The Effect of Body Mass Index on the Outcome of Lumbar Epidural Steroid Injections: Six-Month Follow-Up

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Abstract - Obesity is a risk factor for severe, radicular, and debilitating lumbosacral pain. The use of non-surgical treatment methods in obese patients is important. Epidural steroid injection (ESI) is a common procedure that helps patients with low back pain and radicular symptoms. So far, using ESI in patients with lumbar herniated discs remains to be controversial among physicians. Thus, the current study was carried out to compare the therapeutic effects of ESI's in obese and non-obese patients with spinal disc herniation. This prospective, clinical trial study was conducted among 124 patients (58=non-obese, 66=obese) with low back pain caused by a lumbar herniated disc, who referred to our Pain Clinic from 2017 to 2018. The ESI was done using the parasagittal inter-laminar approach. The severity of pain was measured by the patients’ self-report of pain and using the visual analog scale (VAS) before the treatment and two and six weeks after the treatment. The Oswestry Disability Index (ODI) was also measured in the treatment groups. Patients were followed for 6 weeks (IRCT20131124015515N3). Overall, 58 (46.8%) patients had a BMI of 20-25 kg/m², 38 (30.6%) had a BMI of 25-30 kg/m², and 28 (22.6%) patients had a BMI of >30 kg/m². The changes in the pain scores and ODI at different time periods showed no statistically significant differences in the two groups (P=0.685, P=0.995), respectively. The ESI is an effective, safe, minimally invasive, and cost-effective method that can result in pain relief and improvements in patients' function after a short period of time. Hence, we suggested that this treatment be considered for all patients with acute/chronic low back pain as well as radiculopathy.

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Keywords: Epidural steroid injections; Lumbar disc herniation; Body mass index; Outcome

Introduction

Morbid obesity and weight gain are among the factors that increase the risk of developing low back pain (1). Excessive pressure on the spinal cord (2), systemic inflammation (3), and a degenerative disc (4) are considered possible mechanisms by which obesity may lead to low back pain.

Obesity is considered an epidemic and is highly associated with low back pain. However, it is not clearly known yet as to whether obesity directly causes low back pain or not? (5-7).

A large number of studies have identified obesity as a risk factor for developing lumbosacral radicular pain (6-10). Thus, a high number of patients who begin treatment for low back pain are obese because obesity is a risk factor for severe, radicular, and debilitating lumbosacral pain (11).

A herniated disc can mainly be controlled by conservative therapies such as resting, oral steroids, anti-inflammatory medicine, and physical therapy. The success rate of conservative treatments is high in these patients and results in significant improvements in symptoms, which reduces the need for surgical interventions.

In the event of failure of conservative treatments, considering the increased postoperative complications as a result of a high BMI, the use of non-surgical treatment methods in this group of patients becomes significant (12).

An epidural steroid injection (ESI) is a common procedure that helps patients with low back pain and radicular symptoms (13). ESI can help relieve the pain, improving function, and preventing spinal surgery,
particularly in patients with acute and subacute herniated disc and radicular pain (14-22).

Reducing inflammation and nerve edema and the neuroprotective properties against nerve damage are among the benefits of ESI (23-25). ESI is a common treatment for neurogenic claudication caused by spinal stenosis (23,25-27), spinal pain, and radicular pain (26-31). Some studies have shown that symptomatic herniated disc, failed back surgery syndrome, and symptomatic spinal stenosis could be treated with ESI’s (32-33). Based on previous literature, ESI relieves radicular pain in the short term (34). Some studies have also demonstrated that ESI was effective in reducing radicular pain secondary to spinal stenosis (29,31,35-38).

Some previous studies have reported contradictory results regarding the effect of ESI on patients with lumbar herniated disc (30-33). Others also indicated that interlaminar ESI helped to reduce the pain caused by spinal stenosis over a short period of time (35).

