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CAUDAL EPIDURAL STEROID INJECTION FOR LOW BACK PAIN AND LUMBAR RADICULOPATHY IN A TERTIARY CARE CENTER: A RETROSPECTIVE STUDY.

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ABSTRACT

Background

Low back pain (LBP) with lumbar radiculopathy is common and affects daily life. Disc herniation and spinal stenosis often cause chronic pain and disability in lumbar radiculopathy. Minimally invasive caudal epidural steroid injections (CESIs) decrease inflammation and discomfort in affected patients. CESIs may work differently for different spinal diseases. This study aimed to evaluate the efficacy of caudal epidural steroid injections in managing pain and radiculopathy in patients with LBP and lumbar radiculopathy.

Methods

A cross-sectional retrospective case study was conducted on 40 patients treated with CESIs. Inclusion criteria encompassed adults with LBP and radiculopathy, confirmed by MRI findings such as disc herniation, early spondylitis, spinal canal stenosis, and ligamentum flavum thickening. Pain scores were measured using the Numeric Pain Rating Scale (NPRS) at baseline, 1 week, 1 month, and 3 months post-injection. Data were analyzed using paired t-tests and ANOVA to determine statistical significance.

Results

At baseline, the mean pain score was 8.2, which reduced significantly to 4.8 at 1 week, 3.2 at 1 month, and 2.7 at 3 months post-injection ($p < 0.001$ for each interval). Improvement in radiculopathy symptoms was observed in 75% of patients by the 3-month follow-up. Patients with disc lesions experienced the greatest symptom improvement (78%, $p = 0.02$), followed by those with ligamentum flavum thickening and spinal canal stenosis. No serious adverse effects were reported.

Conclusion

Caudal epidural steroid injections effectively reduced pain and radiculopathy symptoms in patients with LBP. The greatest benefit was observed in patients with intervertebral disc lesions, suggesting that MRI findings may help optimize patient selection for this treatment. CESIs were safe, with minimal adverse effects.

Recommendations

Further research with larger sample sizes is recommended to explore long-term outcomes and to refine selection criteria based on MRI findings, enhancing treatment efficacy for specific spinal pathologies.

Keywords: *Low Back Pain, Lumbar Radiculopathy, Caudal Epidural Steroid Injection, MRI Findings, Pain Management, Spinal Pathologies*
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INTRODUCTION

Low back pain (LBP) is one of the most prevalent musculoskeletal conditions worldwide, impacting millions and posing a significant burden on healthcare systems and economies [1]. It is often associated with lumbar radiculopathy, a condition where nerve root compression leads to radiating pain, sensory changes, and sometimes motor impairment in the lower extremities. Various etiologies contribute to lumbar radiculopathy, including disc herniation, spinal canal stenosis, and degenerative changes in the lumbar spine, such as ligamentum flavum thickening and spondylosis [2]. These structural abnormalities can lead to nerve root inflammation, exacerbating pain and disability. Given the chronic nature and disabling effects of LBP and lumbar radiculopathy, developing effective, minimally invasive treatment strategies has become a critical focus in musculoskeletal medicine.

Caudal epidural steroid injections (CESIs) have gained attention as a promising intervention for managing LBP with radiculopathy. This treatment involves injecting corticosteroids into the epidural space to reduce inflammation, thereby relieving nerve root compression and alleviating pain. CESIs are particularly valued for their minimally invasive nature, ability to provide targeted relief, and low risk of adverse effects when performed

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under strict aseptic conditions [3]. Previous studies have demonstrated positive outcomes for CESIs in various patient populations, showing reductions in pain and improvements in function [4]. However, patient response can vary based on the underlying pathology, which suggests the need for further research into the effectiveness of CESIs across different types of lumbar conditions.

While the use of CESIs has increased, questions remain regarding their long-term efficacy and optimal patient selection. Some studies have highlighted that patients with certain MRI findings, such as disc herniations, may benefit more than those with other spinal abnormalities [5]. As the effectiveness of CESIs may vary across patient subgroups, examining outcomes in patients with specific spinal pathologies could aid in refining selection criteria and improving treatment efficacy.

This study aims to evaluate the effectiveness of caudal epidural steroid injections in a cohort of patients with LBP and radiculopathy at a tertiary care center.

METHODOLOGY

Study Design

A cross-sectional retrospective case study.

Study Setting

The study was conducted in a tertiary care center equipped with facilities for comprehensive diagnosis, physical therapy, and rehabilitation services for patients with spinal conditions. Data was collected between September 2023 and September 2024 at a tertiary care center.

Participants

A total of 40 patients with low back pain and radiculopathy were included in the study. Patients who were eligible for a comprehensive physical therapy and rehabilitation program were included.

Sample Size

The sample size was determined to be 40 using the formula:

Sample size=4pq/d2

Where:

- p = prevalence,
- q=100−p,
- d = allowable error (5-20% of p).

