Turk Neurosurg, 2024
DOI: 10.5137/1019-5149.JTN.45956-23.3

Original Investigation
Spine and Peripheral Nerves

Received: 25.11.2023
Accepted: 02.04.2024
Published Online: 30.12.2024

The Effect of Obesity on the Treatment Outcomes of Lumbar Transforaminal Epidural Steroid Injections

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ABSTRACT

AIM: The aim of this study is to investigate the effect of obesity on the treatment outcomes of lumbar transforaminal epidural steroid injections (TFESIs).

MATERIAL and METHODS: This retrospective study included patients who underwent single-level TFESI in a pain management center between January 2021 and April 2023. Body mass index (BMI) of the patients was evaluated based on the World Health Organization guidelines. Non-obese individuals had a BMI below 25 kg/m^2, those with a BMI between 25 and 30 kg/m^2 were classified as overweight, and those with a BMI greater than or equal to 30 kg/m^2 were deemed obese. The Numeric Rating Scale (NRS) scores for all patients before the procedure, at the first hour, and at the one-month follow-up were documented. Treatment success was defined as a 50% or more reduction in NRS score at one month of follow-up.

RESULTS: This study enrolled a total of 162 participants, with a mean age of 49.5 ± 13.7 years and an average BMI of 27.7 ± 4.36 kg/m^2. The mean pre-procedural pain score was 8.3 (range, 4 to 10). Significant reductions were observed in the mean pain scores at the first hour (0.90) and first month (3.3), compared to the pre-procedural NRS scores (p<.001). Upon categorizing patients based on BMI, no significant differences were observed among the groups regarding age, gender, symptom duration, procedure level, magnetic resonance imaging (MRI) grade, pain scores, and treatment success.

CONCLUSION: Since the potential effects of obesity on the short-term results of lumbar TFESI have not been elucidated yet, practitioners should continue to apply lumbar TFESI in patients with high BMI values.

KEYWORDS: Obesity, Low back pain, Radiculopathy, Epidural injection

INTRODUCTION

The relationship between obesity and low back pain, which poses a burden on the healthcare system, is a subject of ongoing debate. Although it still remains unclear whether obesity directly causes back pain, many studies have shown that obesity is related to low back pain and lumbosacral radicular pain (13,22,39,40,47). On the other hand, some studies have not found a relationship between obesity and low back pain (16,17,46). The continuing lack of clarity in the literature on this subject is disappointing. Despite ongoing debates, the fact that many patients who are treated for low back pain have also obesity requires a focus on this issue.

Publications regarding the potential link between obesity and low back pain attribute this relationship to various mechanisms. First, obesity increases the mechanical load on the spine and causes greater pressure on lumbar spinal structures. Moreover, increased cytokines and acute phase reactants in obesity may cause low back pain by activating proinflammatory pathways (19,42). In addition, both decreased

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spinal mobility (31) and dyslipidemia in obese individuals may predispose to disc degeneration by impairing the nutrition of disc cells (20,21,25). Beyond the cause-effect relationship, another unresolved issue is whether obesity influences the outcomes of different treatments employed for low back pain (5,28,30). In this context, it is also a matter of curiosity whether the purported increase in inflammation and mechanical load has an impact on the outcomes of epidural interventions.

Epidural steroid injections are widely used as a treatment option for lumbosacral radicular pain resistant to conservative therapy, prior to spinal surgery (3,30,35). Predictive factors that may influence the outcome of lumbar epidural steroid injection therapy have been investigated previously (6,9,10,23,24,29,41). While some of these studies focused on clinical factors (9,24), others have emphasized radiological findings (6,23). The remaining studies investigated the impact of both on outcomes (10,29,41). On the other hand, the existing body of literature lacks adequate evidence regarding the effect of obesity on the results of epidural injections in lumbosacral radicular pain.