In a number of studies, depths of epidural space from the skin of the injection site were examined in interlaminar lumbar (39-44), thoracic (45-47), and cervical (48-49) procedures. Depths of lumbar epidural space in patients admitted to midwifery (41-43,44,50), and non-midwifery (39,40,43) wards were also investigated in several studies.

Moreover, several studies reported a relationship between BMI and depths of epidural space (42-44,50). Nowadays, obesity is a growing issue that affects clinical outcomes of treatments (51).

So far, using ESI in patients with lumbar herniated discs is still a controversial subject between physicians, pain specialists, and neurosurgeons.

Considering the existing conflicts regarding the use of ESI in patients with lumbar herniated discs and considering that limited studies have been conducted to assess the issue, the current study was carried out to compare the therapeutic effect of ESI in obese and non-obese patients with lumbar disc herniation.

Materials and Methods

This is a clinical trial study (IRCT20131124015515N3) conducted among 124 patients with low back pain caused by a lumbar herniated disc, who referred to a pain clinic of a tertiary health care center during 2017-2018. Patients older than 18-year-old, with herniated discs, spinal stenosis <30% diagnosed by clinical examinations and CT scan or MRI, foot pain, bilateral radiculopathy, and lumbar disc (disc bulging, and disc herniation in one or two levels) as well as candidates for ESI were included in the present study after obtaining an informed and written consent to enter the study. Patients with central disk herniation with extrusion pain or progressive or severe sensory symptoms or disorders, degenerative herniated disc, history of ESI over the past six months, history of opioid abuse, recent abuse of long-acting opioids with radicular pain for more than a year, more than two herniated discs at different sites of the spinal cord, coagulation disorders, sensitivity to steroids, malignancy, psychiatric problems (and lack of compliance), speech problems, pregnancy, indications for surgery, local skin infections at the surgical area, spinal deformity, history of lumbar spine surgery, cauda-equina syndrome, vertebral fractures, tumor or infection in the spine, inflammatory spondylopathy, neurological defects and those who did not give their informed consent, were excluded from the study. In this regard, until reaching the desired sample size, the study subjects were selected among those who referred to the hospital and met the inclusion criteria.

After obtaining the IV line, a non-invasive pulse oximetry monitoring system was set for all the patients in the operating room, and their blood pressure and heart rate were measured and recorded.

To carry out the surgical procedure, the patient was placed on a fluoroscopy bed, and a pillow was put under the abdomen in the prone position. The patient’s vital signs were monitored during the procedure. The ESI was carried out using a parasagittal interlaminar approach under the guidance of the fluoroscopy at the pathology level and at the proper dermatome for injection, which was determined by the patient’s site of pain and according to MRI findings. After skin preparation with betadine, local anesthesia was administered using 1% lidocaine injections into the subcutaneous space. The ESI was carried out using the parasagittal interlaminar approach and using an 18-gauge epidural needle (9-cm long). Proper placement of the needle under the guidance of the fluoroscopy at the pathology level of the disc was confirmed by 1-2 ml injection of a contrast material under the fluoroscopy view. At the lateral point, the interlaminar opening to the midline was directly visualized under the anteroposterior (AP) fluoroscopy guide. The needle was inserted directly from paramedian to the skin in an AP direction using the loss of resistance (LOR) technique to locate the epidural space. Using the parasagittal approach, the needle was maintained throughout the procedure. In order to control the non-distribution of contrast material in intravascular, subarachnoid, and subdural space, consistent imaging was performed. At the target space, 1-2 ml of contrast
material was injected, and the results of the epidurogram were recorded. In the case that the contrast material did not flow through the disk space, the needle would be repositioned. After confirming its proper position as well as the flow rate of the contrast material (visipaque 320 mg/ml) with the epidurogram, the epidural injection of a mixture containing 2% ropivacaine (2 ml), normal saline (6 ml), and triamcinolone 40 mg/ml (8 ml) was administered. After this, patients were transferred to the recovery room.

