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NEÜ YAYINEVİ

Efficacy of Ultrasound-Guided Caudal Epidural Steroid Injection for Axial or Radicular Low Back Pain

Lomber Aksiyel veya Radiküler Ağrılı Hastalarda Ultrason Kılavuzluğunda Kaudal Epidural Steroid Enjeksiyonunun Etkinliği

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Öz

Amaç: USG kılavuzluğunda kaudal steroid enjeksiyonları (KSE), radyasyon maruziyeti olmaksızın daha kolay uygulanabilme avantajına sahiptir. Bu çalışmanın amacı, USG kılavuzluğunda yapılan KSE'nin aksiyel veya radiküler bel ağrısı tedavisinde etkinliğini değerlendirmektir.
Hastalar ve Yöntem: Bu çalışma retrospektif kesitsel olarak tasarlanmıştır. Aralık 2022-Mayıs 2023 tarihleri arasında, diskojenik veya radiküler karekterde kronik bel ağrısı olan ve USG eşliğinde kaudal epidural steroid enjeksiyonu yapılan 21 hasta çalışmaya dahil edildi. İşlemden 2 ve 6 hafta sonra, hastaların vizüel analog skala (VAS-ağrı), hasta memnuniyet ölçeği, uyku kalitesi düzeyi ve Roland Morris Özürlülük Anketi (RMÖA) düzeyleri değerlendirildi.
Bulgular: Tedavi öncesi düzeylere göre, 2. ve 6. hafta kontrollerde VAS-ağrı skorlarında belirgin gerileme saptandı (p<0.001). Anlamlı ağrı azalması olarak kabul edilen, %50'den fazla ağrı rahatlaması oranı 2. haftada %57,1, 6. haftada ise %38,1'idi. RMÖA skorlarında, benzer şekilde 2. ve 6. haftada anlamlı iyileşme gözlendi (p<0.001) ancak; 2. hafta ile 6. hafta arasında anlamlı fark gözlenmedi (p=0.447). Hastaların %71,4'ü başvuruda uyku kalitesini kötü olarak bildirirken, bu oran 2. ve 6. haftalarda sırasıyla %19,0 ve %23,8'e düşmüştü. Memnuniyet açısından hastaların %91,5'i 2. haftada daha iyi olduklarını belirtirken, bu oran 6. haftada %71,4'e düşmüştür.
Sonuç: USG kılavuzluğunda yapılan KSE, primer konservatif tedaviye dirençli diskojenik-radiküler bel ağrısı olan hastalarda ağrıyı, uyku kalitesini ve dizabiliteyi iyileştirmek ve aynı zamanda yüksek hasta memnuniyetini sağlamak için kısa-orta süreli takipte oldukça etkili ve güvenli bir tedavi seçeneğidir.

Anahtar Kelimeler: Bel ağrısı, kaudal epidural blok, ultrason kılavuzluğu, hasta memnuniyeti

Abstract

Aim: Ultrasound (USG)-guided caudal epidural steroid injections (CESI) have the advantage of being more easily applicable without radiation exposure. The aim of this study is to evaluate the effect of USG-guided CESI on axial or radicular low back pain.
Patients and Methods: This study was designed as a retrospective cross-sectional study conducted in an outpatient setting at a tertiary care hospital. Records of the 21 patients who underwent USG-guided CESI due to axial or radicular low back pain and had an assessment with a visual analog scale (VAS pain), degree of pain relief, patient satisfaction scale, sleep quality, and Roland Morris Disability Questionnaire (RMDQ) in the patient files or electronic database were included in the study between December 2022 and May 2023.
Results: There was a significant difference in VAS pain scores between admission and the 2nd week and between admission and the 6th week (p<0.001). The frequency of meaningful pain reduction accepted as more than 50% pain relief was 57.1% and 38.1% at the 2nd and 6th weeks, respectively. A significant difference was found in RMDQ scores between admission and the 2nd week, between admission and the 6th week (p<0.001), and between the 2nd week and the 6th week (p = 0.447). While 71.4% of the patients described poor sleep at presentation, this ratio was 19.0% and 23.8% at the 2nd and 6th weeks, respectively. While 91.5% of the patients declared that they were better in the 2nd week, 71.4% reported that they were better in the 6th week.
Conclusion: Ultrasonography-guided CESI is an effective treatment method for improving pain, sleep quality, and disability by ensuring high patient satisfaction in individuals with axial or radicular low back pain in a short-to-moderate-term follow-up.