In a study, Baysal Karaca et al. (1) opted for the interlaminar approach while investigating the effect of body mass index (BMI) on the outcomes of epidural injections. However, one of the main limitations to this study was that blind administration was performed without imaging guidance. The rate of inaccurate needle placement and complications is higher in procedures without imaging (27,34,37). With the widespread use of fluoroscopy, performing blind epidural injections for pain management has decreased considerably. In addition, factors such as sex and symptom duration were not equally distributed between the groups. Overweight individuals were considered non-obese, and the study participants were divided into two groups. In another study, Hashemi et al. (14) did not classify overweight individuals separately, but included them among obese individuals. They used the parasagittal interlaminar approach for the epidural injections. No significant difference in treatment efficacy was observed between obese and non-obese individuals. There was also an observed disparity in the age distribution between the groups. In addition, the patients were not staged for nerve root compression according to magnetic resonance imaging (MRI) in either study. Therefore, they overlooked a significant confounding factor (10). Chew et al. (5) similarly reported that obesity did not affect the results of epidural steroid injections. All patients, who underwent caudal, interlaminar, and transforaminal epidural steroid injections (TFESIs) were included in this study. Also, they did not report age, sex, symptom duration, pre-procedural pain scores, or procedural level in the obese and non-obese groups.

To the best of our knowledge, there is only one study in the literature investigating the efficacy of TFESI in patients classified according to BMI. In a pilot study conducted by McCormick and Plastaras (30), the effectiveness of TFESI in obese patients was found to be similar to that in non-obese patients. However, the low number of patients (n=24) led to insufficient statistical power and a lack of confidence in the results.

The objective of this research was to assess the influence of obesity on the treatment outcomes for patients undergoing lumbar TFESI.

MATERIAL and METHODS

Study Design and Study Population

This retrospective, comparative study was conducted at the Pain Management Section of the Department of Physical Medicine and Rehabilitation of a tertiary care centre. After obtaining approval from the institutional Ethics Committee (No: 09.2023.643), patients who underwent single-level TFESI between January 2021 and April 2023 were reviewed. This study was conducted in accordance with the principles of the Declaration of Helsinki. A written informed consent was obtained from all participants for all diagnostic and therapeutic procedures.

Data including demographic data, Numeric Rating Scale (NRS) scores, level of procedure, and symptom duration were retrieved from the hospital records. Inclusion criteria were as follows: age >18 years, undergoing a single-level TFESI with a pre-procedural pain score of ≥4, as assessed by the NRS. The TFESI procedure was specifically conducted for treating lumbar radicular pain arising from single-level paracentral disc herniation. The study exclusively incorporated patients with compression of the L4, L5, and S1 roots. In our clinic, for each level in TFESI, we routinely administer a mixture of 3 mg/1 mL of betamethasone, 1 mL of bupivacaine hydrochloride 0.5%, and 1 mL of 0.9% saline to the epidural space. In our study, all procedures were carried out by an interventional pain specialist with a minimum of 10 years of experience. Patients with a history of lumbar spinal surgery, non-radiating low back pain, foraminal or extraforaminal herniations, spondylolisthesis, major psychiatric disorders, malignancy diagnosis, missing follow-up, and those lacking demographic, clinical data, or MRI scans were excluded from the study. Nerve root compression was graded using the MRI classification system proposed by Pfirmann et al. (33), with patients categorized as low (Grade 1 or 2) or high-degree compression (Grade 3 or 4), following the approach by Ghahreman et al. (10). The BMI assessment followed the World Health Organization (WHO) guidelines, classifying patients as non-obese (BMI <25 kg/m^2), overweight (BMI between 25 and 30 kg/m^2), or obese (BMI ≥30 kg/m^2). The NRS scores of all patients before the procedure, at the first hour, and at the first month were documented. Treatment success was defined as a 50% or more reduction in NRS score at one month of follow-up (11).

