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Research Article

Comparison of interlaminar epidural steroid versus caudal steroid injection for low back pain with radiculopathy due to disc prolapse

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ABSTRACT

Background: Low back pain is a common entity with a lifetime prevalence of 65 to 80 percent in general population, and usually disrupts work, social activity and activity of daily living. The purpose of our study was to evaluate the results of interlaminar epidural steroid injection versus caudal steroid injection for patients of lower back pain with radiculopathy, due to disc prolapse or disc degeneration in terms of pain relief and complications.
Methods: A total of 272 subjects having low back pain with radicular leg pain and MRI evidence of single or double level disc prolapse were chosen. Out of 272, patients were randomly assigned to two group; the first group having 131 patients and second group having 141 patients. The first group received caudal steroid injection, and second group received interlaminar epidural steroid under fluoroscopy control. Follow up for both groups was at 1 week, 6 weeks, and 12 weeks.
Results: The change in pain scores were rated as mild, moderate and excellent. The interlaminar epidural steroid injection fared excellent in earlier follow up, getting to moderate at 12 weeks' time. The caudal steroid injection produced moderate relief in early phase at 12 weeks' time.
Conclusions: The caudal steroid injection is cost effective, easy to administer and is having much less complications as compared to interlaminar steroid injection. Both these procedures are safe, well tolerated procedures, and can be performed as outpatient procedures

Keywords: Caudal injection, Epidural injection, Interlaminar, Low back pain, Radiculopath, Lumbar disc prolapse, Steroid injection

INTRODUCTION

Lower back pain is one of the most common after headache. Along with lower back pain, radiating pain or radicular pain down to the lower limb is a widespread clinical problem that need be addressed precisely. Almost 30% of patients who develop lower back pain usually will suffer from radicular pain at one point of time. More than 50% of the patients with radiculopathy and sciatica have disturbances in performing activities of daily living and difficulty at work, leading to loss of work hours. The most common cause of lumbosacral radiculopathy in all the age group is intervertebral disc prolapse, and almost 10% to 15% of these patients eventually may require surgery due to their persistent symptoms, interference with daily activity, and neurological deficit .[1] However, majority of patients with lumbosacral radiculopathy have uneventful recovery with conservative management. The conservative management is wide and typically includes bed rest during acute

painful phase, oral and parental medications which are NSAIDs, muscle relaxants, pregabalin or gabapentin, Spinal injections, lumbar support and braces, physiotherapy and even non pharmacological medications have been tried with varying results.

Historically, epidural steroid injections (ESIs) and caudal steroid injections have been used in conjunction with medications and physiotherapy as a supplementation in the treatment of radiculopathy. Since the early reports, success rates of ESIs are not constant and range from 20% to 100% (average, 67%) by different authors have been documented.[2] The efficacy of ESIs on an average lasted for about 3 - 4 months. The effectiveness regarding the use of epidural steroid injections is still controversial and subject to debate. These injections have been used for the treatment of radiculopathy from disc prolapse, spinal canal stenosis, and axial spinal pain.[3] Based on the reviewer the evidence is variably rated from indeterminate to strong in various publications.

The benefit to the patient is usually due to one of the three reasons:

1. A physical action of the drug causing increase of space around compressed nerve root.
2. Local anesthetic effect giving immediate pain relief for short period.
3. Long term anti- inflammatory effect of steroid causing pain relief.

The most common of all painful disorders is spinal lower back pain. The lifetime prevalence of low back pain varies from 54% to 80%.[4] Annual prevalence of chronic low back pain ranges from 15% to 45%.[5] The prevalence of low back pain and its impact on general health showed that 25% of patients reporting are Grade II - Grade IV low back pain (high pain intensity with disability), and 14% in patients with neck pain. As per the modern evidence the chronic persistent low back pain in general population is estimated to be from 25% - 60% of patients, one year or longer after the initial episode.[6] Spinal pain is also associated with enormous health, societal, and economic impact. However, every patint needs to be individualized and it is sometimes very difficult for treatment as neither conservative nor surgical treatment provides low back pain relief and definite long-term improvement in few patients.

There are three types of epidural routes - interlaminar, transformational, and caudal [7] and these are administrated in three separate regions of the spine with variable drug delivery at target and variable results complicating the current concept of practice of interventional pain management. The interlaminar injection requires less volume than the caudal route as the entry is directed more closely to the assumed site of pathology. The transformational approach requires very small volume to reach the primary site of pathology as it is a target-specific; specifically, the anterolateral epidural space and the dorsal root ganglion. The caudal entry is relatively easy to perform and is mostly achieved with minimal or no risk of inadvertent dural puncture, but requires a large volume (range from 15-40 ml) of drug to reach the targeted site of pathology. The mechanism of action of epidural of steroid and local anesthetic injections administration are still not very well understood. It is believed that the achieved neural blockade alters or interrupts nociceptive input, of the afferent fibers reflex mechanisms, self-sustaining activity of the neurons, and the pattern of central neuronal activities. Local anesthetics act by interruption of the pain-spasm cycle and nociceptor transmission reverberation. Corticosteroids acts by reducing the inflammation by inhibition of either the synthesis or release of a number of pro-inflammatory mediators and by causing a reversible local anesthetic effect.

