

Comparison of the Results of Combined Epidural Steroid Injection with Other Approaches in Lumbar Disc Herniation: A Retrospective Study

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Received:

12-Jan-2024;

Revision:

07-Apr-2024;

Accepted:

11-Sep-2024;

Published:

30-Oct-2024

ABSTRACT

Background: Epidural steroid injection (ESI) is a minimally invasive treatment for lumbar disc herniation (LDH). It can be applied using a transforaminal (TFESI), interlaminar (ILESI), caudal (CESI), or combined (TFESI + CESI) approach.

Aim: To compare the effectiveness of the three ESI approaches and the combined ESI application in reducing pain in patients with single or multi-level LDH.

Methods: In this retrospective study, we included 239 patients diagnosed with LDH (who complained of low back pain for at least 3 months, had no neurological deficit or history of lumbar surgery, and were not contraindicated for ESI application) who received ESI and were followed up clinically for 2 years. Demographic (age, sex, body mass index (BMI)) and clinical data (duration of low back pain, visual analog scale (VAS) scores before and after ESI, and procedure-related information) were obtained from medical records. The VAS scores noted before treatment and at 3 months, 1 year, and 2 years after ESI were compared. **Results:** The post-treatment VAS scores of the combined ESI (TFESI + CESI) group were significantly lower than those of other approaches applied alone ($P < 0.05$). Furthermore, VAS scores of the ILESI and CESI groups were significantly lower than those of the TFESI group at all three post-treatment time points ($P < 0.05$). The patient's age and BMI were weakly correlated with the post-treatment VAS scores. **Conclusion:** Combined ESI is more effective than any single-approach ESI in LDH and should be considered in suitable patients to increase treatment effectiveness.

KEYWORDS: Anesthetics, low back pain, steroids

INTRODUCTION

Epidural steroid injection (ESI) is a treatment option, indicated in the diagnoses of spinal disc herniations.^[1-3]

Currently, there are three main approaches to applying an ESI, namely transforaminal ESI (TFESI), interlaminar ESI (ILESI), and caudal ESI (CESI); additionally, a combination of approaches can be used. However, the choice of approach depends on the patient's diagnosis, the status of disc herniation, and other patient-related factors, such as anthropometric data.^[2,4]

In this study, we retrospectively evaluated and compared the effectiveness of TFESI, ILESI, CESI, and the combined approach (TFESI + CESI) in patients diagnosed with lumbar disc herniation (LDH).

MATERIALS AND METHODS

Ethics

The study was approved by the local ethical committee (approval no.: HRÜ/23.20.04; dated 30/10/2023). This study was conducted in accordance with the Declaration of Helsinki 1975.

Design and procedure

Patient inclusion and exclusion criteria and data collection

Patients admitted to Physical Medicine and Rehabilitation and Neurosurgery outpatient clinics with

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How to cite this article: Yüksel MO, Kolutek Ay B, Besnek A, Erdogan B. Comparison of the results of combined epidural steroid injection with other approaches in lumbar disc herniation: A retrospective study. *Niger J Clin Pract* 2024;27:1135-40.

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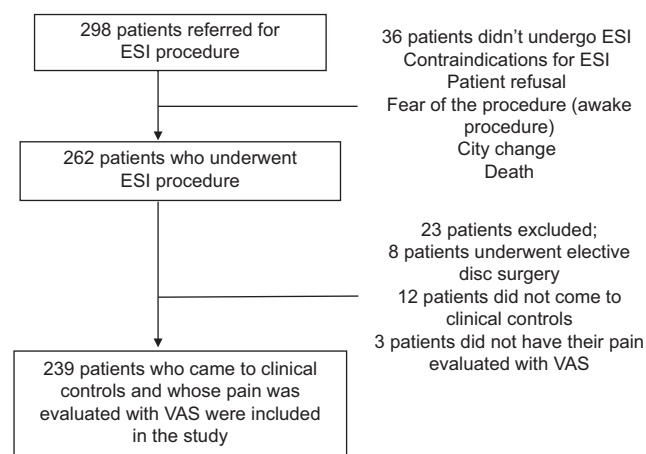


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DOI: 10.4103/njcp.njcp_47_24

complaints of low back pain and/or radicular pain for at least 3 months, with non-extruded and non-sequestered herniated discs on magnetic resonance imaging. We analyzed 298 patients who had no motor deficit or cauda signs, no history of lumbar surgery, did not respond to conservative treatment, whose pain was evaluated by visual analog scale (VAS) in clinical controls and who were referred to ESI (TFESI, ILES, CESI, or TFESI + CESI).

