Differences of Therapeutic Responses to Epidural Steroid Injection in Elderly Patients With Radiculopathy

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Background: Lumbar epidural steroid injections (ESI) administered in patients with radicular symptoms produce variable effects. Further, factors associated with improved outcomes are unclear. We investigated the effect of lumbar ESI not only on pain but also on depression and insomnia. Previous studies have only investigated the relationship between pain and magnetic resonance imaging (MRI) findings. Therefore, we aimed to determine the relationships between pain, MRI findings, sleep, and depression scores.

Methods: Thirty-five patients with lumbar radiculopathy were recruited in the study. After excluding 15 patients, 20 were evaluated both before and after ESI. These patients were categorized into 3 groups according to lumbar MRI findings as disk herniation I (bulging and protrusion) and disk herniation II (extrusion and sequestration) and central canal stenosis group. We evaluated treatment outcomes using changes in the visual analogue scale. Additionally, patients completed the Beck Depression Inventory and the Insomnia Severity Index (ISI) before and after ESI.

Results: After ESI, patients with disk herniation I showed improvement in pain, depression, and sleep; however, there were no significant differences between disk herniation I and the other 2 groups.

Conclusion: We believe that active treatment with ESI may alleviate pain, depression, and insomnia in patients with disk herniation I showing bulging and protrusion.

INTRODUCTION

Lumbar disc herniation or spinal stenosis can impair the quality of life by causing pain in the lower back region, which is often accompanied by pain radiating down the leg; additionally, it may lead to symptoms such as insomnia or depression.1,2

Lumbar epidural steroid injection (ESI) is one of the most common modalities used in patients with low back pain (LBP) and radiating leg pain. Many studies have reported the efficacy of lumbar ESI in treating lumbosacral radiculopathy.3-5 The therapeutic efficacy of lumbar ESI is usually evaluated with the visual analogue scale (VAS) as a subjective indicator or with the straight leg-raising test during physical examination.4,5

Numerous studies have investigated the correlation between pain and magnetic resonance imaging (MRI) findings; however, inadequate research has been conducted on the effect of this correlation on clinical outcomes of ESI. Cohen et al.6 reported that MRI findings had no effect on outcome improvement in patients who underwent lumbar ESI, and that MRI played a negligible role in clinical decision-making. In contrast, Fish et al.7 reported that MRI could predict therapeutic responses to ESI in patients with cervical radiculopathy. Thus, there is no consensus on predictive factors for the effect of ESI on clinical outcomes, and further research is needed to determine whether ESI improves functional deficits.

Patients with LBP not only experience pain, they additionally develop impairments in other aspects of life, of which sleep disturbance is one of the most serious adverse effects.8 Previous studies confirmed that VAS pain intensity scores are correlated with sleep disturbance.9,10 It was also reported that patients with LBP have a high prevalence of sleep disorders and that the hospitalization rate of LBP patients with sleep disorders is twice that of LBP patients without sleep disorders.9,11,12 According to recent studies, sleep disturbance occurs as an inevitable consequence of chronic pain and makes pain management difficult, placing patients with chronic pain at risk of exacerbation.13-15 Moreover, pain is reported to be the most important predictor of depression16, and the correlation between pain and depression has repeatedly
been reported in relation to a large number of disorders17,18).

Based on this background, this study was conducted to determine the associations between ESI and pain management in elderly patients with lumbar radiculopathy, as well as sleep disturbances and depression, and to examine differences in these symptoms according to MRI findings.

MATERIALS AND METHODS

1. Subjects

Among outpatients with LBP and radiating pain who underwent MRI between August 2013 and October 2014 and subsequently received ESI, we selected 35 patients who reported sleep disturbance due to pain or numbness in the legs, or felt anxious about their health status or depressed due to unchanged or deteriorating symptoms after 4 weeks of conservative treatment. In other words, they had ongoing or worsening pain after 4 weeks of medication, physiotherapy, exercise intervention, or other conservative treatments, and had depression or a sleep disturbance due to LBP and radiating leg pain. Of these 35 patients, we excluded 15 with a history of spinal surgery, comorbid peripheral neuropathy, low scores (<24) in the simple mental status examination (judged unable to respond to the questionnaire), and previous treatment for a sleep disorder or depression.