Keywords: Low back pain, caudal epidural block, ultrasound-guided, patient satisfaction

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INTRODUCTION

Low back pain is one of the most commonly encountered health problems worldwide. It is one of the leading causes of deterioration in the quality of life and loss of labor (1). Low back pain can be acute (<1 month), subacute (1-3 months), or chronic (>3 months), depending on the duration of the symptoms. Chronic low back pain prevalence is estimated at 3.9–25.4 percent, and this rate increases in the older population (2). Lumbar disc herniations are one of the most common causes of low back pain and the most common cause of lumbosacral radiculopathy. Lumbar disc herniation is the pathology of the herniated nucleus pulposus, which often presents with a sudden onset of pain in the hips and legs following increased low back pain. According to Magnetic Resonance Imaging (MRI) findings, lumbar disc pathologies are classified as bulging, protrusion, extrusion, and sequestration. Non-operative treatments, including patient education, activity modification, medications, physical therapy modalities, exercises, spinal manipulation, traction (manual or mechanical), and epidural steroid injections are the first choice for most patients (3-5). Epidural steroid injections have been used to treat low back pain and sciatalgia for a long time. Its effectiveness has been demonstrated in many studies (6-8). Epidural injections may be applied with the interlaminar, caudal, or transforaminal approach (9).

Caudal epidural steroid injection (CESI) is the earliest described technique and involves the infusion of the medication into the epidural space from the sacrococcygeal ligament via the sacral hiatus. CESI is also accepted as the easiest and safest technique for epidural injections, although there is a risk of intravascular injection (10,11). Caudal epidural steroid injection may be applied with fluoroscopy, CT, or ultrasonography (USG)-guided. Studies about CESI in the literature include mainly fluoroscopy-guided injections. Ultrasonography-guided CESI has been applied more frequently in recent years. Considering the disadvantage of radiation exposure in fluoroscopy-guided caudal epidural steroid injection and the approximately 30% rate of needle misplacement in blind techniques relying on anatomical landmarks, as well as the significantly shorter procedural duration with ultrasound guidance compared to fluoroscopic procedures, the ultrasound-guided caudal block appears to be a safe, effective, and reasonable approach (12, 13).

This procedure, performed under ultrasound guidance, enables more precise injections, thereby enhancing the success of the treatment. However, standardizing the treatment across a broad clinical spectrum proves challenging. Further research is needed to determine the specific clinical cases in which caudal block is warranted, as well as the optimal approach, timing, and technique. Particularly in recent years, patient satisfaction surveys have emerged as an important outcome measure in evaluating treatment results. To our knowledge, there is no study investigating the efficacy of USG-guided caudal epidural block, taking patient satisfaction into account.

The aim of this study is to investigate the short-term effectiveness, safety, and level of patient satisfaction of USG-guided CESI in patients with chronic low back pain unresponsive to conservative treatment associated with lumbar disc herniation.

PATIENTS AND METHODS

Study design and participants

The study protocol was approved by the Ethics Committee of Karatay University Non-Pharmaceutical and Medical Devices (2023/042). The study was designed as a retrospective and observational case-control study. Patients who underwent USG-guided CESI between December 2022 and May 2023, within the last six months, at a tertiary rehabilitation hospital and met the inclusion criteria were included in the study. Sociodemographic data, pain duration, pain distribution, comorbid diseases, history of lumbar surgery, treatment history, affected disc level, analgesic usage, and examination findings were obtained from patient files and electronic databases. In accordance with the literature, pain localized to the back was defined as 'axial pain' while pain radiating down the leg was defined as 'radicular pain' (7, 10). The presence of neuropathic characteristics in the pain was assessed using the Douleur Neuropathique 4 questions (DN4) (14).