Enrollment



Basic demographic and clinical data of the patients, such as age, sex, body mass index (BMI), pain duration, pain intensity measured using a VAS, and ESI procedure information, were obtained from the hospital's electronic records.

Interventions

All procedures were performed after obtaining written informed consent from the patients. ESI: The patient was monitored. Before the procedure, prophylactic 1 g of cefazolin was administered intravenously; no sedation was used during the procedure to monitor the patient's neurological status. The procedure was performed after obtaining fluoroscopic confirmation (using C-arm fluoroscopy) in the anterior, posterior, lateral, and oblique views. For all patients, 40 mg methylprednisolone acetate (Depo-Medrol, Pfizer Pharmaceuticals Ltd, Luleburgaz, Kirklareli, Turkey) and 2 ml (10 mg) of 0.5% bupivacaine hydrochloride (Marcaine 0.5%, Astra Zeneca, Istanbul, Turkey) was used for a single level. ILES was primarily considered for patients with central and paracentral disc herniation, while TFESI was used in patients with disc herniations located close to the foramen. Patients with multiple-level disc herniation and a radicular pain pattern underwent combined ESI; the combined injection was used to increase the effectiveness by targeting both the epidural space and the transforaminal region. The patients were kept under observation for

15 min after the procedure in the operating room, for the next 2 hours in the ward, and then discharged.

TFESI: We used the preganglionic approach described by Lee *et al.*^[5] The patient was positioned prone on the operating table with the abdomen supported by a pillow, followed by skin antisepsis and sterile draping procedures. The vertebral level or levels where the injection was planned were determined. Next, skin and subcutaneous local anesthesia were achieved with 1 ml of 1% lidocaine; the neural foramen was visualized under fluoroscopy. The needle position was confirmed by entering with a 21-gauge (G) 9-cm spinal needle and injecting 1 ml of contrast material (Omnipaque 300; Iohexol, 300 mg iodine/mL, Amsterdam Health, Princeton, NJ). After ascertaining the correct positioning of the needle, aspiration was performed to control bleeding, and the steroids were injected for a single level. A total of 80 mg of methylprednisolone acetate was used for multiple levels.

CESI: The patient was placed in the prone position on the operating table, with the lower abdomen supported by a pillow; the skin antisepsis and dressing procedures were performed and the sacral hiatus was determined. After providing skin and subcutaneous ligament anesthesia with 1 ml of 1% lidocaine, a 21-G 9-cm spinal needle was inserted 1–2 cm into the caudal epidural area; it was aspirated and checked for bleeding. Needle position was confirmed by administering 1 ml of contrast medium (Omnipaque 300; Iohexol, 300 mg iodine/mL; Amsterdam Health, Princeton, NJ). A single dose of steroid (described above) was injected after aspiration for a single level; an additional 25 cc of saline was injected. A total of 80 mg of methylprednisolone acetate was used for multiple levels.

ILES: The patient was positioned on the operating table in the lateral decubitus position, lying on the extremity with radicular pain and a pillow placed between the legs. After performing the skin antisepsis and sterile draping procedures, the vertebral level (s) to be injected was determined. Skin and subcutaneous local anesthesia was achieved with 1 ml of 1% lidocaine, and the neural foramen was visualized. Needle position was confirmed by entering with a 21-G 9-cm spinal needle and injecting 1 ml of contrast material (Omnipaque 300; Iohexol, 300 mg iodine/mL, Amsterdam Health, Princeton, NJ). After ensuring the correct positioning of the needle, aspiration was performed to control bleeding, followed by injecting the steroid dose for a single level. A total of 80 mg of methylprednisolone acetate was used for multiple levels.

