A Prospective Analysis of Ultrasonography-guided Caudal Epidural Steroid in the Management of Chronic Low Back Pain and Radicular Leg Pain

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ABSTRACT

Introduction: Low back pain and sciatica (LBPS) is a major health and socioeconomic problem in modern India. Inadequate treatment of pain leads to loss of valuable man-hours for the country.

Aim: The study aims to validate the effect of ultrasonography (USG)-guided caudal epidural steroid (CES) injection in the management of pain due to LBPS.

Materials and methods: This is a noncomparative clinical study in patients with LBPS due to lower lumbar and sacral nerve root involvement. Under USG guidance caudal epidural space was identified; mixture of local anesthetic and methyl prednisolone was injected as bolus dose; and visual analog scale (VAS) score and straight leg raising test (SLRT) were recorded pre- and postprocedure. Patients are followed up to 6 months for assessing the pain relief.

Results: The mean VAS score before the procedure is 7.78, postprocedure is 2.95. The SLRT before the procedure is 28.58, and the postprocedure is 71.83. Our study showed statistically significant improvement in pain relief and SLRT.

Conclusion: The USG guidance enables us to perform the procedure in real time and helps us to avoid inadvertent vascular deposition of drug. Caudal approach minimizes the possibility of dural puncture. The USG-CES injection is effective in managing the chronic LBPS of lower lumbar and sacral nerve root involvement.

Keywords: Caudal epidural steroid, Disk degenerative disease, Lower back pain and sciatica, Straight leg raising test, Ultrasonogram.


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Conflict of interest: None

INTRODUCTION

Pain in any anatomical region leads to physical and mental discomfort. The prevalence of LBPS in the Indian population has been found to be as high as 92%. Its incidence is high in India due to multiple physical and socioeconomic factors. The occurrence of low back pain in India is also alarming that nearly 60% of the people in India have suffered from low back pain at some time during their lifespan.

Low back pain also restricts mobility, interferes with normal functioning, and results in chronic pain and permanent restriction in mobility. In India, most of the low-income group people are engaged in physically demanding jobs which may increase the risk of low back pain and disability. Low back pain also affects the quality of life.

The conventional wisdom that in most cases the pain will resolve on its own within few weeks is true, but recent evidence indicates that relief from self-healing is followed by a significant incidence of recurrence usually in less than a year; 10% of all low back pains continue for 4 to 6 weeks, and are hence, called chronic low back pain.

INTRODUCTION

The purpose of the study is to validate the effectiveness of USG-guided CES in reducing the pain of LBPS. Caudal approach is preferred since it is technically easier. Steroid injection acts as an anti-inflammatory and thus reduces pain. The USG-guided technique gives us the advantage of performing the procedure in real time and also proves to be logistically easier and having good patient compliance. Providing adequate pain relief by USG-guided CES after conservative management will avoid unwarranted surgical interventions. The study aimed to explore the effect of USG-guided CES injection in the management of pain due to LBPS.
MATERIALS AND METHODS

A noncomparative clinical study was conducted on 60 patients with American Society of Anesthesiologists (ASA) grades I and II of both sexes, and of age 18 to 80 years. Patients with LBPS due to lower lumbar and sacral nerve root involvement were included in the study. Institutional Ethics Committee approval has been obtained. Informed consent from the patients was obtained.

Inclusion Criteria

- Patients with complain of low back pain, radiating to legs not responding to conservative treatment to whom surgery is not recommended
- Patients of age 18 to 80 years
- ASA grade I, II
- Chronic low back pain unidirectional or bidirectional more than 3 months
- Refractory to analgesics

Exclusion Criteria

- Not satisfying inclusion criteria
- Patient refusal
- Cases with history of surgery
- Cases with severe motor weakness, rapidly progressing neurological deficit, cauda equine syndrome, neurogenic claudication
- Use of steroids for 3 weeks (or) less before the study
- Allergy to steroids, bleeding diathesis, pregnancy
- Patients with severe cardiovascular, respiratory, renal, and hepatic diseases

The outcome measured is efficacy of analgesia provided by caudal administration of epidural steroid by means of VAS score and SLRT. Patients satisfying the inclusion criteria were selected and informed consent was obtained from them. Straight leg raising test, deep tendon reflexes were noted. Routine laboratory investigations like prothrombin time, bleeding time, clotting time, platelets, and random blood sugar were verified before preprocedural assessment. Blood pressure, pulse rate, oxygen saturation, and electrocardiogram (BP/PR/SpO₂/ECG) were monitored, and peripheral venous access achieved.

