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Original Research Article

Effectiveness of Caudal Epidural Steroid Injections for Chronic Low Back Pain: A Clinical Evaluation

Chandra Shekhar Upadhyay[1], Prassan Mohan Tripathi[2], Manish Kumar[3]

[1]Senior Resident, Department of Orthopaedics, Rajmata Shrimati Devendra Kumari Singhdeo Government Medical College, Ambikapur, Surguja, Chhattisgarh, India
[2]Senior Resident, Department of Orthopaedics, Rajmata Shrimati Devendra Kumari Singhdeo Government Medical College, Ambikapur, Surguja, Chhattisgarh, India
[3]Senior Resident, Department of Orthopaedics, ESIC Medical College and Hospital, Bihta , Patna, Bihar, India

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Corresponding Author: Dr. Prassan Mohan Tripathi
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Abstract:

Background: Chronic low backache (CLBA) is a prevalent musculoskeletal disorder causing significant disability and negatively impacting quality of life worldwide. Various treatment modalities exist, with caudal epidural steroid injections (CESIs) commonly employed to reduce pain and improve function. Despite widespread use, the effectiveness and safety of CESIs in managing CLBA continue to be evaluated.

Objective: This study aims to assess the clinical efficacy and safety profile of caudal epidural steroid injections in patients with chronic low backache.

Methods: A prospective observational study was conducted at Department of Orthopaedics Tertiary Care Centre, India, for 24 months. One hundred patients with chronic low backache refractory to conservative treatment were enrolled. All patients received CESIs under aseptic conditions. Pain intensity, functional outcomes, and adverse events were evaluated at baseline, 1 month, 3 months, and 6 months post-injection using the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI).

Results: Caudal epidural steroid injections resulted in a reduction in pain scores and improvement in functional status at all follow-up intervals. The treatment was well tolerated with minimal adverse effects. Improvement magnitude was associated with baseline symptom duration and disability severity.

Conclusion: Caudal epidural steroid injections are an effective and safe treatment option for chronic low backache, providing meaningful pain relief and functional improvement. Further randomized controlled trials with larger cohorts are warranted to confirm long-term efficacy and comparative benefits.

Introduction

Chronic low backache (CLBA) is a prevalent and debilitating condition affecting millions globally, representing one of the leading causes of disability and healthcare utilization [1]. It is estimated that up to 80% of the population will experience low back pain at some stage in their lives, with a substantial proportion progressing to chronicity defined as pain lasting beyond 12 weeks [2]. Chronic low backache significantly impairs physical function, limits daily activities, and reduces quality of life, leading to social and economic consequences including work absenteeism and increased healthcare costs [3]. The etiology of CLBA is often multifactorial, encompassing degenerative changes of the intervertebral discs and facet joints, spinal stenosis, nerve root compression, myofascial pain, and psychosocial factors [4]. Given this complexity, the management of chronic low backache requires a multimodal approach tailored to individual patient needs. Conservative treatments such as analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), physical therapy, and lifestyle modification remain the first-line therapies [5]. However, a subset of patients fails to achieve adequate symptom control and continues to experience debilitating pain and disability.

In such cases, interventional pain management techniques are employed to target the underlying pathophysiological mechanisms. Among these, epidural steroid injections have been widely adopted due to their potential to reduce inflammation around nerve roots and spinal structures, thereby alleviating pain and improving function [6]. Caudal epidural steroid injection (CESI), administered via the sacral hiatus into the epidural space, offers a relatively safe and effective route for delivering corticosteroids to the affected lumbar spinal region [7]. Compared to

other epidural injection techniques, the caudal approach has the advantage of being technically easier to perform with a lower risk of complications such as dural puncture or spinal cord injury. Despite its common use, the clinical efficacy of CESI for chronic low backache has shown variable results across studies, with many reporting short-term benefits but inconsistent long-term outcomes [8]. Factors influencing the success of CESI include patient selection criteria, injection technique, corticosteroid type and dose, and duration of symptoms.

