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Effect of High-Volume Epidural Steroid Injection on Pain Score and Neck Disability Index in the Treatment of Cervical Radicular Pain: A Retrospective Analysis

Servikal Radiküler Ağrı Tedavisinde Yüksek Volümlü Epidural Steroid Enjeksiyonunun Ağrı Skoru ve Boyun Dizabilite İndeksi Üzerine Etkisi: Retrospektif Bir Analiz

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ABSTRACT

Objective: Cervical radicular pain resulting from disc herniation significantly affects patient's quality of life. Cervical interlaminar epidural steroid injections (CILESIs) are a common treatment for patients who are unresponsive to conservative therapies. This study aimed to evaluate the effectiveness of high-volume (8 mL) CILESIs in treating pain and neck disability.

Method: This retrospective study included patients treated with high-volume CILESIs from January 2021 to January 2024 who had cervical disc herniation unresponsive to conservative treatment. Patients with low-volume treatments, previous cervical surgeries and interventions were excluded. Pain intensity was measured using a numeric rating scale (NRS), and disability was assessed using the neck disability index (NDI) before treatment and at 1 week, 1 month, and 6 months after treatment.

Results: Of 146 patients who fulfilled the inclusion criteria, 132 were included in the study. The mean age was 49.38 ± 5.68 years. The NRS scores significantly reduced from 7.64 ± 0.62 at pre-treatment to 2.62 ± 0.99 at 6 months post-treatment ($p<0.001$). The NDI scores also significantly decreased from 49.27 ± 5.65 at pre-treatment to 15.15 ± 5.02 at 6 months post-treatment ($p<0.001$). No acute or chronic complications occurred.

Conclusion: High-volume CILESIs significantly reduced pain and improved neck disability for up to 6 months in patients with cervical radicular pain, and no acute or chronic complications were observed. It is an effective treatment method that can be performed safely.

Keywords: Epidural injections, neck pain, radiculopathy, disc herniation

ÖZ

Amaç: Disk herniasyonundan kaynaklanan servikal radiküler ağrı hastanın yaşam kalitesini önemli ölçüde etkiler. Servikal interlaminar epidural steroid enjeksiyonları (SİLESE) konservatif tedavilere yanıt vermeyen hastalar için yaygın bir tedavidir. Bu çalışmanın amacı, yüksek volumlü (8 mL) SİLESİ'nın ağrı ve boyun dizabilitesi üzerine etkinliğini değerlendirmektir.

Yöntem: Ocak 2021 ile Ocak 2024 tarihleri arasında konservatif tedaviye yanıt vermeyen servikal disk herniasyonu olan ve yüksek volumlü SİLESE ile tedavi edilen hastaların dijital dosyaları retrospektif olarak incelendi. Düşük volüm uygulanmış hastalar, servikal bölgeden geçirilmiş ameliyatları ve girişimleri olan hastalar çalışma dışı bırakıldı. Tedaviden önce ve tedaviden 1 hafta, 1 ay ve 6 ay sonra ağrı derecesini değerlendirmek için numerik rating skala (NRS), engelliliği değerlendirmek için boyun dizabilite indeksi (BDİ) kullanıldı.

Bulgular: Dahil edilme kriterlerini karşılayan 146 hastadan 132'si çalışmaya alındı. Ortalama yaş 49,38 ± 5,68 yıldı. Hastaların NRS skorları tedavi öncesi 7,64 ± 0,62 iken 6. ayda 2,62 ± 0,99'a düştüğü görüldü ($p<0,001$). Hastaların BDİ skorları ise tedavi öncesinde 49,27 ± 5,65 iken 6. ayda 15,15 ± 5,02'ye gerilediği saptandı ($p<0,001$). Hiçbir akut veya kronik komplikasyon gözlenmedi.

Sonuç: Yüksek volumlü SİLESE'ler servikal radiküler ağrısı olan hastalarda 6 aya kadar ağrıyı önemli ölçüde azaltmış ve boyun özürlülüğünü iyileştirmiştir ve hiçbir akut veya kronik komplikasyon gözlenmemiştir. Güvenle uygulanabilecek etkili bir tedavi yöntemidir.

Anahtar sözcükler: Epidural enjeksiyon, boyun ağrısı, radikülopati, disk hernisi

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INTRODUCTION

Neck pain is a common complaint after low back pain. Cervical facet syndrome, myofascial pain, and cervical disc herniation are the common causes of neck pain (1).