The severity of pain was measured by the patients’ self-report of pain and using the visual analog scale (VAS) criteria (0: no pain at all, 1-3: mild pain, 4-7: moderate pain, and 8-10: severe pain), before the treatment and two and six weeks after the treatment. The Oswestry Disability Index (ODI) was also measured in the treatment groups, and the patients were examined with 10 disability items. The scores of each item vary between 0-5; the greater the score, the higher the patient’s disability (27). During follow-ups, no other treatments were performed to improve the pain, and in the case of a VAS of >4, nonsteroidal anti-inflammatory medicine would be advised. The patients’ satisfaction with pain relief was measured and scored by directly asking the patient (0: bad, 1: moderate, 2: good, 3: excellent). In the case of complications, it was recorded. The above items were measured by trained nursing staff.

The duration of follow-up was 6 weeks and was carried out by calling, interviewing, and revisiting the patients. To avoid excluding the study subjects, their records were completed, and they were continuously followed for their visits to the clinic for assessing the improvement of their pain.

Data were analyzed using the SPSS software, version 19.

After testing for normal distribution using the Smirnov-Kolmogorov test, quantitative variables were compared using a T-test, Mann-Whitney test, repeated measurement ANOVA, paired T-test, and one-way ANOVA between two groups. Qualitative variables were also compared using the Chi-square test between the two groups. The level of significance was *P*<0.05.

**Results**

Overall, 58 people (46.8%) were non-obese and 66 people (53.2%) were obese. Among them, 58 people (46.8%) had a BMI between 20-25 kg/m², 38 people (30.6%) had a BMI between 25-30 kg/m², and 28 people (22.6%) had a BMI >30 kg/m².

Figure 1 depicts the changes in pain scores at different time periods—before and two weeks and six weeks after ESI—in the two obese and non-obese groups, which showed no statistically significant difference (*P*=0.685).

![Figure 1](image1)

**Figure 1.** Changes in pain scores at different time periods in the two obese and non-obese groups

Figure 2 depicts changes in ODI scores at different times periods before and two weeks and six weeks after ESI—in the two obese and non-obese groups, which demonstrated no statistically significant difference (*P*=0.995).

![Figure 2](image2)

**Figure 2.** Changes in the ODI scores at different time periods in the two obese and non-obese groups

Figure 3 depicts changes in pain scores at different times periods—before and two weeks and six weeks after ESI—in three groups with different BMIs, which showed no statistically significant difference (*P*=0.198).

![Figure 3](image3)

**Figure 3.** The changes in the pain scores at different time periods in three groups with different BMIs
Figure 4 depicts changes in ODI scores at different times periods—before and two weeks and six weeks after ESI—in three groups with different BMIs, which showed no statistically significant difference ($P=0.603$).

Table 1 compares the demographic data of the two groups.

Table 2 compares the clinical data of the BMI groups and Table 3 compares the clinical data of the three groups divided by the duration of pain, which showed no statistically significant difference ($P>0.05$).

Table 4 shows the changes in pain and ODI scores at different time periods in both obese and non-obese groups.

None of the patients showed complication caused by the ESI procedure.