Procedural Technique

The patients were positioned in the prone posture with a supportive pillow beneath their abdomen to decrease lumbar lordosis. The injection site underwent thorough cleansing using povidone iodine, followed by draping with a sterile cover. Utilizing fluoroscopy with an average 10 to 30° oblique and 0 to 15° cranial angle, the foramen was visualized. 3 to 4 mL of prilocaine 2% was administered into the skin and subcutaneous tissue. Subsequently, a 22-gauge, 3.5-inch spinal needle was incrementally advanced toward the 6 o'clock position of

the pedicle under intermittent fluoroscopic guidance. Confirmation of the needle's location in the epidural space was validated through a lateral image. The contrast material (1 to 2 mL) was injected, and following the observation of epidural spread without vascularity, a 3 mL mixture of 3 mg/1 mL of betamethasone, 1 mL of bupivacaine 0.5%, and 1 mL of saline was administered (Figure 1A, B). Potential complications were monitored for one-hour post-injection, after which patients were discharged and scheduled for a clinic revisit after one month.

Statistical Analysis

A priori sample size was calculated as 132, as previously described in the literature (30). The sample size was determined to ensure a 95% confidence interval (CI) and 90% power, considering the relationship between BMI and the success of epidural treatment after one month. Statistical analysis was performed using the SPSS version 22.0 software (IBM Corp., Armonk, NY, USA). Continuous variables were expressed in mean ± standard deviation (SD) or median (min-max), while categorical variables were expressed in number and frequency. The chi-square test was used to compare categorical variables. The Shapiro–Wilk test was used to analyze the normal distribution of the quantitative data. Repeated measures analysis of variance (ANOVA) was used to analyze changes over time with treatment, and Bonferroni correction was employed for multiple comparisons. A P value of <0.05 was considered statistically significant.

RESULTS

A retrospective analysis was conducted of 1,472 epidural injections administered between January 2021 and April 2023 in a clinical setting. Cases with caudal (n=118) and interlaminar approaches (n=260) were excluded, and only cases with transforaminal approach (n=1094) were analyzed. Based on the inclusion and exclusion criteria, a total of 162 participants were recruited (Figure 2).

The patients had an average age of 49.5 ± 13.7 years, and the mean duration of symptoms was 21.2 ± 5.8 months. The number of female patients was higher (n=95, 58.6%). The mean BMI for all participants was 27.7 ± 4.36 kg/m^2. Considering the grade of nerve compression, 72 and 90 were classified as Grade 1-2 and Grade 3-4, respectively. The L5 nerve root injection was the most common procedure (63.6%), followed by S1 (21.6%) and L4 (14.8%) injections. No serious complications were observed during or after the procedures. The main minor complication was vasovagal reaction in six patients (3.7%) (Table I).

The patients exhibited a mean pre-procedural pain score of 8.3 (range, 4 to 10). The mean pain scores at the first hour and the first month (0.90 and 3.3, respectively) were found to be significantly reduced compared to the pre-procedural NRS scores (p< .001) (Table II).

A total of 116 (71.6%) patients achieved successful treatment outcomes. While categorizing patients based on BMI, there were no discernible differences among the groups regarding age, gender, symptom duration, procedure level, MRI grade, pain scores, and treatment success (Table III).

Although a higher treatment success was observed in cases with low-grade compression than in those with high-grade compression while grading nerve root compression on MRI, no statistically significant difference was observed (p= .073) (Table IV).