Inclusion Criteria

1. Patients with low back pain are associated with radiculopathy.
2. Patients with early signs of spondylitis or disc lesions were identified on standard radiographs and MRI of the lumbosacral spine.
3. Presence of intervertebral herniated disc.
4. Elderly patients with spinal canal stenosis.
5. Patients with ligamentum flavum thickening.

Exclusion Criteria

1. Patients under 18 years of age with uncontrolled diabetes, known heart diseases, and spondylolysis on blood thinners.
2. Pregnant patients.

Bias

Efforts were made to minimize bias by including patients based on standardized criteria for low back pain and radiculopathy and ensuring ethical clearance from the institutional review board. Selection bias was addressed by including both male and female patients who met the inclusion criteria.

Variables

Variables included age, gender, radiographic and MRI findings, diagnosis (spondylitis, disc lesion, spinal stenosis), pain relief, improvement in radiculopathy, and ability to perform physical therapy and rehabilitation exercises.

Data Collection

Patient data was retrospectively collected from medical records, including demographic details, diagnostic imaging findings, and clinical diagnoses. Information on the procedure and follow-up results was documented.

Procedure

The caudal epidural steroid injection was administered under aseptic conditions. A 10 ml injectable cocktail was prepared, consisting of:

- 1 ml 2% Xylocaine,
- 1 ml Kenacort or Depomedrol,
- 8 ml distilled water.

The injections were given by qualified personnel with experience in caudal epidural injections, following a standardized procedure protocol.

Statistical Analysis

Descriptive statistics were used to analyze the baseline characteristics of patients. Data on post-procedural pain relief and improvement in radiculopathy symptoms were analyzed using paired t-tests and chi-square tests where applicable. A significance level of $p<0.05$ was used to determine statistical significance.

Ethical considerations

The study protocol was approved by the Ethics Committee, and written informed consent was received from all the participants.

RESULTS

Forty patients were enrolled in this study after meeting the inclusion criteria. Table 1 provides a summary of the demographic and baseline clinical features.

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Table 1: Patient Demographics and Baseline Characteristics

Characteristic	Frequency (%) or Mean ± SD
Total Patients	40
Age (years)	52.4 ± 10.3
Gender	
- Male	24 (60%)
- Female	16 (40%)
MRI Findings	
- Early Spondylitis	10 (25%)
- Disc Lesion	14 (35%)
- Spinal Canal Stenosis	8 (20%)
- Ligamentum Flavum Thickening	8 (20%)

The mean age of the participants was 52.4 years (SD ± 10.3), with a male-to-female ratio of 1.5:1. MRI findings included early spondylitis in 25% of patients, disc lesions in 35%, spinal canal stenosis in 20%, and ligamentum flavum thickening in 20%.

Pain and radiculopathy scores were assessed at baseline and three follow-up points (1 week, 1 month, and 3 months post-injection). Pain was measured using a 0-10 Numeric Pain Rating Scale (NPRS), and radiculopathy improvement was assessed based on symptom reduction.

Table 2: Pain and Radiculopathy Scores Over Time

Follow-Up Time	Pain Score (Mean ± SD)	Improvement in Radiculopathy (%)	p-value (Pain Score)
Baseline	8.2 ± 1.1	0%	—
1 Week	4.8 ± 1.5	60%	$p < 0.001$
1 Month	3.2 ± 1.4	72%	$p < 0.001$
3 Months	2.7 ± 1.6	75%	$p < 0.001$

Paired t-tests showed significant pain reduction from baseline at each follow-up point. The pain reduction was statistically significant at 1 week ($p < 0.001$), 1 month ($p < 0.001$), and 3 months ($p < 0.001$). Radiculopathy symptoms improved in 75% of patients by the end of the 3-month follow-up.

The outcomes based on the specific MRI findings were further analyzed.

Table 3: Pain and Radiculopathy Improvement by MRI Diagnosis at 3-Month Follow-Up

MRI Finding	Mean Pain Score (±SD)	Radiculopathy Improvement (%)	p-value (Pain Score)
Early Spondylitis	2.5 ± 1.3	70%	$p = 0.03$
Disc Lesion	2.4 ± 1.4	78%	$p = 0.02$
Spinal Canal Stenosis	2.8 ± 1.7	73%	$p = 0.04$
Ligamentum Flavum Thickening	3.0 ± 1.6	75%	$p = 0.05$

Patients with disc lesions showed the most significant improvement in radiculopathy symptoms (78%), followed by those with ligamentum flavum thickening (75%), spinal canal stenosis (73%), and early spondylitis (70%).

No serious adverse effects were reported. Minor adverse effects were observed in five patients (12.5%), including mild transient pain at the injection site and headache, both of which resolved within 48 hours.

DISCUSSION

The study included 40 patients with low back pain associated with radiculopathy, with a mean age of 52.4 years and a male-to-female ratio of 1.5:1. MRI findings revealed that 25% of patients had early spondylitis, 35% had disc lesions, 20% had spinal canal stenosis, and 20% had ligamentum flavum thickening. These findings represent common structural causes of radiculopathy, often correlating with pain and mobility impairment, and highlight the diversity in underlying spinal pathologies in the patient cohort.