Evaluation

The effect of different ESI approaches on pain intensity

was determined by documenting the VAS scores before the procedure (pretreatment) and 3 months, 1 year, and 2 years after the procedure. We examined whether patient-related factors, such as sex and BMI, influenced the effectiveness of an approach, and if there is a relationship between the ESI approach results and the number of disc levels involved.

Statistical analysis

All data were analyzed using SPSS (Statistical Package for Social Sciences for Windows version 22.0). To decide whether to use parametric or nonparametric tests for statistical testing, we evaluated the normality of the distribution using the Kolmogorov-Smirnov test. Dependent variables were examined using mixed repeated-measures ANOVA, and the Bonferroni multiple comparison test was used to determine the source of the difference. The relationship between numerical variables was examined using Pearson's and Point-biserial correlation coefficients. A significance level of $P < 0.05$ was to determine statistical significance.

RESULTS

The average age of the study group was 49.27 ± 9.12 years; more than half ($n = 138$; 57.74%) of the patients were female. The average BMI of the sample was 24.86 ± 3.57 kg/m² and the average pain duration was 11.04 ± 4.04 months [Table 1]. Figure 1 illustrates the frequency distribution for the study patients receiving ESI using different approaches.

Table 1: General characteristics and clinical parameters of the patients

	Mean±SD
Age	49.27±9.12
BMI	24.86±3.57
Pain Duration (month)	11.04±4.04
Sex	
Male <i>n</i> (%)	101 (42.26)
Female <i>n</i> (%)	138 (57.74)

BMI=Body Mass Index, SD=Standard Deviation

The pretreatment VAS scores were statistically different between the ESI approach groups ($P < 0.05$). The pretreatment VAS scores of patients who underwent combined ESI (TFESI + CESI) were higher than those for patients who underwent ILES, CESI, and TFESI. Likewise, patients undergoing ILES and CESI had higher pretreatment VAS scores than patients who underwent TFESI.

Regarding the post-treatment phase, the VAS scores at 3 months, 1 year, and 2 years post-treatment showed a statistically significant difference depending on the approach used ($P < 0.05$). At all three post-treatment time points, the VAS scores of patients who underwent combined ESI were lower than those for patients who underwent ILES, CESI, or TFESI alone, and patients undergoing ILES and CESI had significantly lower VAS scores compared to patients who underwent TFESI.

Furthermore, in all four groups (underwent TFESI, ILES, CESI, and combined ESI), there was a statistically significant within-group difference between VAS scores measured over time ($P < 0.05$). The Bonferroni multiple comparison test was used to determine the time at which

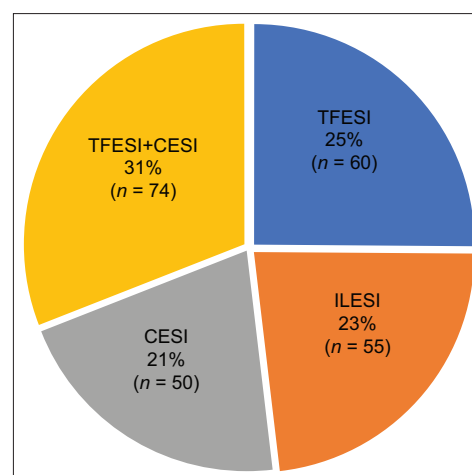


Figure 1: Percentage distribution of ESI cases according to approaches. CESI:caudal epidural steroid injection, ILES: interlaminar epidural steroid injection, TFESI:transforaminal epidural steroid injection