Patient was put in prone position. Cleaning and draping were done (Fig. 1).

Under USG guidance, in transverse view sacral cornua, sacroccocygeal ligament and sacral hiatus were identified, then probe was tilted longitudinally to identify the sacral cornua and sacroccocygeal ligament. After local infiltration with 2 mL of 2% lignocaine, 18 gauge epidural needle is introduced under USG guidance. Vascular structures are avoided by real-time screening. The ligament is pierced under USG guidance and the needle advanced behind the sacral cornua until it disappears. After negative aspiration for cerebrospinal fluid and blood, 80 mg methylprednisolone and 8 cc of 0.125% bupivacaine were given. Patients were advised to lie in supine position after procedure. Patients were observed in postanesthesia care unit for 24 hours. Postprocedure, data compilation was done, and statistical analysis made to arrive at the conclusion (Figs 2 and 3).

RESULTS AND STATISTICS

Based on our literature search, we determined that a sample size of 60 participants in each group was sufficient for this study using a desired power of 0.8 and error of 0.05. The primary analysis of power was the pain score.
Statistical analysis was performed using Student’s paired t-test when appropriate with p < 0.05 required to reject the null hypothesis. Statistical Package for the Social Sciences statistical software (version 17) was used (Graph 1).

The mean age of the study participants was 42.55 years; 66.7% (n = 40) were males and 33.3% (n = 20) were females (Table 1, Graphs 1 and 2).

The mean VAS scores before the procedure, after the procedure, and during the follow-up period are given in Table 2 and Graph 3.

The mean VAS score before the procedure is 7.78, and postprocedure mean VAS score is 2.95. There is an average of 4.83 decrease in VAS score after the procedure with 95% confidence interval (CI) ranging from 4.615 to 5.052. The decrease is statistically significant (p-value < 0.01) (Table 3).
The result of SLRT (in degrees) before the procedure is 28.58, and postprocedure SLRT (in degrees) is 71.83 (Table 4, Graph 4).

There is an average of 43.25° increase in SLRT after the procedure with 95% CI ranging from 40.478 to 46.022 (Table 5). The increase is statistically significant (p-value = 0.01).

The results of SLRT (in degrees) before the procedure is 28.58, and 6 months postprocedure mean SLRT result (in degrees) is 80.33 (Table 6).

There is an average increase of 51.75° in SLRT 6 months after the procedure with 95% CI ranging from 49.269 to 54.231. The increase is statistically significant (p-value < 0.01). The BP and PR were recorded pre- and postprocedure and no significant difference was found. Three patients are uncooperative during the procedure and are not included in the study. No complications are reported during our study, including dural puncture or inadvertent vascular injection.

**DISCUSSION**

Lower back pain and sciatica is mostly a self-limiting condition, but in patients whose pain is constant or progressive it causes tremendous loss in terms of decreased productivity, disability, and increased treatment cost. Disk degeneration and hernia ion which produces mechanical compression and chemical irritation due to proinflammatory mediator release is the probable cause of LBPS pain. Epidural injection with local anesthetic and steroid is one of the most commonly used interventions in the pain management of LBPS. Caudal epidural analgesic was first introduced to medicine by Sicard and Cathelin in 1901. This approach to the epidural space is the earliest known technique for epidural steroid injections or blocks. However, it did not gain universal recognition until 1925 when Riner popularized its use. The first published report from Evans reported good results of caudal epidural injections with saline in patients with low back pain. The results were attributed to physical

**Table 3: Comparison of pre- and postprocedure VAS scores**

<table>
<thead>
<tr>
<th>p-value</th>
<th>95% CI</th>
<th>Lower bound</th>
<th>Upper bound</th>
<th>Standard error</th>
<th>Mean difference</th>
<th>Mean ± SD</th>
<th>VAS scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.01*</td>
<td>5.052</td>
<td>4.615</td>
<td>0.85</td>
<td>4.83</td>
<td>7.78 ± 0.59</td>
<td>Preprocedure VAS score</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.95 ± 0.57</td>
<td>Postprocedure VAS score</td>
<td></td>
</tr>
</tbody>
</table>