Cervical radicular pain may occur due to cervical disc herniation. Radicular pain radiates to the arms with compression of the cervical spinal nerves, negatively affects the quality of life and sleep of patients and causes loss of labor. Treatment options include conservative approaches, such as medical and physical therapies, spinal interventional methods, and surgery. Cervical epidural steroid injections are an effective treatment for patients who do not benefit from conservative treatment and have no indications for surgical treatment (2,3).

Transforaminal or interlaminar routes can be used for epidural injections. The transforaminal route for epidural steroid injections in the cervical region carries a higher risk compared to the interlaminar route. Considering the risk of complications that may occur during transforaminal injections due to intra-arterial injection, arterial vasospasm, or arterial injury, particularly in the vertebral artery, interlaminar epidural injections are safer (4).

According to the American Society of Interventional Pain Physicians comprehensive evidence-based guidelines, fluoroscopy-guided cervical interlaminar epidural steroid injection (CILESI) has been shown to have an evidence level of 1 for disc herniation-related pain and a strong recommendation for long-term effects, and an evidence level of 2 for spinal stenosis and a moderate-to-strong recommendation for long-term effects (3).

A survey among Spine Intervention Society physicians assessing trends in steroidal agents and diluent choices for epidural steroid injections showed that 21% of the respondents preferred a high volume (>4.5 mL) for CILESIs (5).

To the best of our knowledge, no study has evaluated the effect of high-volume CILESIs on pain and its clinical outcomes in a long-term follow-up and reported its complications. We aimed to evaluate the effect of high-volume CILESIs on pain and neck disability for 6 months.

MATERIALS and METHODS

Study Population

This retrospective study was approved by the Institutional Review Board of Başakşehir Çam ve Sakura City Hospital (approval no:26.06.2024.62). The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki as revised in 2013. Following approval from the ethics committee, the files of patients who underwent cervical epidural steroid administration at our clinic between January 2021 and January 2024 were examined digitally.

Inclusion criteria

The data of patients who presented with pain due to cervical disc herniation, did not benefit from conservative treatments, and were treated with high-volume (8 mL) CILESIs were reviewed.

Exclusion criteria

The patients who had previously undergone surgery for cervical disc herniation, those who had undergone multiple interventional treatments in pain clinic for the cervical region, those in whom a low volume was used for treatment, and those who underwent surgery during the follow-up were excluded from the study.

Numeric Rating Scale (NRS)

The pain intensity was measured using the NRS, with a score between 0 and 10, where 0 represents no pain and 10 represents the most severe pain. This scale was evaluated face-to-face with the patients before the procedure and at the 1st week, 1st month, and 6th month of follow-ups.

Neck Disability Index (NDI)

This questionnaire was used to assess the extent to which neck pain affects the ability of patients to perform activities of daily living. It provides information about the level of disability of patients after the total score is calculated based on the evaluation of the answers received from 10 questions between 0 and 5 points and after the calculation of a percentage. This scale was administered face-to-face with the patients before the procedure and at the 1st week, 1st month, and 6th month of follow-ups.

Follow-up

The NRS and NDI values were recorded in the digital files of the patients before the procedure, and on the 1st week, 1st month, and 6th month after the procedure (hereafter 1st week, 1st month, and 6th month values, respectively).

Intervention

First, the patient was placed in prone position, and intravenous (iv) access was established in the operating room. The patient was monitored, and the procedure area was sterilized and covered. No iv anesthetic agent was administered to the patient. Using an 18-gauge Tuohy needle, the aim was to reach the C7-T1 epidural space with the loss of resistance technique guided by fluoroscopic images. The insertion site of the needle was marked below the C7 spinal process, and local