Table 2: Comparison of VAS Values According to Method and Time

	ILES ¹ x̄±SD	CESI ² x̄±SD	TFESI + CESI ³ x̄±SD	TFESI ⁴ x̄±SD	Difference between groups
PI VAS ^a	8.13±0.96	8.14±1.16	8.87±0.72	7.08±1.44	3>1,2,4/1,2>4
PoI 3 rd Month VAS ^b	3.16±1.03	3.44±1.28	2.15±0.95	4.10±1.34	3<1,2,4/1,2<4
PoI 1 st year VAS ^c	3.78±1.12	4.14±1.05	2.89±1.06	4.92±1.28	3<1,2,4/1,2<4
PoI 2 nd year VAS ^d	4.65±1.22	4.66±1.08	3.92±1.01	5.62±1.32	3<1,2,4/1,2<4
Within-Group difference	a>b, c, d/c, d>b/d>c	a>b, c, d/c, d>b/d>c	a>b, c, d/c, d>b/d>c	a>b, c, d/c, d>b/d>c	
Time	F:(3.708)=1310.08; P<0.05 part eta square :0.847				
Time*Process group	F:(9.708)=46.75; P<0.05 part eta square :0.373				

F=Mixed design analysis of variance for dependent samples. ESI=caudal epidural steroid injection, ILES=interlaminar epidural steroid injection, TFESI=transforaminal epidural steroid injection, PI=preinjection, PoI=post injection, VAS=Visual Analog Scale

Table 3: Relationship between VAS Scores and Age, Sex and BMI

	Age ^a	Sex ^b	BMI ^a
ILESI			
Pre-injection VAS	0.09	-0.01	0.274*
Post-injection 3 rd month VAS	0.08	0.05	-0.08
Post-injection 1 st year VAS	0.14	0.04	-0.13
Post-injection 2 nd year VAS	0.14	0.07	-0.07
CESI			
Pre-injection VAS	-0.342*	0.09	.a
Post-injection 3 rd month VAS	0.01	-0.11	0.04
Post-injection 1 st year VAS	0.02	-0.01	0.01
Post-injection 2 nd year VAS	0.12	0.08	-0.06
Combined (CESI + TFESI)			
Pre-injection VAS	0.324**	-0.01	0.08
Post-injection 3 rd month VAS	-0.18	-0.15	0.00
Post-injection 1 st year VAS	-0.21	-0.19	0.02
Post-injection 2 nd year VAS	-0.10	-0.10	0.15
TFESI			
Pre-injection VAS	0.12	0.07	-0.13
Post-injection 3 rd month VAS	-0.05	-0.02	0.08
Post-injection 1 st year VAS	0.06	-0.02	0.14
Post-injection 2 nd year VAS	0.08	-0.07	0.14
General			
Pre-injection VAS	0.12	0.02	0.12
Post-injection 3 rd month VAS	-0.12	-0.04	-0.01
Post-injection 1 st year VAS	-0.08	-0.04	-0.01
Post-injection 2 nd year VAS	-0.02	0.00	-0.01

^aPearson correlation coefficient ^bPoint Pair Series Correlation Coefficient * $P < 0.05$ ** $P < 0.01$. BMI=body mass index, CESI=caudal epidural steroid injection, TFESI=transforaminal epidural steroid injection, ILESI=interlaminar epidural steroid injection, VAS=visual analog scale

the difference was most pronounced. In each method, the pretreatment VAS scores were compared to the scores at 3 months, 1 year, and 2 years post-treatment. We observed that the 2nd year VAS scores were significantly higher than that of the 1st year [Table 2 and Figure 2].

A negative and moderate, yet statistically significant, relationship was found between pretreatment VAS scores and the patient's age in the CESI group ($r = -0.324$; $P < 0.05$). However, the combined ESI group patients demonstrated a positive and moderate correlation between pretreatment VAS scores and the patient's age ($r = 0.324$; $P < 0.05$). In both the ILESI and CESI groups, the patient's BMI exhibited a weak, positive, and statistically significant correlation with the pretreatment VAS scores (ILESI: $r = 0.274$; $P < 0.05$; CESI: $r = 0.281$; $P < 0.05$). Apart from this, no other variable showed any correlation with the VAS scores in any group ($P > 0.05$) [Table 3].