The inclusion criteria were as follows:

- axial or radicular low back pain for at least three months unresponsive to conservative treatment
- age >18 years
- magnetic resonance imaging (MRI) findings were compatible with a lumbar disc lesion
- having routine post-injection clinical follow-ups at 2. and 6. week follow-ups
- patients who were evaluated with the Visual Analogue Scale (VAS) and had a VAS score of 5 or above.

- the patients were queried about sleep quality and patient treatment satisfaction survey, and Roland Morris Disability Questionnaire (RMDQ) during their follow-ups.

The exclusion criteria were as follows:

- patients who had received a lumbar injection previously; those with low back pain caused by secondary factors or red flags (fracture, malignancy, infection, rheumatic diseases, etc.).
- patients with an injection site infection, cauda equina syndrome, or progressive neurological deficit.
- patients who underwent interventional pain treatment or physical therapy programs after the CESI.

The Roland Morris Disability Questionnaire (RMDQ) is a validated tool in Turkish that assesses the impact of back pain on daily life (15). This questionnaire comprises 24 questions, with each question being answered as either yes (1 point) or no (0 point). The total score ranges from 0 to 24, where higher scores indicate a poorer functional status. To evaluate sleep quality, the 6th question of the Pittsburgh Sleep Quality Index (PSQI) was utilized, which is a 4-point Likert scale (16). This question, "How was your sleep quality last week?" was answered as 0 for very bad, 1 for fairly bad, 2 for fairly good, and 3 for very good. Patient satisfaction was assessed using a Likert-type questionnaire ranging from 1 to 7. On this scale, the options were defined as follows: 1 for "much better," 2 for "better," 3 for "slightly better," 4 for "no change," 5 for "slightly worse," 6 for "worse," and 7 for "much worse." Participants were instructed to select the option that best represented their own condition.

For US-guided CESI caudal block application in our clinic, the patient is lying prone, the lower lumbar-sacral region is sterilized with betadine, and the caudal canal is determined with the help of USG under sterile conditions. First, the optimal transverse view was obtained, which revealed the superficial sacrococcygeal ligament between the two sacral cornua and the deeper sacral bone. The target in this transverse view is the hypoechoic region known as the caudal canal, located between the sacrococcygeal ligament and the sacral bone. Subsequently, the probe was rotated 90 degrees for a longitudinal view to facilitate the "in-plane" insertion of the needle into the sacral hiatus. To prevent dural puncture or hemorragia, the needle should not be advanced more than 10–15 mm beyond the apex, as its tip becomes invisible beyond this point. A mixture of steroid, local anesthetic, and serum physiologic (20 mg/1 ml triamcinolone, 4 ml 0.5% bupivacaine, and 4 ml isotonic) is injected into the caudal canal with a 10 cc syringe, 20-gauge, 90-mm spinal needle under USG guidance (Fig. 1). After entering the canal through the sacrococcygeal ligament, the needle is advanced approximately 10–15 mm and blood control is performed. 9 ml of the mixture are slowly injected (Fig. 2). Then, the patients are monitored for 1 hour regarding vital signs, complications and discharged to their homes.

Figure 1. Image depicting the caudal block injection procedure

Statistical analysis

Data were analyzed with SPSS 25.0 (IBM Co., Inc., USA). The Shapiro-Wilk test was used to determine whether the variables had a parametric distribution.