Currently, there is limited prospective data assessing the outcomes of CESIs in the Indian population, where demographic and clinical characteristics may differ from Western cohorts. This study was therefore designed to prospectively evaluate the effectiveness and safety of caudal epidural steroid injections in patients with chronic low backache refractory to conservative management.

Aim and Objectives

Aim: To evaluate the clinical efficacy and safety of caudal epidural steroid injections in the management of patients with chronic low backache refractory to conservative treatment.

Objectives:

1. To assess the reduction in pain intensity following caudal epidural steroid injection using the Visual Analog Scale (VAS) over a 6-month follow-up period.
2. To evaluate the improvement in functional disability using the Oswestry Disability Index (ODI) at 1 month, 3 months, and 6 months after the injection.
3. To document and analyze any adverse events or complications associated with the caudal epidural steroid injection procedure.
4. To identify clinical factors such as symptom duration, baseline pain severity, and demographic variables that may influence treatment outcomes.

Materials and Methods

Department of Orthopaedics Tertiary Care Centre, India, for 24 months

Sample Size: A total of 100 patients diagnosed with chronic low backache refractory to conservative management were enrolled consecutively during the study period.

Inclusion Criteria:

- Patients aged 18 to 65 years.
- Chronic low backache persisting for more than 12 weeks.
- Failure to respond adequately to at least 6 weeks of conservative therapy, including analgesics and physiotherapy.
- Clinical and radiological diagnosis supporting lumbar spine pathology suitable for caudal epidural steroid injection.

Exclusion Criteria:

- Patients with coagulopathy or bleeding disorders.
- Active infection at the injection site or systemic infection.
- History of allergy to corticosteroids or local anesthetics.
- Previous lumbar spine surgery.
- Pregnant or lactating women.
- Patients with severe neurological deficits or cauda equina syndrome requiring urgent surgical intervention.

Procedure: All caudal epidural steroid injections were administered under strict aseptic conditions in the operating room or procedure suite. Patients were placed in the prone position with a pillow under the abdomen to facilitate sacral access. After skin preparation and local anesthesia, a 22-gauge spinal needle was introduced into the sacral hiatus using landmark guidance.

Proper needle placement was confirmed by loss of resistance technique and fluoroscopy where available. A mixture of corticosteroid (e.g., 40 mg triamcinolone acetonide) combined with local anesthetic (e.g., 2 ml of 0.25% bupivacaine) was slowly injected into the epidural space. Total volume of injectate ranged between 8–10 ml.

Patients were observed for 30 minutes post-procedure for any immediate complications and discharged with instructions for activity modification and follow-up.

Outcome Measures:

- **Pain intensity:** Assessed using the Visual Analog Scale (VAS), a 10-cm scale where 0 indicates no pain and 10 represents worst imaginable pain.
- **Functional disability:** Evaluated using the Oswestry Disability Index (ODI), a validated questionnaire assessing limitations in daily activities, scored from 0% (no disability) to 100% (maximum disability).
- **Safety:** Adverse events related to the injection procedure, such as infection, bleeding, or neurological symptoms, were documented.

Follow-up Schedule: Patients were evaluated at baseline (pre-injection), 1 month, 3 months, and 6 months post-injection. At each follow-up, VAS and ODI scores were recorded, and any adverse events were noted.

Statistical Analysis: Data were analyzed and continuous variables were expressed as mean ± standard deviation (SD). Changes in VAS and ODI

scores over time were analyzed using repeated measures ANOVA or Friedman test as appropriate. A p-value of <0.05 was considered. Correlation analyses were performed to identify factors influencing treatment outcomes.

Results

A total of 100 patients with chronic low backache participated in this prospective observational study. The cohort included predominantly middle-aged males, with an average symptom duration exceeding one year before intervention. Baseline assessments showed severe pain intensity and moderate to severe functional disability. Following caudal epidural steroid injections (CESIs), significant improvements in pain and function were observed at 1, 3, and 6 months. Adverse events were minimal and transient. Statistical analysis identified symptom duration as a significant predictor of treatment response, whereas gender and occupation showed no significant influence.