Lastly, there was no statistically significant difference between the VAS scores measured over time and the

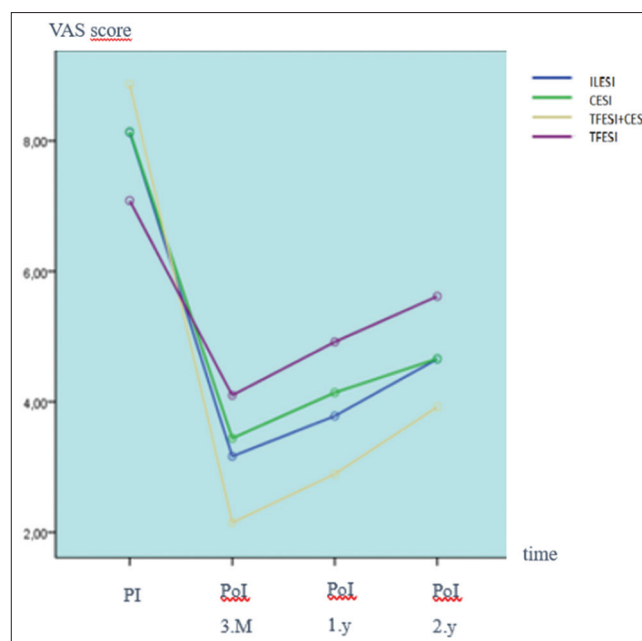


Figure 2: Distribution of VAS Values According to Method and Time. CESI:caudal epidural steroid injection, ILESI:interlaminar epidural steroid injection, PI: preinjection, Pol:postinjection, TFESI:transforaminal epidural steroid injection, VAS:visual analog scale

number of levels involved, or between VAS pain scores measured over time, the number of levels involved, and the approach used ($P > 0.05$); [Table 4].

DISCUSSION

ESI is a minimally invasive treatment option applicable for both radicular and non-radicular disc herniation to achieve quick pain relief and improve functionality by repeating injections as required. Although most frequently indicated in the diagnoses of spinal disc herniations and stenosis, it can also be applied in other spinal conditions, such as spondylolysis, radiculitis, post-laminectomy syndrome, scoliosis, and post-herpetic neuralgia. All three approaches, TFESI, ILESI, and CESI, are used, and the choice of technique varies depending on the clinician's decision, the location of the herniated disc, the number of affected levels, and the anthropometric data of the patients.^[1-3,6] In this study, we examined and compared the pain-relieving ability of the three approaches for ESI (when used alone or combined) in LDH.

Previous studies have evaluated the short- and long-term results of the three approaches and compared the methods with each other.^[6-10] Manchikanti *et al.*^[8] followed up on patients receiving ESI using the three methods from the 3rd month post-treatment till 2 years after injection. All three methods were found to be effective in LDH patients, with the treatment response with ILESI more effective than other methods. Similarly,

Table 4: Relationship between VAS scores, method and pathology level

	Preinjection VAS Mean±SD	Post-injection 3 rd month VAS Mean±SD	Post-injection 1 st year VAS Mean±SD	Post-injection 2 nd year VAS Mean±SD
ILESI				
1 level	8.14±0.99	3.02±1.03	3.58±1.07	4.47±1.18
2 levels	8.08±0.90	3.67±0.89	4.50±1.00	5.33±1.15
General	8.13±0.96	3.16±1.03	3.78±1.12	4.65±1.22
CESI				
1 level	8.17±1.25	3.42±1.23	4.11±1.06	4.61±1.13
2 levels	8.07±0.92	3.50±1.45	4.21±1.05	4.79±0.97
General	8.14±1.16	3.44±1.28	4.14±1.05	4.66±1.08
Combined (TFESI + CESI)				
1 level	8.81±0.80	2.21±1.02	2.95±1.01	3.86±1.03
2 levels	8.81±0.57	2.08±0.84	2.92±1.13	3.96±1.08
3 levels	9.43±0.53	2.00±1.00	2.43±1.13	4.14±0.69
General	8.87±0.72	2.15±0.95	2.89±1.06	3.92±1.01
TFESI				
1 level	7.43±1.50	4.07±1.14	4.86±1.17	5.64±1.28
2 levels	7.00±1.41	4.05±1.40	4.89±1.32	5.57±1.35
3 levels	6.50±2.12	5.50±0.71	6.00±1.41	6.50±0.71
General	7.08±1.44	4.10±1.34	4.92±1.28	5.62±1.32
General				
1 level	8.28±1.14	2.99±1.24	3.66±1.21	4.44±1.23
2 levels	7.78±1.34	3.39±1.46	4.21±1.44	4.99±1.37
3 levels	8.78±1.56	2.78±1.79	3.22±1.92	4.67±1.22
General	8.10±1.27	3.14±1.36	3.86±1.36	4.67±1.31
Time*Patology level			F=1.29; P: 0.21>0.05	
Time*Process*Patology level			F=1.32; P: 0.24>0.05	