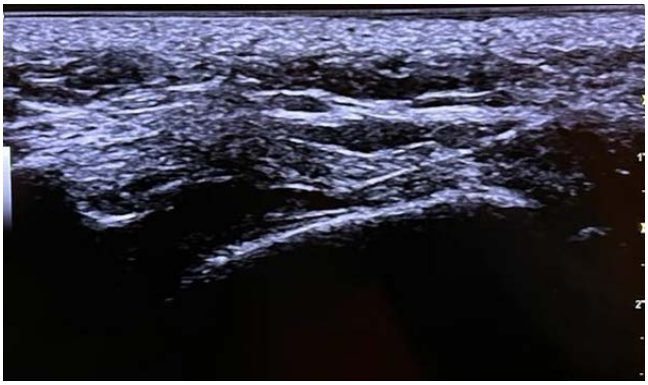

Figure 2. In-plane ultrasound-guided technique demonstrating the entry of the spinal needle into the caudal canal

Table 1. Demographic features of the patients

		N (%) or mean±SD
Age		51.24±14.08
Sex	Female	13(61,9)
	Male	8 (38,1)
BMI (kg/m^2)		27.15±4.35
Educational status	Illiterate	2 (9,5)
	Primary school	14 (66,7)
	Intermediate school	4 (19,0)
	High school	-
	University	1 (4,8)
Marital status	Married	14 (66,7)
	Single or widow	7 (33,3)
Occupation	Housewife	9 (42,9)
	Working	7 (33,3)
	Retired	5 (23,8)
Economic status	İncome equal to the outcome	12 (57,1)
	Income higher than the outcome	5 (23,8)
	Income lower than the outcome	4 (19,0)
Smoking	No	18 (85,7)
	Yes	3 (14,3)

SD: Standard deviation, BMI: Body mass index

Table 2. Clinical characteristics of the patients

		n (%) or mean±SD
Pain distribution	Low back pain	3 (14,3)
	Low back and unilateral radicular pain	15 (71,4)
	Low back and bilateral radicular pain	3 (14,3)
Neuropathic pain	Yes	18 (85,7)
	No	3 (14,3)
VAS pain		7.29±1.45
RMDQ score		16.62±5.24
Sleep Quality	0-very bad	5 (23,8)
	1-fairly bad	10 (47,6)
	2-fairly good	6 (28,6)
	3-very good	-
Analgesic usage	NSAID	5 (23,8)
	Gabapentinoids	2 (9,5)
Neurogenic claudication	Yes	9 (42,9)
	No	12 (57,1)
Lumbar operation history	Yes	6 (28,6)
	No	15 (71,4)
Affected disc level	L3-4	1 (4,8)
	L4-5	2 (9,5)
	L5-S1	8 (38,1)
	L4-5 and L5-S1	10 (47,6)
MRI finding	Protrusion	12 (57,1)
	Extrusion	3 (14,3)
	Protrusion and extrusion	6 (28,6)
Comorbidity	Yes	10(47,6)
	No	11 (53,4)
Comorbid disease*	HT	5 (23,8)
	DM	4 (19,0)
	Asthma/COPD	4 (19,0)
	CAD	1 (4,8)
	BPH	3(14,3)

VAS: Visual analog scale, RMDQ: Roland-Morris Disability Questionnaire, NSAID: Nonsteroidal anti-inflammatory drugs, COPD: Chronic obstructive pulmonary disease, BPH: Benign prostate hyperplasia, MRI: Magnetic resonance imaging

Table 3. Visual analog scale, Roland-Morris Disability Questionnaire, sleep quality scores, and patient satisfaction status of the participants

		Baseline	2nd week	6th week	p
		n(%) or mean±SD			
VAS pain		7.29±1.45	3.62±1.66	3.90±2.28	<0.001[a] <0.001[b] 0.447[c]
VAS score reduction of >50%		-	12 (57,1)	8 (38,1)	
RMDQ		16.62±5.24	11.38±3.91	9.67±4.55	<0.001[a] <0.001[b] 0.027[c]
Sleep Quality	0-very bad	5 (23,8)	1(4,8)	1 (4,8)	
	1-bad	10 (47,6)	3 (14,3)	4 (19,0)	
	2-good	6 (28,6)	13 (61,9)	9 (42,9)	
	3-very good	-	4 (19,0)	7 (33,3)	
Patient Satisfaction	much better	-	3 (14,3)	4 (19,0)	
	better	-	8 (38,1)	2 (9,5)	
	a little better	-	8 (38,1)	9 (42,9)	
	no change	-	2 (9,5)	5 (23,8)	
	a little worse	-	-	1 (4,8)	
	much worse	-		-	