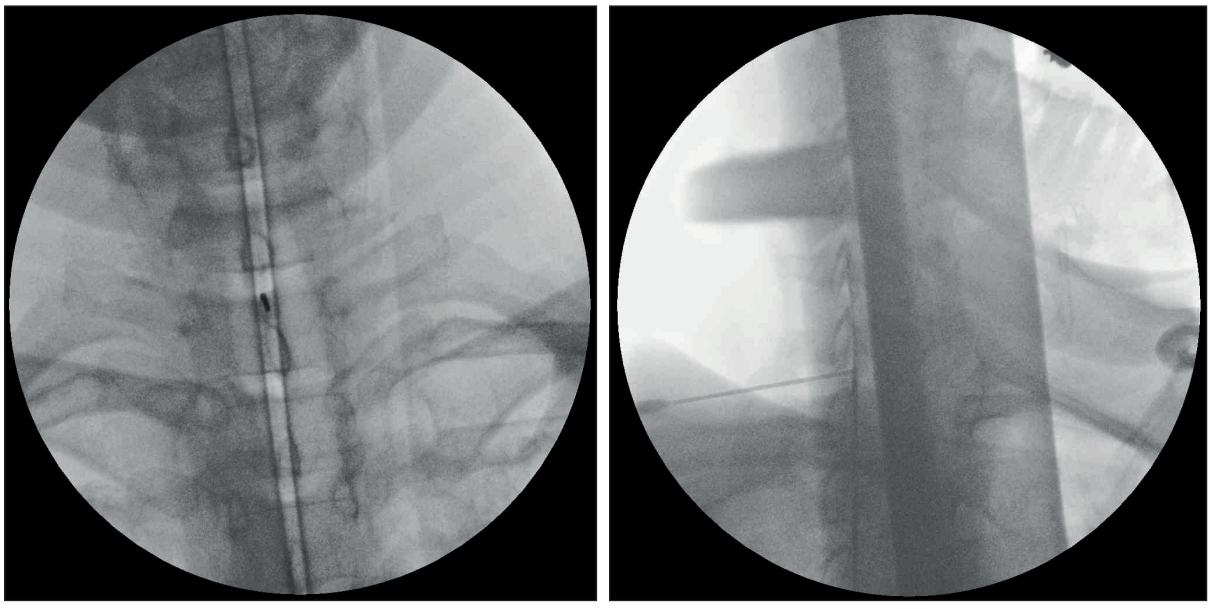

Figure 1: A) Antero-posterior fluoroscopy image of cervical epidural steroid injection. **B)** Contralateral oblique fluoroscopy image of contrast spread.

anesthesia was applied using 2 mL 2% lidocaine. Afterward, an 18-gauge Tuohy needle was passed through the skin, subcutaneous tissue, ligamentum supraspinale and interspinale, and finally, the ligamentum flavum. The loss of resistance was felt, and 1 mL of iohexol was injected; X-ray images were taken in the anterior-posterior, contralateral oblique, and lateral positions, confirming that the contrast spread was in the epidural space with no vascular spread (Figure 1). Next, 8 mL of injectate containing 16 mg dexamethasone (4 mL) and 4 mL saline was administered into the epidural space. The drug was injected slowly for approximately 1 min, during which the patient was verbally communicated with and confirmed that they did not experience any uncomfortable sensation. After the needle was removed, the patient's head was slowly turned left and right a few times to help the exit and spread of the injectate from the neural foramen to avoid an increase in pressure and uncomfortable sensation. This procedure was then terminated. After the patient was observed on the operating room for 5 min and his blood pressure was measured, he was taken to the recovery room and discharged with recommendations after 2 h of follow-up.

Statistical Analysis

The statistical package for social sciences (SPSS) 23 Windows package was used for the statistical analysis (IBM, New York, USA). The means, standard deviations, medians, and minimum and maximum values of the data are presented. Normality assessment was performed using the Kolmogorov–Smirnov test, Q-Q plots, and a histogram. The Friedman test was used for statistical analyses between the repeated measurements of NDI and NRS values pre-procedure, 1st week, 1st month, and 6th months. The Wilcoxon test was used for pairwise comparisons of the pre-procedure, 1st week, 1st month, and 6th month NRS and NDI values. $P < 0.05$ was considered significant at 95% confidence interval.

RESULTS

A total of 146 patients were eligible for this study. However, 14 patients who had no NRS score, no NDI score, and did not complete the controls were excluded from the evaluation. Thus, the files of 132 patients were analyzed digitally. The demographic data of the patients and the level of herniation are shown in Table I.