SD: Standard deviation

**Table 4: Straight leg raising test (degrees)**

<table>
<thead>
<tr>
<th>Mean ± SD</th>
<th>SLRT (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.58 ± 7.60</td>
<td>Preprocedure SLRT</td>
</tr>
<tr>
<td>71.83 ± 6.24</td>
<td>Postprocedure SLRT</td>
</tr>
<tr>
<td>74 ± 4.94</td>
<td>SLRT 1 week</td>
</tr>
<tr>
<td>76 ± 5.27</td>
<td>SLRT 3 months</td>
</tr>
<tr>
<td>80.33 ± 6.10</td>
<td>SLRT 6 months</td>
</tr>
</tbody>
</table>

SD: Standard deviation

**Table 5: Straight leg raising test pre- and postprocedure**

<table>
<thead>
<tr>
<th>p-value</th>
<th>95% CI</th>
<th>Upper bound</th>
<th>Lower bound</th>
<th>Standard error diff</th>
<th>Mean difference</th>
<th>Mean ± SD</th>
<th>SLRT—pre- and postprocedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.01</td>
<td>46.022</td>
<td>40.478</td>
<td>1.385</td>
<td>43.25</td>
<td>28.58 ± 7.6</td>
<td>Preprocedure SLRT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>71.83 ± 6.24</td>
<td>Postprocedure SLRT</td>
<td></td>
</tr>
</tbody>
</table>

SD: Standard deviation

**Table 6: Straight leg raising test preprocedure and 6 months**

<table>
<thead>
<tr>
<th>p-value</th>
<th>95% CI</th>
<th>Upper bound</th>
<th>Lower bound</th>
<th>Standard error diff</th>
<th>Mean difference</th>
<th>Mean ± SD</th>
<th>SLRT (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.01</td>
<td>54.231</td>
<td>49.269</td>
<td>1.24</td>
<td>51.75</td>
<td>28.58 ± 7.6</td>
<td>Preprocedure SLRT</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80.33 ± 6.10</td>
<td>SLRT 6 months</td>
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</tr>
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</table>

SD: Standard deviation
displacement of nerves and to lysis of neuronal adhesions provided by injected saline.

Parr et al. concluded that there was good evidence for short- and long-term relief of chronic pain secondary to disk hernia or radiculitis with local anesthetic and steroids and fair relief with local anesthetic only. Further, this systematic review also provided evidence of good relief for caudal epidural injections in managing chronic axial or diskogenic pain, spinal stenosis, and postsurgery syndrome. Our study recommended CES injection in chronic diskogenic pain.

Elgueta et al. findings suggested that USG provides similar pain relief and functional improvement as same as fluoroscopy for epidural/caudal steroid injection in patients afflicted with chronic spinal pain. Although one trial demonstrated shorter needling time with ultrasound (US) guidance (i.e., real-time scanning of needle advancement) compared with US assistance, these findings require further validation. Compared with conventional palpation of landmarks, USG assistance results in fewer needle passes/insertions and skin punctures. Our experience is that USG guidance is as good as fluoroscopy in terms of successful epidural injections.

Perlas states neuraxial USG has been recently introduced to regional anesthesia practice. The limited data available to date suggest that it is a useful adjunct to physical examination, allowing for a highly precise identification of regional landmarks and a precise estimation of epidural space depth, thus facilitating epidural catheter insertion. We found that USG guidance allows us to visualize the anatomy and makes the procedure technically easier.

Watts and Silagy identified 11 suitable trials of good quality involving a total of 907 patients in whom epidural corticosteroids is used in the treatment of sciatica.

Use of epidural (caudal or lumbar) in short increased odds ratio of pain relief when compared with placebo, for long-term pain relief up to 12 months. For long-term relief of pain (up to 12 months) the OR is 1.87 (95% CI 1.31-2.68). They concluded from the quantitative evidence from meta-analysis of pooled data from randomized trials that epidural administration of corticosteroids is effective in the management of lumbosacral radicular pain. We agree with this study that long-term pain relief is achieved due to steroid injection.