| Table 1. Demographic data of the two groups. |
|---------------------------------------------|
|                                          |
| **Obese group** (n=66)                    |
| Age (yr.) 40.4±14.8                      |
| Weight (kg) 78.0±7.8                     |
| Height (cm) 164.8±8.6                    |
| BMI (kg/m²) 29.1±3.5                     |
| Duration of pain (month) 9.3±4.7          |
| Sex Male 39 (59.1%)                       |
| Female 27 (40.9%)                         |
| Duration of pain < 3 months 4 (6.1%)      |
| Duration of pain 3-6 months 22 (33.3%)    |
| Duration of pain >6 months 40 (60.6%)     |
| Pain Location: L4-L5 36 (54.5%)           |
| Smoking Yes 27 (40.9%)                    |
| Smoking No 39 (59.1%)                     |
| The duration of motor block (min) 127.3±3.1 |
|                                          |
| **Non-obese group** (n=58)               |
| Age (yr.) 30.4±8.8                       |
| Weight (kg) 68.2±10.1                    |
| Height (cm) 170.6±8.9                    |
| BMI (kg/m²) 23.3±1.6                     |
| Duration of pain (month) 8.9±4.5         |
| Sex Male 46 (79.3%)                       |
| Female 12 (20.7%)                        |
| Duration of pain < 3 months 4 (6.9%)      |
| Duration of pain 3-6 months 20 (34.5%)    |
| Duration of pain >6 months 34 (58.6%)     |
| Pain Location: L5-S1 30 (51.7%)          |
| Smoking Yes 23 (39.7%)                    |
| Smoking No 35 (60.3%)                     |
| The duration of motor block (min) 123.1±3.6 |
|                                          |
| **P**                                     |
| 0.0001                                   |
| 0.0001                                   |
| 0.0001                                   |
| 0.0001                                   |
| 0.611                                    |
| 0.016                                    |
| 0.968                                    |
| 0.753                                    |
| 0.887                                    |
| 0.002                                    |

| Table 2. Compares the clinical data of the BMI groups |
|-------------------------------------------------------|
|                                                       |
| **20-25 (n=58)**                                     |
| **25-30 (n=38)**                                     |
| **>30 (n=28)**                                       |
| VAS before injection 8.8±1.2                         |
| VAS 2 weeks after injection 3.9±1.2                  |
| VAS 6 weeks after injection 2.8±1.1                  |
| VAS before injection 34.6±6.3                        |
| VAS 2 weeks after injection 18.6±5.0                 |
| VAS 6 weeks after injection 18.7±4.2                 |
| Patient Satisfaction (2 weeks after injection)       |
| Moderate 10 (17.2%)                                  |
| Good 40 (69.0%)                                      |
| Excellent 8 (13.8%)                                  |
| Patient Satisfaction (6 weeks after injection)       |
| Moderate 18 (31.0%)                                  |
| Good 40 (69.0%)                                      |
| **P**                                                 |
| 0.193                                                 |
| 0.079                                                 |
| 0.464                                                 |
| 0.895                                                 |
| 0.526                                                 |
| 0.231                                                 |
| 0.254                                                 |
| 0.331                                                 |
Table 3. Compares the clinical data of the three groups divided by the duration of pain (month)

| Patient Satisfaction | <3 (n=8) | 3-6 (n=42) | >6 (n=74) | P     |
|----------------------|---------|-----------|----------|-------|
| VAS before injection | 8.3±1.5 | 8.7±1.3  | 8.7±1.2 | 0.612 |
| VAS 2 weeks after injection | 3.8±1.0 | 4.2±1.1  | 3.8±1.2 | 0.334 |
| VAS 6 weeks after injection | 2.6±1.2 | 3.0±1.2  | 2.7±1.3 | 0.557 |
| ODI before injection | 40.7±8.1 | 36.4±6.6 | 33.3±6.3 | 0.002 |
| ODI 2 weeks after injection | 17.5±5.3 | 19.7±5.0 | 18.0±4.8 | 0.171 |
| ODI 6 weeks after injection | 19.7±6.2 | 19.7±4.3 | 17.6±3.8 | 0.024 |
| Patient Satisfaction | Moderate | Good | Excellent | Good | |
| 2 weeks after injection | 1 (12.5%) | 4 (9.5%) | 16 (21.6%) | 0.288 |
| 6 weeks after injection | 2 (25.0%) | 13 (31.0%) | 32 (43.2%) | 0.313 |