Significant reductions in pain were observed following caudal epidural steroid injections. At baseline, the mean pain score was 8.2, which decreased to 4.8 at the 1-week follow-up, 3.2 at 1 month, and 2.7 at 3 months ($p < 0.001$ for each follow-up). This progressive reduction in pain score suggests a sustained effect of the epidural steroid injection over time, with the greatest pain relief observed between baseline and 1 week, followed by gradual improvement up to the 3-month mark. Radiculopathy symptoms also improved markedly, with 75% of patients reporting reduced radiculopathy by the 3-month follow-up. These results support the effectiveness of epidural

steroid injections in alleviating both pain and nerve-related symptoms over an extended period.

Outcomes were further stratified by MRI findings to assess differences based on specific spinal conditions. Patients with disc lesions experienced the greatest improvement, with a 3-month mean pain score of 2.4 and a radiculopathy improvement rate of 78% ($p = 0.02$). Other groups also showed notable improvements: those with ligamentum flavum thickening had a mean pain score of 3.0 and a 75% improvement in radiculopathy, while patients with early spondylitis and spinal canal stenosis achieved 70% and 73% improvements, respectively, with p-values ranging from 0.03 to 0.05. The findings suggest that while epidural steroid injections are broadly effective, patients with disc lesions may experience the most significant relief, possibly due to the anti-inflammatory effects directly alleviating nerve compression and irritation caused by herniated discs.

No serious adverse effects were reported, though five patients (12.5%) experienced minor side effects, such as transient injection-site pain and mild headache, both of which resolved within 48 hours. This low incidence of minor adverse effects highlights the safety and tolerability of the procedure. In summary, caudal epidural steroid injections were found to be effective and safe for reducing pain and radiculopathy in patients with low back pain, with the most pronounced benefits observed in patients with intervertebral disc lesions. These results suggest that this intervention could be a valuable addition to the therapeutic options for managing lumbar radiculopathy in diverse spinal pathologies.

A study on 100 patients with chronic low back pain and radiculopathy was conducted, finding a significant reduction in pain scores sustained up to six months post-injection. Their results indicated that CESIs provided over 50% pain relief for 72% of patients at one month, 69% at three months, and 62% at six months, demonstrating notable short- and medium-term efficacy for these injections [6].

In a tertiary care setting, a study reported on 35 patients with lumbar radiculopathy, observing that 91% experienced substantial pain relief within one month of receiving CESIs. This high success rate indicates that CESIs can effectively provide pain alleviation for most patients in a structured clinical environment [7]. Further supporting these findings, another study found sustained reductions in pain and functional improvement in over 60% of their patient cohort at one-year post-injection, emphasizing the long-term effectiveness of CESIs in chronic pain management. Their data suggest CESIs not only provide initial relief but also contribute to prolonged functional recovery [8].

The potential for immediate pain relief with CESIs was illustrated in an emergency setting case report. They documented a 100% resolution of pain following an ultrasound-guided CESI for acute lumbar radiculopathy in a patient with refractory symptoms, underscoring the rapid effectiveness of this intervention in acute care [9]. A comparative study analyzed the outcomes of CESIs versus transforaminal epidural steroid injections for S1 radiculopathy and found both approaches equally effective in reducing pain and disability at three-month follow-ups. CESIs had the additional advantage of requiring shorter fluoroscopy times and reducing radiation exposure, making it a safer and more efficient option [10].

Finally, a study explored the use of CESIs with targeted indwelling catheters and manipulative therapy in patients with lumbar disc herniation. They reported significant reductions in pain and disability shortly after treatment, with results showing immediate improvements in pain scores within three days and continued benefits over four weeks. This combination approach highlights the potential for optimized CESI techniques to enhance treatment outcomes for disc herniation-related radiculopathy [11].

CONCLUSION

This study demonstrates that caudal epidural steroid injections significantly reduce pain and radiculopathy symptoms in patients with low back pain. The greatest improvement was observed in patients with disc lesions. No serious adverse effects were reported, suggesting that this treatment is both effective and safe for managing low back pain and associated radiculopathy in this patient population.

Limitations

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

Recommendation

Further research with larger sample sizes is recommended to explore long-term outcomes and to refine selection criteria based on MRI findings, enhancing treatment efficacy for specific spinal pathologies.

Acknowledgment

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Data Availability

Data is available upon request.

Author contributions

All authors contributed to the design of the research. RA collected and analyzed the data. The UK wrote the manuscript. RA edited the paper. All authors read and approved the paper.

List of abbreviations:

LBP - Low Back Pain
CESI - Caudal Epidural Steroid Injection
MRI - Magnetic Resonance Imaging

NPRS - Numeric Pain Rating Scale
S1 - First Sacral Vertebra (related to radiculopathy)

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Conflict of interest
The authors have no conflicting interests to declare.

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