Murakibhavi and Khemka conducted prospective studies on the efficacy of CESs. For a sample size of 50 patients, all patients responded well to first injection of CES itself and Oswestry disability index score was improved. Our results support the existence of both short-term and long-term (up to 6 months) relief from symptoms for the group. Our analysis is in line with this study supporting short- and long-term relief of symptoms. Bogduk et al. concluded that CESs were clinically effective with a favorable profile.

Manchikanti et al. evaluated the effectiveness of CES injections from transforaminal and interlaminar epidural injections. These investigators have shown, overall, CESs to be superior to interlaminar epidural injections and equal to transforaminal epidural injections. Our study concurs with the view that CES injection is effective. Ahmed documented CES injection is effective in patients with chronic low back pain.

Dashfield et al. evaluated caudal epidural injection and root blocks but concluded that both treatments were effective and had no significant differences. Sayegh et al. concluded continuous epidural infusion (CEI) containing local anesthetic and steroids seems to be effective when treating patients with LBPS. The CEI containing steroid preparations demonstrated better and faster efficacy. Long-term benefits points to steroid actions and is in concurrence with the above study. Cohen et al. recorded CES injections are best in the treatment of radicular symptoms due to disk herniation and previous surgery and carry an extremely low risk of inadvertent dural puncture. Bush and Hillier conducted controlled study in the management of sciatica. The study assessed the efficacy of epidural injection of 80 mg triamcinolone acetate plus procaine HCl in saline administered through caudal route. Twelve received treatment and 11 placebo. The active group showed significant pain relief and improved quality of life and mobility (p = 0.01). North American Spine Society (NASS) reported that spinal corticosteroid injections have been shown to be very safe in large cohorts of over 20,000 consecutive subjects. In majority of patients, good long-term pain relief is achieved. The procedure is easy to perform and has low complication rate.

Runu et al. found that epidural steroid injection is a safe and effective mode of treatment of low back pain. It provides pain-free period to enable the patient for physiotherapy, which helps in early recovery. We agree with the above study that epidural steroid injection is safe and effective method in the treatment of LBPS. It is hypothesized that corticosteroids exert their anti-inflammatory actions either by inhibiting the synthesis or release of inflammatory substance, membrane stabilization, inhibition of neural peptide synthesis, or action of phospholipase A2, and prolonged suppression of ongoing neuronal discharge is also possible. The administration of any saline solutions may dilute locally accumulated chemical irritants. The NASS Comments on Draft AHRQ Technology Assessment on pain management has studied injection therapies for low back pain and recorded that nonimage-guided injections are inaccurate. Given the goal of an injection is to deliver an aliquot of medication to a specific target tissue, a consideration of nonspecific
injections as equal to image-guided injections is inappropriate in modern medicine. We favor USG-guided caudal epidural because it is a real-time imaging technique.

In our study, USG guidance helped us to visualize the anatomical structures and guide the needle in real time. Color Doppler enabled us to avoid vascular injections. Caudal approach to the epidural space minimized the inadvertent dural puncture incidence. Methyl prednisolone 80 mg with 0.125% bupivacaine is administered. The local anesthetic relieved immediate pain, and the steroid with its antiinflammatory property achieved long-term pain relief in LBPS. Caudal epidural done under blind technique increases the incidence of vascular injection and dural puncture. It is a complication that can make the patients suffer from headache and restricts mobility. It can also lead to more dreaded meningitis. Fluoroscopy guidance involves logistical problem of shifting the patients to a fluoroscopy unit and exposure to radiation. We favor USG-guided CES injection for its minimal incidence of complications and ease of performing the technique. Fluoroscopy guidance involves logistical problem of shifting the patients to a fluoroscopy unit and exposure to radiation. Caudal injection does not require difficult positioning as needed for blind lumbar epidural technique. Fluoroscopy guidance involves logistical problem of shifting the patients to a fluoroscopy unit and exposure to radiation. CES injection can become a mainstay in the treatment LBPS because of the advantage it has over fluoroscopy and blind technique.

CONCLUSION

Caudal epidural steroid injection offers relatively simple, rapid, and easily performed daycare procedure that can offer significant pain relief in LBPS and provides better quality of life. They are safe to perform under ultrasound guidance, less technical skills demanding, and with less complication. Caudal epidural steroid injections offer an interesting alternative approach in managing LBPS in patients who had failure of conservative treatment and is not a candidate for surgery.

REFERENCES