DISCUSSION

Obesity is a major public health issue that may be associated with low back pain. Unfortunately, physicians believe that TFESIs are less effective in individuals with obesity. Some studies have examined the relationship between epidural steroid injection and obesity; however, the small number of patients and the lack of predictive factors are shortcomings of these studies. In the present study, we classified patients

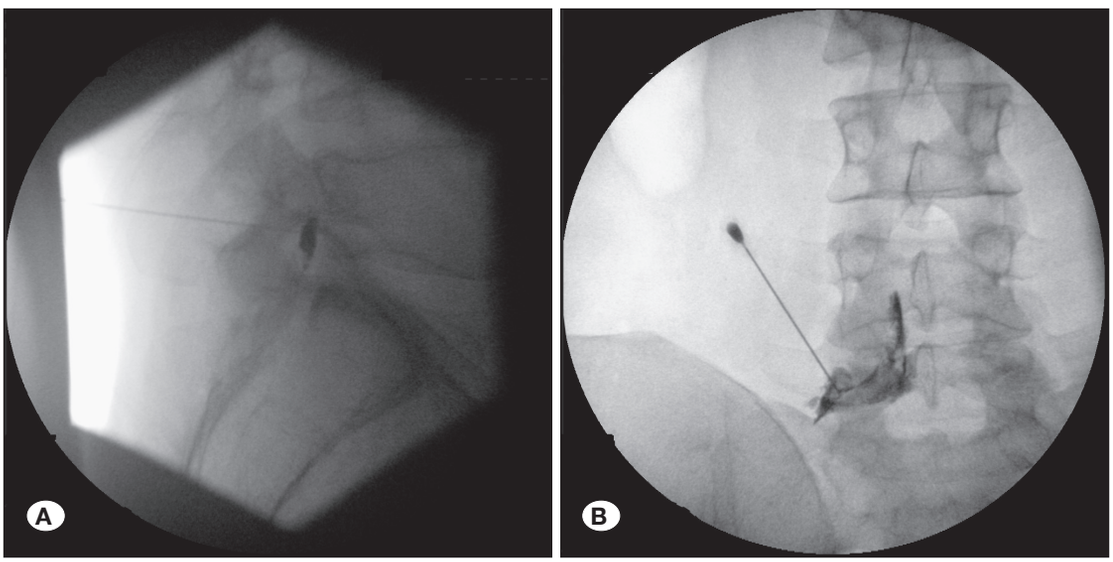

Figure 1: Contrast Spread in Lumbar Transforaminal Epidural Injection **A)** lateral imaging **B)** anteroposterior imaging.