Primary Outcome

A statistically significant difference was found between the NRS scores of the pre-procedure, 1st week, 1st month, and 6th month controls by Friedman analysis ($p<0.001$). The Wilcoxon paired two-sample test was used to compare the pre-procedure NRS scores with the 1st week, 1st month, and 6th month NRS values. A statistically significant decrease was found in the NRS values between the 1st week, 1st month, and 6th month values compared to the pre-procedure values ($p<0.01$) (Table II).

Secondary Outcome

A statistically significant difference was found between the NDI scores of the pre-procedure, 1st week, 1st month, and 6th month controls by Friedman analysis ($p<0.001$). The Wilcoxon paired two-sample test was used to compare the preproce-

Table I. Demographic Characteristics of Patients

		Mean ± SD	n (%)
Age (years)		49.38 ± 5.68	
Height (cm)		166.88 ± 7.45	
Weight (kg)		74.47 ± 7.33	
Gender	Female		70 (53)
	Male		62 (47)
LOH	C3-4		15 (11)
	C3-4, C4-5		6 (4)
	C4-5		18 (14)
	C4-5, C5-6		8 (6)
	C5-6		28 (21)
	C5-6, C6-7		9 (7)
	C6-7		17 (13)
	C6-7, C7-T1		9 (7)
	C7-T1		22 (17)

LOH: Level of herniation, **SD:** standard deviation.

Table II. Comparison of Pre-Procedure NRS Values with NRS Values at 1 Week and 1 and 6 Months

	Mean ± SD	Median (Q1-Q3)	p-value
NRS			
Pre-procedure	7.64 ± 0.62	8 (7–8)	
1st week control	2.33 ± 0.68	2 (2–3)	*<0.001**
1st month control	2.33 ± 0.95	2 (2–3)	*<0.001***
6th month control	2.62 ± 0.99	3 (2–3)	*<0.001****

:** Analysis of pre-procedure and 1st week control NRS values, *:** Analysis of pre-procedure and 1st month control NRS values, *****:** Analysis of pre-procedure and 6th month control NRS values, **NRS:** Numeric Rating Scale, **SD:** Standard deviation.

dural NDI values with the 1st week, 1st month and 6th month NDI values. A statistically significant decrease was found between the 1st week, 1st month and 6th month values compared to the pre-procedural values ($p<0.01$) (Table III).

DISCUSSION

In this study, we found that high-volume cervical epidural steroid injection for treating neck pain caused by cervical disc herniation reduced pain complaints and decreased NDI values for 6 months. Additionally, no acute or chronic complications were observed in any patient after high volume cervical epidural steroid injection.

Cervical interlaminar procedures can be performed at the C5-6, C6-7, and C7-T1 levels. However, there may be risks, such as cord damage due to anatomical variations (non-closure, gap) of the ligamentum flavum in the cervical region. A cadaveric anatomy study showed that the C2 level had the minimal ligamentum flavum coverage on both the medial and lateral sides, along with the largest empty space. In contrast, the C6 and C7 levels had the most ligamentum flavum coverage on both sides and the smallest empty space (6).

Table III. Comparison of Pre-procedure NDI Values with NDI Values at 1 Week and 1 and 6 Months

	Mean ± SD	Median (Q1-Q3)	p-value
NDI			
Pre-procedure	49.27 ± 5,65	50 (44–52)	
1st week control	13.3 ± 4.1	12 (10–16)	*<0.001**
1st month control	13.27 ± 4.6	13 (10–18)	*<0.001***
6th month control	15.15 ± 5.02	14 (12–20)	*<0.001****

:** Analysis of pre-procedure and 1st week control NDI values, *:** Analysis of pre-procedure and 1st month control NDI values, *****:** Analysis of pre-procedure and 6th month control NDI values, **NDI:** Neck Disability Index, **SD:** Standard deviation.

In a study evaluating the anatomy of the cervical ligamentum flavum using magnetic resonance images, the level with the highest level of complete closure was shown to be the C7-T1 level, indicating that this level may be safer for cervical epidural procedures than the C5-6 and C6-7 levels (7).

In the light of the above data, the safest level seems to be C7-T1. There is no clear consensus on the volume to be provided in CILESIs. Studies comparing volumes used in CILESIs are limited.