VAS: Visual analog scale, RMDQ: Roland-Morris Disability Questionnaire
[a]baseline-2nd week, [b]baseline-6th week, [c] 2nd week-6th week comparisons

Categorical data were expressed as numbers and percentages (%). Numerical variables with parametric distribution are shown as the mean ± standard deviation (SD), and non-parametrically distributed numerical variables are shown as the median (min-max). The numerical variables with a non-parametric distribution and repeated measurements were compared using the Wilcoxon signed-rank test and the Friedman test. P<0.05 was accepted for statistical differences.

RESULTS

A total of 21 patients were included in the study. The mean age was 51.24 years (range, 31 to 82 years). The majority of the patients were female; 2/3 graduated from primary school, and again, 2/3 were married. The majority (85%) of them were non-smokers. The demographic characteristics of the patients are shown in Table 1. In four patients, the procedure was difficult, and repeated entries were made (resulting in success). Apart from this, no complications (hypotension, bleeding, paraparesis or monoparesis, urinary retention, etc.) were observed in any of the patients.

85.7% (18/21) of the patients had radicular and neuropathic pain. The VAS pain score was 7.29±1.45, and the RMDQ score was 16.62±5.24. According to the quality question of the PSQI, 71.4% described poor sleep quality. 1/3 of the patients reported having used analgesics. Approximately half of the patients had disc pathology in both the L4-5 and L5-S1 discs. The clinical characteristics of the patients are presented in Table 2.

There was a significant difference in VAS pain scores between admission and the 2nd week and between admission and the 6th week (p<0.001), but no statistical difference was found between the 2nd week and the 6th week (p = 0.447). The frequency of meaningful pain reduction accepted as more than 50% pain relief was 57.1% (12/21) and 38.1% (8/21) in the 2nd and 6th weeks, respectively. A significant difference was found in RMDQ scores between admission and the 2nd week, between admission and the 6th week (p<0.001), and between the 2nd week and the 6th week (p = 0.027). While 71.4% (15/21) of the patients described poor sleep according to sleep quality at presentation, this ratio was 19.0% (4/21) in the 2nd week and 23.8% (5/21) in the 6th week. While 91.5% (19/21) of the patients declared that they were better in terms of general health status in the 2nd week, 71.4% (15/21) reported that they were better at the 6th control. VAS pain, RMDQ, sleep quality scores, and satisfaction status of the patients at admission, 2nd and 6th weeks are demonstrated in Table 3.

DISCUSSION

The objective of this study was to assess the short-term effectiveness of CESI for lumbosacral disc herniation, and the results showed that CESI was effective for pain relief up to the 6th week in terms

of pain and disability, evaluated with VAS pain and RMDQ. Additionally, CESI treatment was found to significantly improve sleep quality throughout the follow-up period. A substantial proportion of patients reported better health status, demonstrating a high level of satisfaction with the treatment. CESI is a widely used effective method for lumbosacral radicular pain, although some studies suggest that transforaminal or interlaminar epidural injections have better outcomes (17,18). But it is the easiest and safest way to get epidural injections, and the advantage of avoiding radiation exposure makes it even more significant. Therefore, the application under USG guidance renders it a practical and valuable approach.

Caudal epidural steroid injection under USG guidance was as effective as fluoroscopy-guided CESI up to the 2nd month in a study conducted in patients with lumbosacral radicular pain (19). Similarly, in a study by Poutoglidou et al. (20), USG-guided CESI was as effective as nonimage and fluoroscopy-guided CESI regarding VAS and the Oswestry Disability Questionnaire (ODQ) in the first month. However, in a study involving patients with post-lumbar surgery syndrome who underwent single-level discectomy, both CESI and transforaminal epidural injections (TFESI) demonstrated comparable effectiveness, with only TFESI showing superior results in terms of disability at the 3rd week (21). Also, some studies investigated combining CESI and TFESI. Munjupong et al. (22) compared CESI plus TFESI versus only TFESI in 54 patients with chronic radicular pain, and they concluded that CESI plus TFESI was superior to TFESI at 3rd months regarding pain relief but not for functional evaluation. In this study, the greater effectiveness of CESI in pain relief may be attributed to its specific impact on the lower lumbosacral nerve roots. If CESI plus TFESI were compared solely to CESI, the effectiveness of CESI could be more easily rationalized.