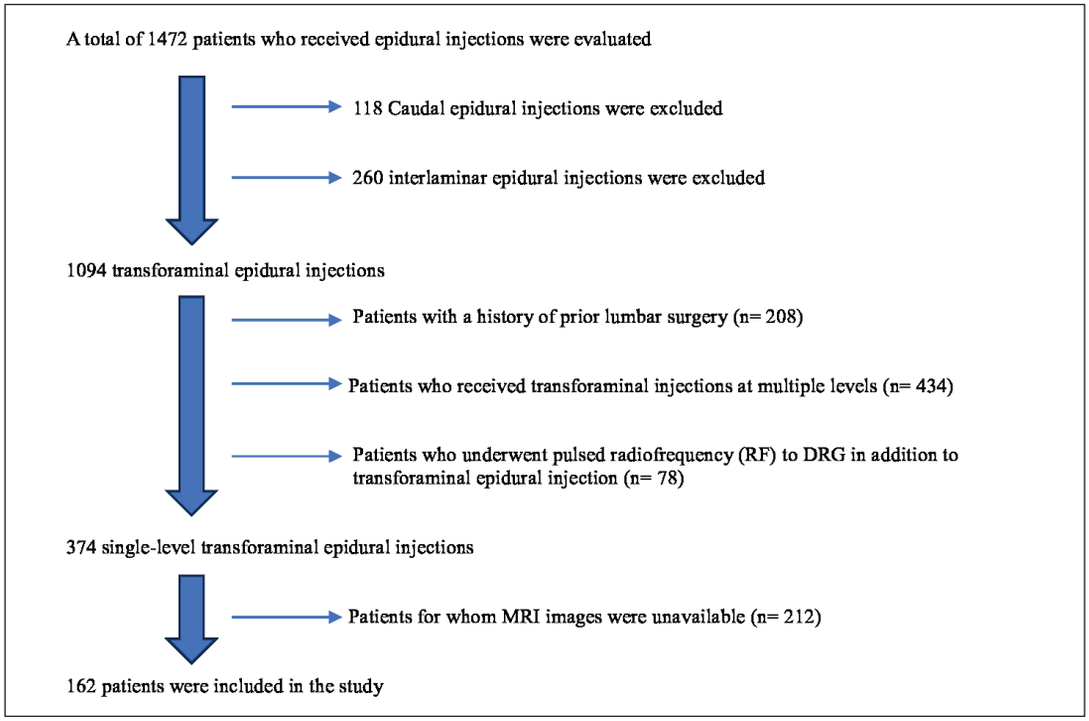

Figure 2: Study flowchart.

Table I: Demographic and Procedural Characteristics

Variable		**Value (n=162)**
Age (years)		49.5 ± 13.7
Gender, n (%)	Female	95 (58.6)
	Male	67 (41.4)
Symptom duration (month)		21.2 ± 5.8
BMI		27.7 ± 4.36
Pre-NRS		8.3 (4-10)
NRS 1. hour		0.90 (0-9)
NRS 1. month		3.3 (0-10)
Procedure level, n (%)	L4	24 (14.8)
	L5	103 (63.6)
	S1	35 (21.6)
Procedure side, n (%)	Right	65 (40.1)
	Left	97 (59.9)
MRI grade, n (%)	Grade 1-2	72 (44.4)
	Grade 3-4	90 (55.6)
Complications, n (%)	Major complications	Not observed
	Minor complications	
	Vasovagal reaction	6 (3.7)
	Increased pain	5 (3.1)
	Non-positional headache	2 (1.2)
	Dural puncture	1 (0.6)
	Postdural puncture headache	1 (0.6)

BMI: *Body mass index,* ***Pre:*** *Before treatment,* ***NRS:*** *Numeric Rating Scale.*

according to their BMI values and examined the effect of BMI on short-term treatment success. Our study results showed that obesity did not affect the treatment success.

Table II: Time Changes of Numerical Rating Scores of All Patients

	Mean (Min-max)	p-value
Pre-NRS[1]	8.3 (4-10)	
NRS. 1.hour[2]	0.90 (0-9)	<0.001[a]
NRS. 1.month[3]	3.3 (0-10)	

[a] ***Posthoctests:*** *1-2, 1-3 significant,* ***Pre:*** *Before treatment,* ***NRS:*** *Numeric rating scale.*

Epidural steroid injections can be administered via the caudal, transforaminal, and interlaminar approaches. However, due to its greater potential to access the anterior epidural space and affected nerve root, the transforaminal approach has become increasingly preferred in recent years (4,11). Current evidence suggests that TFESI is an effective treatment for lumbosacral radicular pain (11,15,27). To target specific nerve roots and establish a more homogeneous study group, we included cases in whom the transforaminal approach was chosen for epidural injections.

How the definition of low back pain is established, and the choice of the study population can significantly affect the interpretation of the results. There is a distinction between actively seeking treatment for low back pain and merely acknowledging its presence when asked (22). In the present

