and post-intervention values. For all statistical tests, a p-value of < 0.05 was considered statistically significant.

RESULTS

The demographic characteristics of 44 patients were analyzed. Of the patients, 17 were female, and 27 were male. The mean age was 47 years, and the mean body mass index (BMI) was 25.9 kg/m². The majority of patients were classified as ASA II (63.6%). The most common level of disc herniation was C7–T1 (38.6%), whereas all procedures were performed through the C7–T1 intervertebral level using a standardized interlaminar approach. The right side was affected in 52.3% of cases (Table 1).

Procedure-related data showed that no complications occurred in 93.2% of patients. One patient experienced a vasovagal reaction, one had tachycardia, and one developed pruritus. No clinically significant hemodynamic instability requiring pharmacological intervention or procedure interruption was observed during the study period. The mean cumulative radiation dose was 3.28 mGy, and the mean fluoroscopy time was 23.95 seconds. The mean post-procedural patient satisfaction score, assessed on a Likert scale, was 4.70. The mean pre-procedural NRS-11 score was 8.34, while the mean NRS-11 score at 4 hours after the procedure was 2.00 (Table 2).

Table 1. Demographic and clinical characteristics of patients

Sex, n (%)	
Female	17 (38.6)
Male	27 (61.4)
Age (years)	47.00 ± 10.08
BMI (kg/m^2)	25.90 ± 3.95
Pain duration (months)	6.36 ± 3.49
ASA, n (%)	
1 2 3	15 (34.1) 28 (63.6) 1 (2.3)
Level of cervical disc herniation, n (%)	
C3-C4 C4-C5 C5-C6 C6-C7 C7-T1	1 (2.3) 3 (6.8) 11 (25) 12 (27.3) 17 (38.6)
DH, n (%)	
Protrusion	44 (100)
Side of pain, n (%)	
Right	23 (52.3)
Left	21 (47.7)

BMI: body mass index; **ASA:** American Society of Anesthesiologists; **CDH:** cervical disc herniation; **DH:** disc herniation; **n:** number of patients. Numerical variables are presented as mean ± standard deviation.

Table 2. Procedure-related variables during sedation

Procedural level, n (%)	
C7-T1	44 (100)
Intra-procedural complications, *n* (%)	
None Vasovagal reaction Tachycardia Pruritus	41 (93.2) 1 (2.3) 1 (2.3) 1 (2.3)
Cumulative radiation dose (mGy)	3.28 ± 0.50
Intra-procedural fluoroscopy time (seconds)	23.95 ± 1.80
Post-procedural Likert scale score, n (%)	
3 4 5	1 (2.3) 11 (25) 32 (72.7)
Post-procedural patient Likert scale (mean)	4.70 ± 0.50
Pre-procedural NRS-11	8.34 ± 0.86
NRS-11 at 4 hours post-procedure	2.00 ± 1.14

Values are presented as n (%) or mean ± standard deviation.

NRS-11: Numeric Rating Scale-11; **n:** number of patients.

A statistically significant reduction in NRS-11 scores was observed at 4 hours after the procedure compared with baseline ($p < 0.001$) (Table 3, Figure 3).

Mild-to-moderate sedation (MOAA/S score 3–4) was successfully achieved in all patients. No episodes of deep sedation (MOAA/S ≤2) were observed during the procedures.

DISCUSSION

Our study examined patients who underwent CESI under sedation. Radiation dose and duration, patient satisfaction, and complications were evaluated. The main findings of this study are as follows: cervical interlaminar epidural steroid injections performed under mild-to-moderate sedation were associated with a significant short-term reduction in pain scores, patient satisfaction levels were high, radiation exposure levels were low, and no major neurological or cardiopulmonary complications were observed. Importantly, the observed reduction in pain scores reflects only the immediate short-term analgesic response and should not be interpreted as evidence of sustained clinical efficacy. The primary objective of the present study was to evaluate early procedural outcomes, including immediate pain response, patient satisfaction, radiation exposure, and procedure-related complications.