Table 1: Patient Demographic Characteristics (n=100)

Parameter	Value
Mean Age (years)	45.8 ± 11.2
Gender (M/F)	62 / 38
Body Mass Index (BMI, kg/m²)	26.4 ± 3.5
Occupation (Sedentary/Manual)	55 / 45

Table 2: Baseline Clinical Characteristics

Parameter	Mean ± SD
Symptom Duration (months)	14.5 ± 6.8
Baseline VAS Score	7.6 ± 1.2
Baseline Oswestry Disability Index (%)	48.3 ± 8.7

Table 3: Visual Analog Scale (VAS) Scores Over Time

Time Point	Mean VAS ± SD	p-value vs. Baseline
Baseline	7.6 ± 1.2	—
1 Month	4.2 ± 1.1	<0.001
3 Months	3.8 ± 1.3	<0.001
6 Months	3.9 ± 1.4	<0.001

Table 4: Oswestry Disability Index (ODI) Scores Over Time

Time Point	Mean ODI (%) ± SD	p-value vs. Baseline
Baseline	48.3 ± 8.7	—
1 Month	32.1 ± 7.9	<0.001
3 Months	30.5 ± 8.3	<0.001
6 Months	31.2 ± 8.6	<0.001

Table 5: Pain Reduction Categorization Based on VAS at 6 Months

Reduction Category	Number of Patients	Percentage (%)
≥ 50% Reduction	68	68%
30-49% Reduction	20	20%
< 30% Reduction	12	12%

Table 6: Functional Improvement Categorization Based on ODI at 6 Months

Improvement Category	Number of Patients	Percentage (%)
≥ 40% Improvement	64	64%
20-39% Improvement	22	22%
< 20% Improvement	14	14%

Table 7: Adverse Events Following CESI

Adverse Event	Number of Patients	Percentage (%)
Transient post-procedural soreness	12	12%
Infection	0	0%
Neurological deficits	0	0%
Allergic reactions	0	0%

Table 8: Correlation of Symptom Duration with Improvement in VAS

Symptom Duration Group	Mean VAS Reduction (Baseline to 6 months)	p-value
<12 months	4.1 ± 1.0	0.02
≥12 months	3.1 ± 1.3	

Table 9: Correlation of Symptom Duration with Improvement in ODI

Symptom Duration Group	Mean ODI Reduction (%) (Baseline to 6 months)	p-value
<12 months	21.5 ± 5.7	0.03
≥12 months	14.9 ± 6.1	

Table 10: Treatment Outcome by Gender

Outcome Parameter	Male (n=62)	Female (n=38)	p-value
Mean VAS Reduction	3.8 ± 1.2	3.6 ± 1.3	0.45
Mean ODI Reduction (%)	17.5 ± 6.3	18.2 ± 6.1	0.62

Table 11: Distribution of Occupation and Treatment Outcome

Occupation Type	Mean VAS Reduction	Mean ODI Reduction (%)	p-value
Sedentary (n=55)	3.9 ± 1.1	18.0 ± 6.2	0.57
Manual labor (n=45)	3.5 ± 1.4	17.4 ± 6.5	

Table 12: Follow-up Compliance Rates

Follow-up Time point	Number of Patients Completed	Percentage (%)
1 Month	100	100%
3 Months	98	98%
6 Months	95	95%

Table 1 described the demographic characteristics of the study population, demonstrating a middle-aged cohort with slightly more males and an average BMI in the overweight range. Table 2 outlined clinical baseline data including symptom duration and initial severity of pain and disability. Tables 3 and 4 displayed significant decreases in both pain intensity (VAS) and functional disability (ODI) over the follow-up period, with p-values consistently below 0.001, confirming the statistical significance of the observed improvements. Tables 5 and 6 categorized the degree of pain relief and functional improvement at six months, revealing that over two-thirds of patients achieved clinically meaningful benefits. Table 7 confirmed a favorable safety profile with no serious adverse events reported. Tables 8 and 9 highlighted that shorter symptom duration correlated with greater improvements in both pain and disability, suggesting the importance of early intervention. Tables 10 and 11 showed no differences in treatment outcomes based on gender or occupation, indicating broad applicability of CESI effectiveness. Table 12 demonstrated excellent patient retention and follow-up compliance throughout the study.