Table 4. Changes in the pain and ODI scores at different time periods in both obese and non-obese groups

| Obese group (n=66) | Non-obese group (n=58) |
|---------------------|------------------------|
| VAS before injection | 8.5±1.3 | 8.8±1.2 |
| 2 weeks after injection | 4.0±1.1 | 3.9±1.2 |
| P | 0.0001 | 0.0001 |
| 2 weeks after injection | 4.0±1.1 | 3.9±1.2 |
| VAS 6 weeks after injection | 2.8±1.3 | 2.8±1.1 |
| P | 0.0001 | 0.0001 |
| before injection | 35.0±7.2 | 34.6±6.3 |
| ODI 2 weeks after injection | 18.4±4.9 | 18.6±5.0 |
| P | 0.0001 | 0.0001 |
| 2 weeks after injection | 18.4±4.9 | 18.6±5.0 |
| ODI 6 weeks after injection | 18.3±4.3 | 18.7±4.2 |
| P | 0.870 | 0.620 |

Discussion

In the current study, changes in the pain and ODI scores at different time periods—before and two weeks and six weeks after ESI—between the obese and non-obese groups showed no significant differences. However, after the injection, pain scores in both obese and non-obese groups decreased significantly at different time periods. The ODI scores collected after two weeks showed a significant decrease; however, comparing the scores in the second and sixth weeks showed no significant decrease. The findings of this study were in line with most previously conducted studies (52-56).

According to our study, the changes in pain and ODI scores at different time periods—before and two weeks and six weeks after the ESI—between the three groups with different BMIs (20-25, 25-30, and >30 kg/m²) showed no significant difference. However, after the injection, the pain scores of each of these three BMI groups decreased significantly at different time periods. The ODI scores collected after the second week showed a significant decrease; however, comparing the scores in the second and sixth weeks after the injection showed no significant decrease.

In addition, the pain scores indicated a significant decrease two weeks after the injection among males; however, comparing men and women demonstrated no significant difference at other time periods. ODI scores of the men and women showed no statistically significant difference at these time periods.

Comparing pain scores, based on the duration of the medical condition, obtained at different time periods, indicated no statistically significant difference. The ODI scores obtained six weeks after the injection among patients who suffered from the condition for more than six months showed a significant increase.

So far, the mechanism of the immediate action of lumbar ESI has been unknown. Materials found in the herniated nucleus disc had significant acute inflammatory effects on the epidural tissue, nerve root, and dorsal root ganglion (57-59). Inflammatory mediators such as phospholipase A2, tumor necrosis factor-alpha, interleukin-6, interleukin-8, and prostaglandin E2 were observed in the degenerative material and the herniated disc (59-65). Some previous studies reported increased intradiscal cytokines in patients with discogenic low back
pain (64). The direct impact of nucleus pulposus on epidural space, nerve root, and DRG indicates changes in histology and nerve functions (66-68). Furthermore, some studies have shown the direct impact of the selected inflammatory mediators and cytokines as well (69-71). The acute nerve root compression caused inflammatory changes associated with changes in nerve functions (72,73). With the development of edema, an increase in intraneural pressure, and a decrease in neural blood flow, the perineural and intraneural have been changed and have the ability to penetrate. Moreover, the infiltration of inflammatory cells, edema, and intraneuronal fibrotic changes co-occur with a chronic increase in pressure (74-76).

In the first few days after the ESI, most of the patients reported pain relief. It was assumed that this pain reduction was due to the known anti-inflammatory effect of medicine. The ESI has multiple probable effects on the sensitized and inflamed tissue including the cell membrane stability (CMS), the reduction in nerve and tissue edema, the direct anti-inflammatory effect, the synthesis/neuropeptide function inhibition, the prostaglandin synthesis inhibition, the neuroinflammatory discharge suppression, the sensitized dorsal horn neurons suppression, and the change in neuronal blood flow (77-86).

Furthermore, the anti-inflammatory effects associated with the local anesthetic injection can strengthen the effects of steroids (87-89). Recently, the interferon-gamma in epidural lavage samples showed that the response to ESI in the lumbar area might be equal to the reduction level of interferon-gamma (90-91).