Intra-arterial or intravenous injection during epidural procedures may result in hematoma, infection, dural or subdural injection, spinal cord injury, and discitis [14]. No major complications were observed during CESI in our study. Pruritus was considered a minor complication, as it could be related to opioid use. However, no definitive conclusions can be drawn regarding the cause of minor complications. The vasovagal response and tachycardia observed were thought to be more closely related to the patients' anxiety levels and needle phobia. In our study, the mean patient satisfaction score was 4.7 according to the Likert scale. We believe that mild-to-moderate sedation may improve patient comfort and reduce the risk of neurological complications associated with conscious sedation; however, further controlled studies are needed to confirm this assumption. The C7–T1 ligamentum flavum junction defect is considered a safer site for intervention in the cervical spine [15,16]. The combined use of fluoroscopy and the loss-of-resistance technique may reduce the risk of complications in patients. However, there is insufficient evidence to determine whether CESI is superior to the transforaminal technique.

Table 3. Comparison of pre- and post-procedural NRS scores

Comparison	Mean Difference	Std. Deviation	Std. Error Mean	Wilcoxon-Z	p
Pre- and 4-hour post-procedural NRS-11 scores	6.34091	1.47763	0.22276	-5.806	<0.001

Std: standard, **NRS-11:** Numeric rating scale-11

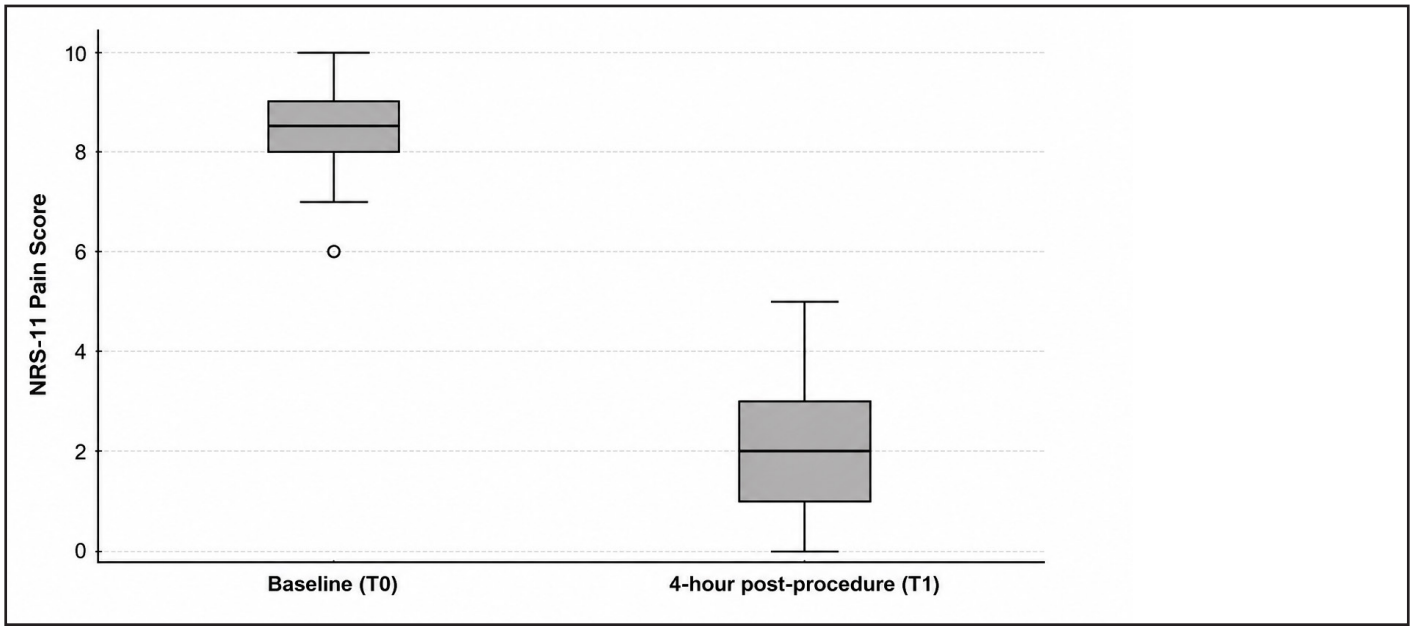

Figure 3. Change in NRS-11 scores before the procedure (T_0) and at 4 hours post-procedure (T_1)

In our study, sedation was standardized according to a predefined clinic protocol. However, dose titration was individualized based on patient age, body weight, ASA score, baseline anxiety level, and clinical response to initial bolus administration. The target sedation depth was mild-to-moderate sedation (MOAA/S 3–4) in all patients. Due to the retrospective design of the study, randomization was not possible, which represents a significant limitation of our study.