In a study evaluating CILESI spread from the C7-T1 level with opaque material, volumes of 2.5 mL, 5 mL, and 10 mL were compared. They found that 2.5 mL reached 50% of the C4 level and 31% reached the C2 level, while the volumes of 5 and 10 mL showed adequate cephalad and caudal spread, and there was no statistical difference between them, so they recommended the lower volume of 5 mL. Although there was no statistically significant difference, the rate of reaching C4 level and above was higher in patients administered a volume of 10 mL. However, the effects of the volumes on long-term pain and NDI were not stated in the study (8).

The diameter of the optic nerve sheath was measured in a study using a high volume (14 mL) of injectate from the C5-6 level, and the most critical increase was observed at the fourth minute, which did not continue, and it was determined that the high volume did not increase the optic nerve sheath diameter in the long term. In that study, complications due to increased intracranial pressure were not observed in any patient (9).

Previous studies have shown that cervical epidural steroid injection with a volume of 5 mL is effective (10). However

to our knowledge, no studies have compared the effects of injectate volumes. In our study, the safe zone of the C7-T1 interval was used in all patients, and CILESIs were performed with a high-volume injectate. A statistically and clinically significant reduction in pain compared to that at pre-procedure was maintained in all patients for 6 months along with a statistically and clinically significant reduction in neck disability index scores compared to those at pre-procedure. No complications related to the high-volume injections were observed.

Our study has certain limitations. The most important limitation is the lack of a control group. The retrospective nature of our study is another limitation. Prospective randomized-controlled trials comparing different volumes of injectables may lead to a consensus on the injectate volume for performing CILESIs.

CONCLUSION

A higher volume of injectate is safe and effective for providing pain relief up to 6 months. Pain palliation and improvement in NDI without acute or chronic complications can be achieved with high volume CILESIs from the C7–T1 interlaminar level, which is a safer entry site. Further studies comparing different injectate volumes and long-term outcomes are recommended to optimize treatment protocols.

AUTHOR CONTRIBUTIONS

Conception or design of the work: BE, TTS
Data collection: BE
Data analysis and interpretation: TTS
Drafting the article: BE, TTS
Critical revision of the article: BE, TTS
The authors (BE, TTS) reviewed the results and approved the final version of the manuscript.

REFERENCES

1. Popescu A, Lee H. Neck pain and lower back pain. Med Clin North Am 2020;104(2):279-92.
2. Corp N, Mansell G, Stynes S, et al. Evidence-based treatment recommendations for neck and low back pain across Europe: A systematic review of guidelines. Eur J Pain 2021;25(2):275-95.
3. Manchikanti L, Knezevic NN, Navani A, et al. Epidural interventions in the management of chronic spinal pain: American Society of Interventional Pain Physicians (ASIPP) Comprehensive Evidence-Based Guidelines. Pain Physician 2021;24(S1):27-208.
4. Lee JH, Lee Y, Park HS, Lee JH. Comparison of clinical efficacy of transforaminal and interlaminar epidural steroid injection in radicular pain due to cervical diseases: A systematic review and meta-analysis. Pain Physician 2022;25(9):1351-66.
5. Clements N, Vydra D, Cushman DM, et al. Trends in steroid agent and diluent choices for epidural steroid injections: A survey of Spine Intervention Society physicians. Reg Anesth Pain Med 2019;44:809-13.
6. Rahmani MS, Terai H, Akhgar J, et al. Anatomical analysis of human ligamentum flavum in the cervical spine: Special consideration to the attachments, coverage, and lateral extent. J Orthop Sci 2017;22(6):994-1000.
7. Joshi J, Roytman M, Aiyer R, Mauer E, Chazen JL. Cervical spine ligamentum flavum gaps: MR characterization and implications for interlaminar epidural injection therapy. Reg Anesth Pain Med 2022;47(8):459-63.
8. Lee SE, Joe HB, Park JH, et al. Distribution range of cervical interlaminar epidural injections: A comparative study with 2.5 mL, 5 mL, and 10 mL of contrast. Pain Physician 2013;16(2):155-64.
9. Kim H, O JH, Hong SJ, Shin KM, Park J, Kang SS. Cervical interlaminar epidural injections at high doses do not increase optic nerve sheath diameter on a long-term basis. Pain Physician 2016;19(8):1173-9.
10. Li BZ, Tang WH, Li Y, Zhou L, Liu MG, Bao SX. Clinical efficacy of epidural injections of local anesthetic alone or combined with steroid for neck pain: A systematic review and meta-analysis. Biomed Res Int 2022;2022:8952220.