Klunklin et al. (23) evaluated repeated USG-guided CESI three times at 0, 3, and 6th weeks in 110 patients with low back pain and sciatica. They found that >50 pain relief was 20%, 26%, 74%, and 83% at 2, 4, 6, and 24th weeks, respectively. In the 24th week, ODQ had reduced by more than 50% in most patients. In this series of 21 patients, meaningful pain relief was 57.1% in the 2nd week, higher than the study mentioned above, but 38.1% in the 6th week, lower than the study. Higher meaningful pain relief in the 6th week may be due to repeated injections, of course. Compared to this study published in 2022, it is noteworthy that we observed greater effectiveness in the second week of our study. This could be attributed to the different half-lives of the local anesthetics used (lidocaine vs. bupivacaine). Additionally, using a lower volume of local anesthetic may help reduce the risk of motor blockage and alleviate symptoms such as nausea and dizziness. Senkal et al. (24) compared USG-guided and fluoroscopy-guided CESI in the 3rd week and 3rd month in 90 patients. USG-guided CESI was superior to fluoroscopy regarding successful injection rate on the first attempt and procedure time, and both techniques were similar in pain relief and improving disability evaluated with a numeric rating scale and ODQ at the 3rd week and 3rd month. This study shows that the similar effect of both fluoroscopy- and US-guided CESI continues up to the 3rd month with a single injection. In these two recent studies, the extent of needle advancement from the entry point into the sacral canal was not specified. However, considering the anatomy, it is expected to be approximately 4.5–6.0 cm above the dura mater (25). At these upper levels, the peridural space is also well vascularized. Therefore, after entering the sacral epidural space, when the tip of the needle is no longer visible under ultrasound, advancing the needle no more than 1–1.5 cm is important for safety reasons. We paid attention to this aspect, and no cases of blood aspiration, cerebrospinal fluid aspiration, or local infection were observed in our patients. Although the number of patients was limited, the practice of not advancing the needle too far supports a safe and effective approach. Indeed, current approaches indicate that injecting immediately after penetrating the sacrococcygeal ligament is sufficient and safer for CESI (26). At this point, ultrasound guidance CESI is superior to fluoroscopy due to its ability to visualize the sacrococcygeal ligament and allow for injection at the immediate entrance of the sacral canal after penetrating the sacrococcygeal ligament (without advancing 1 to 1.5 cm). It offers the advantage of being able to be performed in a shorter time, accessing the sacral canal in a single attempt, and easily identifying cases where the sacral canal is closed, which is seen in approximately 3% of cases.

The present study has several limitations that should be acknowledged. First, it is a retrospective study design, which inherently carries limitations associated with data collection. Additionally, being a single-center study with a relatively small sample size, the generalizability of the findings is limited. Another limitation is the lack of blinding for the assessors, which

introduces the possibility of evaluator bias. However, it is important to note that we took significant measures to minimize this bias and maintain the reliability of the study. Despite these limitations, our study holds notable strengths. To the best of our knowledge, it is the first study conducted in Turkey that takes patient satisfaction into account as an important outcome measure. Moreover, the study focused on patients who had undergone conservative treatments and underwent USG-guided CESI with highly selective indications. The findings strongly demonstrate the effectiveness and safety of this approach. These strengths highlight the valuable contributions of our study to the current literature.

CONCLUSION

Caudal epidural steroid injection is safe, effective in the short term, and comfortable for patients. Considering the aspects of being radiation-free and user-friendly in daily practice, the use of USG-guided CESI can provide high efficacy and patient satisfaction in appropriately selected cases. Large randomized controlled trials with large patient populations and long follow-ups may provide more information about its effectiveness.

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