Table III: Demographic and Clinical Data Between the Groups

Variable		BMI < 25 (n=43, 26.5%)	BMI: 25-30 (n=74, 45.7%)	BMI>30 (n=45, 27.8%)	p-value
BMI (kg/m^2)		22.68 ± 1.75	27.27 ± 1.38	33.10 ± 2.95	<0.001
Age (years)		47.35 (19-89)	49.46 (21-79)	53.82 (24-75)	0.078
Pre NRS		8.14 ± 1.15	8.22 ± 1.30	8.44 ± 1.20	0.470
NRS 1st hour		1.02 (0-7)	0.73 (0-8)	1.04 (0-9)	0.551
NRS 1st month		3.76 (0-9)	3.10 (0-10)	3.29 (0-9)	0.481
Symptom duration (month)		23.96 (1-120)	16.20 (1-120)	28.50 (1-180)	0.241
Gender, n (%)	Male	20 (45.5)	31 (41.9)	15 (33.3)	0.391
	Female	22 (54.5)	43 (58.1)	30 (66.7)	
Treatment success, n (%)	Yes	30 (65.2)	53 (71.6)	33 (78.5)	0.110
	No	16 (34.8)	21 (28.4)	9 (21.5)	
MRI grade, n (%)	1-2	20 (46.5)	32 (43.2)	20 (44.4)	0.973
	3-4	23 (53.5)	42 (56.8)	25 (55.6)	
Procedure level, n (%)	L4	6 (13.9)	10 (13.5)	8 (17.8)	0.759
	L5	28 (66.0)	46 (62.2)	29 (64.4)	
	S1	9 (20.1)	18 (24.3)	8 (17.8)	

BMI: *Body mass index;* ***Pre:*** *Before treatment;* ***NRS:*** *Numeric Rating Scale.*

Table IV: Treatment Success of All Groups according to MR Imaging Grading

Variable		All patients (n=162)	BMI < 25 (n=43)	BMI: 25-30 (n=74)	BMI>30 (n=45)
Grade1-2 treatment success n (%)	Yes	54 (75)	15 (75)	22 (69)	17 (85)
	No	18 (25)	5 (25)	10 (31)	3 (15)
Grade3-4 treatment success n (%)	Yes	61 (68)	12 (52)	31 (74)	18 (72)
	No	29 (32)	11 (48)	11 (26)	7 (28)
p		0.073	0.011	0.326	0.107

BMI: *Body mass index.*

study, patients seeking medical attention for low back pain at our clinic were included. Individuals who do not actively seek treatment for low back pain are outside the scope of the study. Ultimately, the relationship between BMI and TFESI was investigated in individuals experiencing moderate-to-severe low back pain (NRS ≥ 4).

The current study included patients with nerve root compression at the L4, L5, and S1 levels. It has been reported that the upper and lower lumbar levels exhibit different kinematic behaviors under heavy load (36), while obesity-related compressive deformation is higher at lower lumbar levels (7). To eliminate potential confounding factors arising from this reason, procedures above the L4 level were excluded from the study.

Additionally, there are reasons for establishing certain exclusions criteria in the current study. In individuals with psychiatric disorders, there is both altered nociception and a pattern of chronic pain resistant to treatment (32,38). Additionally, communication issues regarding pain feedback may arise in these individuals. Therefore, they have been excluded from the study. The patients undergoing lumbar spinal surgery constitute a confounding factor in the evaluation of the results of epidural injections due to the altered biomechanics, along with the prolonged presence of central sensitization (8). Consequently, this patient group has been excluded from the study. It is well established that epidural injections are more effective in patients with radicular pain compared to those with axial lower back pain; hence, patients without leg pain have not been included in the study (26).

As mentioned previously, the literature regarding the relationship between low back pain and obesity is controversial. Leboeuf-Yde et al. (22) reported in their systematic review that obesity was a risk factor for low back pain rather than a direct cause. However, Zhou et al. (47) demonstrated a causal relationship between obesity and lumbar radicular pain. In addition, there are also publications suggesting no association between obesity and low back pain (16,46). In two meta-analyses, Shiri et al. (39,40) revealed that both obesity and being overweight increased the risk of low back pain and were strongly associated with seeking treatment. On the other hand, in their meta-analysis, they also indicated a publication bias regarding the reporting of studies demonstrating the relationship between obesity and low back pain. We also observed this trend in our literature review. Our results revealed that being overweight or obese did not affect the results of TFESI treatment and did not create any suspicion of bias in the aforementioned sense.