All 20 enrolled patients had a follow-up examination 2 weeks after an ESI and underwent a physical examination and questionnaire survey. The reason for this timeframe was that the Insomnia Severity Index (ISI) is a self-reported questionnaire based on a 2-week sleep log.

According to MRI findings, patients were divided into 2 groups: a disc herniation group and a central spinal stenosis group. Depending on the degree of herniation, the disc herniation group was subdivided into disc herniation I and disc herniation II groups. Patients with disc bulging or protrusion were assigned to the disc herniation I group and those with disc extrusion or sequestration were assigned to the disc herniation II group.

There were 12 males and 8 females, with a mean age of 62.4 years (range: 52–77 years). Of the 18 patients with disc herniation, 11 were assigned to the disc herniation I group and seven to the disc herniation II group. Central spinal stenosis was observed in 18 patients (Table 1).

2. Methods

We performed lumbar ESI on each patient. We injected the steroid solution into the epidural space near the nerve root, which was located using a blind technique, coupled with a loss-of-resistance technique. For the injection, we chose dexamethasone instead of triamcinolone and prepared the steroid solution by mixing 2 g of dexamethasone, 3 mL of 1% lidocaine, and 5 mL of saline. The same steroid dose was used for all patients regardless of body weight and severity of symptoms.

We assessed the severity of pain, sleep disturbance, and depression at baseline and at week 2 using the VAS, ISI, and Beck Depression Inventory (BDI), respectively. Using IBM SPSS ver. 18.0 (IBM Co., Armonk, NY, USA), we performed a t-test for statistical data analysis and the Jonckheere-Terpstra test to compare the 3 groups. This study was approved by the Asan Medical Center Institutional Review Board (approval number: S2016-1041-0003).

RESULTS

After the ESI, VAS scores decreased to 44.4±21.9 from a baseline value of 68.4±17.3, ISI decreased from 5.9±6.4 to 3.7±4.3 points, and BDI from 10.0±7.9 to 7.0±5.1 points (Table 2).

Among patients with MRI-confirmed disc herniation, those in the disc herniation I and II groups showed VAS score decreases of 49.4±13.4 and 27.9±16.9, respectively. The patients in the central spinal stenosis group showed a postoperative VAS reduction of 20.6±15.4. Only the improvement shown by the disc herniation I group was statistically significant (Table 3).

The disc herniation I and II groups showed improvements in the ISI scores by -5.2±4.0 and -3.1±5.7 points, respectively. Patients with central spinal stenosis showed improvement of -2.6±1.0 points. Statistically significant changes were shown

Table 1. Demographic data

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr), mean±SD</td>
<td>62.4±13.0</td>
</tr>
<tr>
<td>Sex, male:female</td>
<td>12:8</td>
</tr>
<tr>
<td>Duration of pain (day), mean±SD</td>
<td>130±42</td>
</tr>
</tbody>
</table>

Table 2. Changes in parameter scores from preintervention to postintervention

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Preintervention</th>
<th>Postintervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS</td>
<td>68.4±17.3</td>
<td>44.4±21.9</td>
</tr>
<tr>
<td>ISI</td>
<td>5.9±6.4</td>
<td>3.7±4.3</td>
</tr>
<tr>
<td>BDI</td>
<td>10.0±7.9</td>
<td>7.0±5.1</td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation. VAS, visual analogue scale; ISI, Insomnia Severity Index; BDI, Beck Depression Inventory.
The intergroup comparison of the three groups did not yield any statistically significant results (p>0.05 each).

**DISCUSSION**

Radiating pain in the lower extremities caused by lumbar radiculopathy greatly impairs daily functioning and has substantial influence on the effect of rehabilitation interventions. Lumbar ESI can alleviate LBP and radiating leg pain caused by lumbar radiculopathy and can improve daily functioning by the following mechanisms: (1) decrease in inflammatory responses, (2) inhibition of humoral and cell-mediated immune responses, (3) nerve membrane stabilization, and (4) conduction block of C-fiber nociceptors. There are reports that lumbar ESI has therapeutic effects on lumbar radiculopathy; however, there remains lack of supporting evidence in terms of clinical cohorts and outcome predictions. Moreover, although there are a large number of outpatients with depression and sleep disturbance due to LBP and radiating leg pain, there are insufficient data to evaluate related therapeutic effects or predict clinical outcomes.

This lack of evaluation data led us to design this study aimed at determining the factors enabling prediction of clinical effects of lumbar ESI on depression and sleep disturbances, as well as on LBP.