The rationale for administering steroids in CESI is to reduce local inflammation, limit fibrosis, and decrease ectopic discharges in the nerve membrane [17]. The use of particulate versus non-particulate steroids in CESI does not appear to affect procedural success [18]. In our clinic, dexamethasone is routinely preferred because of its minimal particulate content.

Fluoroscopy is a standard tool used to perform epidural procedures accurately and safely and is therefore widely utilized. However, even with the use of protective equipment and appropriate fluoroscopy modes, there remains a risk of radiation exposure. There is currently no clear evidence regarding the long-term radiation exposure of healthcare workers during fluoroscopy-guided algology procedures. Yamashita et al. reported cumulative radiation exposure exceeding international reference levels in spinal procedures performed under fluoroscopic guidance [19]. Sacaklı et al. compared four different epidural techniques in terms of radiation exposure, including caudal epidural, cervical and lumbar interlaminar, and lumbar transforaminal injections. Among these techniques, cervical interlaminar epidural procedures were associated with the lowest radiation exposure [20]. In our study, the mean cumulative radiation dose was 3.28 mGy, and the mean fluoroscopy time was 23.95 seconds. We believe that the coordinated use of mild-to-moderate sedation in collaboration with the anesthesia team may reduce radiation exposure; however, further clinical studies are required to draw definitive conclusions.

In the study by Levi et al., 973 patients underwent cervical transforaminal injections without sedation and were retrospectively evaluated, with no neurological or cardiac

complications reported [21]. Concerns persist regarding the use of sedation in CESI because of the potential risk of permanent neurological injury. Such potential damage is more likely to occur with deep sedation. In our study, mild-to-moderate sedation was administered, communication with the patient was maintained, and no major complications were observed during the procedure. Deep sedation was avoided. We believe that close collaboration with anesthesiologists is an important factor in this regard.

Limitations

This study has several limitations. First, the retrospective design, relatively small sample size, and the lack of a control group limit the generalizability of the results. Additionally, the lack of further follow-up constitutes another limitation of the study. Therefore, the present findings are limited to early post-procedural outcomes and do not provide information regarding long-term clinical benefit. There is currently no consensus in the literature regarding the routine use of sedation in algology practice. Additionally, no comparison was made between different depths of sedation or between sedated and non-sedated patients, which limits conclusions regarding the relative benefits of sedation. In this context, our study provides limited evidence regarding the possible association between sedation use in cervical epidural procedures and clinical outcomes. However, prospective, controlled studies with larger sample sizes are required to validate these findings and to clarify the true effect of sedation.

CONCLUSIONS

CESI were associated with significant short-term pain reduction and high patient satisfaction in this retrospective cohort. While mild-to-moderate sedation was used without major complications, the absence of a comparison group and detailed sedation-level analysis precludes definitive conclusions regarding its superiority or necessity. Therefore, prospective and controlled studies are required to more clearly establish the efficacy and safety of sedation. Furthermore, sedation during such interventions should be performed in close collaboration with anesthesiologists.

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Conflict of Interest: The authors have no competing interests to declare.

Informed Consent: Informed consent was obtained from all participants.

Data Availability Statement: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical Approval: The study was approved by the University of Health Sciences, Kanuni Sultan Suleyman Training and Research Hospital Ethics Committee (Approval number: 2026.01.342, Date: 2026-01-15).

Author Contributions: Conception and design (H.I.A, G.A.), Supervision (H.I.A., G.A., F.A.E.), Materials (H.I.A., G.A.), Data Collection and/or Processing (H.I.A., G.A., F.A.E.), Analysis and/or Interpretation (H.I.A., G.A.), Literature Review (F.A.E.), Writing (H.I.A., G.A.), Critical Review (F.A.E)

Author Statement Regarding the Use of Artificial Intelligence-Enhanced Tools:

During the preparation of this manuscript, the authors used artificial intelligence–assisted tools to improve language quality and readability. The authors carefully reviewed and edited the output generated by these tools and take full responsibility for the content of the manuscript. Artificial intelligence tools were not used for data analysis, interpretation of results, or generation of scientific conclusions.

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