F: Mixed design analysis of variance for dependent samples, CESI=caudal epidural steroid injection, SD=standard deviation, TFESI=transforaminal epidural steroid injection, ILESI=interlaminar epidural steroid injection, VAS=visual analog scale

Kamble *et al.* also concluded that all three methods were effective in single-level LDH; however, they found that the TFESI application improved lumbar functionality more than other methods in short- and long-term follow-ups. Therefore, the existing literature is inconclusive regarding the efficacy of any one method as some studies show the superiority of one method over the others, while others report comparable effects with all methods. These differences may be attributed to patient characteristics, the type of steroid used, the condition of the herniated disc, the number of herniated discs, and the clinician's expertise in administering the injection using different approaches (midline-parasagittal, sitting-prone-lateral decubitus, etc.).^[1,7,11-14]

In our study, all three post-treatment VAS scores (3rd month, 1st year, and 2nd year) of patients who underwent ILESI and CESI were lower than those of patients who underwent TFESI, which concurs with the findings reported by Manchikanti *et al.*,^[8] probably because the control period was the same as that in our study. Furthermore, we observed that the control results of patients who underwent combined ESI were lower than those achieved using any of the three methods

alone, i.e. the combined application was more effective than ESI applied with a single approach. It has been shown in the literature that the combined application of TFESI and CESI is more effective than the application of TFESI alone. Evran *et al.*^[4] conducted a study involving patients with recurrent LDH detected after surgery and found that combined ESI application was more effective than TFESI application alone in terms of lumbar function and pain scores assessed at 3 weeks, 3 months, and 6 months post-treatment. Similarly, a study assessing the efficacy of the combined ESI approach versus TFESI alone at 3 months after injection in patients with spinal stenosis, spondylolisthesis, and failed back surgery syndrome, in addition to LDH concluded that combined ESI was more effective than only TFESI application.^[15] Another study comparing the 1-year results of combined ESI and TFESI applied to patients with LDH showed that the addition of CESI to TFESI was more effective than TFESI application alone.^[16]

In this regard, our study provides more long-term data in the form of 2-year follow-up results, which demonstrated that the VAS scores of patients who underwent combined ESI were still lower than those who underwent ESI with

single approaches. Thus, combined TFESI and CESI injections may be more effective than any isolated ESI application. A possible explanation of this phenomenon is that the CESI application reaches the epidural space while TFESI is added to the foramen level in the same session, which creates a synergistic effect by administering more steroids and fluid to the inflamed area.^[4,15,16] In this study, we used methylprednisolone, which is a potent steroid used in ESI, and has a higher anesthetic effect than other steroids and nonsteroidal anti-inflammatory drugs, apart from its anti-inflammatory and anti-ischemic effects.^[1]

This is the first study to include patients with isolated LDH, to perform multiple-level disc ESI with multiple approaches and their combination, and to examine the relationship between these approaches over a 2-year follow-up.

In conclusion, a combined ESI approach (TFESI + CESI) can be used in appropriate patients to increase and prolong the effectiveness of ESI applications. Because it is a retrospective study with a limited number of patients, further prospective experimental studies are required to verify these results.

Key messages

Combined ESI approach (TFESI + CESI) can be used in appropriate patients to increase and prolong the effectiveness of ESI applications.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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