Our study focused on determining whether lumbar ESI is effective in alleviating pain and improving depression and sleep disturbances in patients with LBP and radiating leg pain, and whether there are differences in outcomes depending on the MRI findings causing lumbar radiculopathy. The VAS, ISI, and BDI score comparisons with baseline values confirmed overall post-ESI improvements in pain, insomnia, and depression. In terms of changes in association with MRI findings causing LBP and radiating leg pain, patients in both disc herniation and central spinal stenosis groups showed reduction in all scores. However, only the disc herniation I group, i.e., patients with disc bulging and protrusion, showed statistically significant improvements.

Among previous studies, Choi et al. compared patients who responded to ESI with those who did not, and reported that among patients who responded to ESI — despite a lack of significant differences in MRI findings — evaluation in terms of the type of nucleus pulposus, hydration, size of herniated nucleus pulposus, or association with spinal stenosis revealed a significant proportion with a centrally located nucleus pulposus or extraforaminal herniation of the nucleus pulposus.
However, Cohen et al.\(^\text{6}\) reported that patients with lumbar radiculopathy whose MRI findings were shown during lumbar ESI had less leg pain in the first month than those who underwent lumbar ESI with blinding of the MRI findings; however, no differences were seen in the third month.

The current study differs from previous studies in that it classified the underlying disease causing LBP and radiating leg pain according to the MRI findings, and compared the baseline and post-ESI pain, insomnia, and depression index scores. Furthermore, the current study examined the therapeutic effects of pain management on insomnia and depression after classifying the underlying diseases. The disc herniation I group (bulging and protrusion) showed statistically significant differences in all test items compared with the disc herniation II group (extrusion and sequestration) and the central canal stenosis group, which showed no statistically significant differences. This is assumed to be attributable to the closeness of the herniated disc to the injection point in the two earlier stages of herniation (bulging and protrusion), such that all injected solution could reach the lesion area.\(^\text{2,29}\)

ESI clearly improved LBP and radiating leg pain, which in turn improved daily functioning through decreased sleep disturbance and depression in patients with earlier-stage disc herniation. On the other hand, the disc herniation II group, i.e., patients with later-stage disc herniation (extrusion and sequestration) and the central canal stenosis group did not show statistically significant improvements; this was presumably due to limitation of drug delivery to the area surrounding the lesion or insufficient delivery to the lesion, which was dependent on the degree of disc adhesion. Nevertheless, VAS, ISI, and BDI scores decreased in these groups as well, albeit without statistical significance. This is presumably because dexamethasone, the steroid used in our experiment, has a stronger systemic effect than the conventionally used triamcinolone; thus, dexamethasone could exert its therapeutic effect even when it could not reach the lesion sufficiently due to disc adhesion. The disc herniation I group showed clear evidence of therapeutic effect on the lesion for the reasons described above and showed significant changes in all test items. The slight (statistically nonsignificant) post-ESI improvements displayed in the other 2 groups in pain, insomnia, and depression may be explained by the systemic effects of the steroid.

The significance of this study lies in the fact that it confirmed the therapeutic effect of lumbar ESI in reducing LBP and radiating leg pain in patients with disc bulging and protrusion who additionally complained of sleep disturbance and depression. The study findings may be used as a supportive material for recommending epidural nerve block injections such as ESI for disc herniation patients at earlier stages (bulging and protrusion) after confirming the stages with an advanced investigation procedure such as lumbar MRI.

This study had the following limitations: The sample size was small, the results were not based on long-term follow-up, and central canal stenosis was not subdivided according to the MRI-confirmed severity of stenosis. Further research with a larger sample size and a longer follow-up period is hence necessary. Another limitation of this study was the blind technique used for locating the lesion, which leaves scope for improvement in accuracy, even though we attempted to minimize procedural error by having the same surgeon perform all ESI procedures. Additionally, other factors that may be associated with sleep disturbances and depression were not considered in the analysis, and subject recruitment was limited to those with LBP and radiating pain.

To address these limitations, it may be necessary to conduct a more comprehensive study focusing on pain and its related sleep disturbances and depression.

**Conflict of Interest Disclosures:** The researchers claim no conflicts of interest.

**REFERENCES**

10. Chen Q, Hayman LL, Shmerling RH, Bean JF, Leveille SG.