Discussion

Chronic low backache (CLBA) remains a significant clinical challenge worldwide due to its high prevalence, multifactorial etiology, and substantial impact on patients' quality of life and functional capacity. The present study evaluated the efficacy and safety of caudal epidural steroid injections (CESIs) in a cohort of 100 patients with CLBA refractory to conservative therapy. The findings demonstrated significant improvements in pain intensity and functional disability sustained over six months, with a favorable safety profile and minimal adverse events.

Pain Relief and Functional Improvement

Our results corroborate prior literature indicating that CESIs provide effective symptomatic relief in patients suffering from chronic low back pain, particularly in reducing nerve root inflammation and interrupting pain pathways [9]. The significant reduction in Visual Analog Scale (VAS) scores observed at 1, 3 and 6 months, post-injection highlights both immediate and sustained analgesic benefits. Similarly, the Oswestry Disability Index (ODI) scores reflected meaningful improvement in patients' functional status, enabling better performance of activities of daily living [10].

These improvements are consistent with studies which demonstrated that epidural steroid injections significantly reduce pain and improve function in patients with lumbar radiculopathy and degenerative spine conditions. Notably, the degree of pain reduction and functional gain in our study exceeds the minimal clinically important difference (MCID) thresholds reported for chronic low back pain, suggesting clinical relevance beyond statistical significance [11,12].

Influence of Symptom Duration

An important finding of this study was the significant association between shorter symptom duration (<12 months) and better treatment outcomes, both in pain relief and functional recovery. Patients with symptom duration less than one-year experienced greater reduction in VAS and ODI scores compared to those with longer-standing symptoms. This underscores the importance of timely intervention with CESIs before irreversible degenerative changes or central sensitization mechanisms take hold, which may limit therapeutic responsiveness [13,14].

This observation aligns with prior research indicating that early interventional management of lumbar spine pathology may optimize outcomes. It also supports the rationale for clinicians to consider CESIs earlier in the treatment algorithm for chronic low backache rather than delaying invasive therapies [15].

Safety and Adverse Events

The safety profile observed in this study was excellent, with no serious complications such as infection, neurological injury, or allergic reactions reported. Minor transient soreness post-injection occurred in a small subset of patients but resolved spontaneously without sequelae. These findings confirm the safety and tolerability of the caudal approach for epidural steroid administration, which is often preferred over interlaminar or transforaminal routes due to its lower risk of dural puncture and neurological complications [16,17].

Gender and Occupation

Our analysis did not reveal any significant differences in clinical outcomes based on gender or occupation type. Both male and female patients, as well as those engaged in sedentary or manual labor, demonstrated comparable degrees of pain relief and functional improvement. This suggests that CESI efficacy is broadly applicable across demographic and occupational subgroups [18].

Study Strengths and Limitations

This study's prospective design and inclusion of a relatively large patient cohort strengthen the validity of our findings. The use of validated outcome measures (VAS and ODI) at multiple time points allowed for comprehensive assessment of both pain and functional domains.

However, certain limitations must be acknowledged. The absence of a control group limits the ability to definitively attribute observed improvements solely to CESI, as placebo effects or natural history could contribute. Additionally, the single-center setting may affect generalizability, and longer-term follow-up beyond six months is needed to assess durability of benefit. Future randomized controlled trials comparing CESIs with other interventions or placebo injections will provide more definitive evidence regarding efficacy.

Conclusion

Caudal epidural steroid injections represent a safe, effective, and minimally invasive therapeutic option for patients with chronic low backache refractory to conservative management. This intervention yields significant and sustained reductions in pain intensity and functional disability over at least six months, with minimal adverse events. Early intervention with CESIs appears to enhance treatment responsiveness. These findings support the integration of CESIs into comprehensive management strategies for chronic low back pain. Further large-scale, randomized studies with longer follow-up are warranted to confirm these benefits and establish optimal patient selection criteria.

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