As stated by McCormick and Plastaras (30), there is a belief among physicians that individuals with obesity will benefit less from epidural injections. Another reason for physicians' reluctance to administer TFESI treatment in obese patients is that these individuals pose challenges in terms of procedural techniques and maneuvering long needles (4). Additionally, some studies in the literature indicate that technical difficulties, such as a decrease in scope resolution, highlight the need for more careful planning and application of such interventions in obese patients (43). Since we found that BMI did not affect the short-term results of TFESI, we conclude that TFESI treatment should not be avoided in this patient population.

The present study, similar to other studies in the literature (1,5,14,30), demonstrates that obesity does not alter the outcomes of epidural injection treatment. Additionally, the current study has notable strengths compared to previous studies. First, the variables proposed as predictive factors in different studies were distributed similarly across all three groups in the current study (6,9,10,23,24,29,41). Thus, investigating the impact of obesity on TFESI became more reliable. Moreover, the use of only the transforaminal approach sets our study apart from others. While McCormick and Plastaras (30) utilized the transforaminal approach, their low patient numbers, and Baysal Karaca et al.'s (1) lack of imaging guidance posed significant limitations. Finally, the utilization of nerve root compression grading and inclusion of cases with only single-level procedures strengthened the current study.

According to the nerve compression staging system reported by Ghahreman and Bogduk (10), patients were distributed in comparable proportions across the groups in the present study. This distribution has effectively prevented potential intergroup disparities in treatment response that may arise from severe mechanical compression. Patients with low-grade compression had a higher treatment success rate than those with high-grade compression. This finding is consistent with the report by Ghareman and Bogduk. However, no statistically significant differences were observed (p=.073).

In this study, assessing obesity only using BMI can be considered a limitation. Other measures, such as total body fat mass, subcutaneous fat index (SFI), waist-to-hip ratio, and skinfold thickness can provide different insights (2,22). Urquhart et al. (44) emphasized the importance of body composition and reported that fat mass is associated with low back pain. However, they noted no significant difference in the total body lean tissue between individuals with and without low back pain. Based on this, they suggested that metabolic processes and systemic inflammation might be more significant than the load on the spine. Specifically, the size of adipose tissue, rather than body mass, could increase inflammatory burden, potentially influencing the effectiveness of steroid injections. Berikol et al. (2) reported that SFI was associated with intervertebral disc degeneration and low back pain, and this relationship became evident at the lower lumbar levels. Reports on the relationship between the waist-to-hip ratio and low back pain are contradictory. Han et al. (12) did not find a substantial association between this ratio and low back pain, whereas Yip et al. (46) found a lower risk of developing low back pain in individuals with higher waist-to-hip ratios. In summary, while investigating the impact of obesity on epidural injection outcomes, prospective studies incorporating the aforementioned measures, in addition to BMI, may be beneficial for future research endeavors.

Another limitation is related to the extent to which patients adhered to the recommendations during the one-month period following the injection. Physical exercise is an important non-pharmacological treatment method for low back pain and obesity (18,45). In our clinic, we provide an

exercise program for patients who have undergone lumbar epidural injections. However, not all patients are able to be included in the rehabilitation program accompanied by a physiotherapist. Therefore, it is unclear how well the exercise program is followed.

CONCLUSION

In conclusion, the effects of obesity on the short-term outcomes of lumbar TFESI remain unilluminated, and there is no valid reason for avoiding these injections in individuals with higher BMI values. Therefore, practitioners of interventional pain management should continue administering epidural injections in obese patients. Further larger-scale, prospective comparative studies are needed to establish a clear causal relationship.

Declarations

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

Funding: This study received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Data availability statement: The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

AUTHORSHIP CONTRIBUTION

Study conception and design: SK, SS, BY, BAP, RS, OHG
Data collection: SK, BY, BAP, RS
Analysis and interpretation of results: SK, BY, BAP, RS
Draft manuscript preparation: SK
Critical revision of the article: SS, OHG
All authors (SK, SS, BY, BAP, RS, OHG) reviewed the results and approved the final version of the manuscript.

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