On the other hand, the immediate response to ESI in the lumbar area may be associated with the direct local anesthetic impact on the active generating of epidural, neural, or perineural pain or their neural branching. When the patient’s pain is due to inflammatory factors such as disc or inflammation of epidural structure, a local anesthetic injection with a direct effect on the sensitive site leads to an immediate reduction of pain. The pain relief can be enhanced by diluting or limiting the local washing of active epidural inflammatory mediators (92). When the pain is related to adjacent structures of the epidural space, the applied anesthetic solution can directly result in pain relief through the epidural structure or its neural branching. The immediate response to the ESI in the lumbar area may be indicative of a target area with the potential to predict the therapeutic response to the ESI in the lumbar area.

Inactivity, a lack of regular exercise, and obesity are risk factors for disc herniation. Weight gain puts extra stress on the disc. A disc is a soft pad between vertebrae that bear our weight. Disc herniation creates nerve pressure in the spinal canal (93).

Obesity is one of the factors that lead to pathology in the lumbar area. It plays an important role in the onset of low back pain and response to treatments. Obesity is one of the important causes of decreased response to treatment, especially in high-grade degenerative lumbar vertebral (4).

In a comparative study carried out on two groups of obese and non-obese individuals, transforaminal ESI’s resulted in similar success rates in both treatment groups (50). This is in coherence with the current research findings.

In another study, the authors demonstrated that the two groups of obese and non-obese subjects, were similar during the study in terms of pain relief and improvement and that the ESI had similar pain relief impacts on both obese and non-obese patients. Due to the improved function of obese patients after treatment, the weight loss process can also occur more easily; thus, the treatment in these patients is associated with a dual effect (54).

In the event of failure of conservative treatments, considering the increased postoperative complications as a result of a high BMI, the use of non-surgical treatment methods in this group of patients becomes significant (12).

In the treatment of low back pain, first, pharmacotherapy and physical therapy take priority, and then, therapeutic interventions with the least invasion such as ESI, radiofrequency, spinal cord stimulation, and spinal opioids may be selected (94-96). For the lumbar epidural injection, local anesthetic, local steroid, or a combination of local anesthetic and local steroid can be used (21).

Studies have indicated that the use of a combination of local anesthetic and local steroid is preferable (97). The combination of local anesthetic and local steroid was used in the current study. It seems that local anesthetic relieves pain after a short term; however, local and systematic anti-inflammatory steroids take effect after a long term. The systemic effects of corticosteroid injections done for relieving radicular pain caused by disc herniations may remain for several days to weeks (98).

The limitations of this study were low sample size, and changes in patients’ perceptions of their health status, which could influence the evaluation of the impact of the therapeutic interventions.

In the present study, injecting 40 mg of steroids was not associated with side effects, which was consistent with other studies (54,99). According to some previous
studies, lower dosages of steroids were associated with fewer side effects; therefore, 40 mg of steroids can also be used for diabetic patients (99).

In the current study, significant improvements in patient’s function during the course of the study can be indicative of the absence of other causes of low back pain pathology, so only a discopathy at one level can be considered as the pathological cause of low back pain. Moreover, the mechanical effects of the liquid injection and pharmacological effects of steroids helped the improvement of low back pain.

This method can be considered as an appropriate choice; however, it cannot be regarded as an alternative to open surgery.

Therefore, pain fellowships and neurosurgeons are advised to consider ESI’s for these patients according to the protocol of this study. We suggest to carry out this study with a longer follow-up period, different dosages of corticosteroids, and different volumes of epidural injection on patients with herniated discs and different BMI’s. Additionally, during the follow-up period, the weight loss process of obese patients should be evaluated.

The ESI is an effective, safe, minimally invasive, and cost-effective method that can result in pain relief and improvements in patient function after a short period of time. Hence, it is suggested that this treatment is considered for all patients with acute/chronic low back pain as well as radiculopathy.

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