METHODS

A total of 272 patients after obtaining written informed consent for the study were included. Patients who had complain of low back pain with radiculopathy, who were not relieved by previous trial of NSAIDs, concurrent pregabalins, gabapentin and back rehabilitation with a MRI evidence of single or double disc prolapse. Out of 272, patients were randomly assigned to two group first group having 131 patients and second group having 141 patients. First group received caudal steroid injection and second group received interlaminar epidural steroid under fluoroscopy control. Follow up for both groups were at 1 week, 6 weeks and 12 weeks and if necessary at 6 months. The entire patient concurrently received NSAIDs, Physiotherapy and back rehabilitation in conjunction with the injection procedure. The choice of NSAIDs was uniform across the two groups. Typically both these procedures were performed as outpatient procedure.

In group I - A total 20 to 40 ml was injected with 2 ml (80 mg) methylprednisolone with 2ml of 1% lignocane added by 0.9% saline to make the rest of infiltrate.

In group II total 6 – 8 ml was injected with 2 ml (80 mg) methylprednisolone with 2ml of 1% lignocane and added with 0.9% Saline to make rest of infiltrate

Case selection:

Inclusion criteria: The protocol was approved by the ethics committee. Age group of 25-65 years along with duration of radiculopathy between 1-12 months. Sciatica is defined as radiating pain below the knee in one or both legs. Signs of nerve-root irritation (a positive straight-leg test-radicular pain on leg elevation).Nerve-root compression (motor, sensory, or reflex deficits) with MRI evidence of disc prolapse. Oswestry Low Back Pain Disability Questionnaire score higher than 20.

Exclusion criteria:

Age less than 25 years and more than 65 years. Any Cauda equina syndrome or MRI scans without evidence of nerve-root compression were excluded. Patients who received spinal corticosteroid injections within last one year, progressive or non-progressive neurologic deficits were also excluded to prevent bias. Structural spinal deformities (scoliosis greater than 40°, spondylolisthesis), Previous Low back surgery, Pregnancy, Diabetes mellitus, Blood-coagulation disorder and Allergy to local anesthetics were excluded

Materials:

- Injection methylprednisolone acetate
- Isotonic saline (0.9%)
- 1% lidocaine
- A20-gauge, 3.5-inch spinal needle
- Syringes 5ml, 20 ml and 50 ml

Methods:

Interlaminar epidural injection technique: The injection was performed using Local anaesthetic, via midline approach using fluoroscopy control in a lateral position comfortable to the patient. Upon contact with the ligamentum flavum, a loss of resistance technique is used for proper advancement that results in penetration into the epidural space.

Patient in lateral position usually is comfortable to radiculopathy patients and also opens the spinous processes for better access. Direct midline approach between the spinous processes engages the interspinous ligament and targets the posterior epidural space. Further advancing in 1 mm increments with "air release technique" using a low-resistance syringe. An injected puff of air at each position causes the plunger to bounce back, except when the epidural space has been encountered. Position of the needle now is confirmed under fluoroscopy.

Caudal epidural injections technique: Patient in prone position the sacral cornua are often palpable and border the sacral hiatus, thus serving as landmarks for entry site into the sacral canal under fluoroscopy control. Confirm the approach on the lateral view usually making a 45 degree approach through the hiatus to bone. Retract slightly and advance horizontally in the midline, confirming placement in the canal with lateral fluoroscopy. Terminate advancement at the mid-portion of S3 and then delivery of drug is commenced, checking at times to ensure that the needle is in space. Due to the large area in the caudal space and the distance from the nerve roots, large volume of medications are required to deliver the drug at the area of the pain generator.

Reports in literature suggests that blind caudal injection without fluoroscopic control results in 30-40% of needle misplacement, such as needle tip placement outside the epidural space, intravascular injection and not at the presumed level of pathologic process. Therefore it is recommended that caudal steroid injections be performed under fluoroscopic for appropriate placement in order to improve the safety, accuracy and potential efficacy of caudal steroid injections.

RESULTS

A total 272 patients were enrolled for the study out of which 144 were male (52.94%) and 128 were female (47.05%).

Table 1: Pre injection and post injection visual analogue score (VAS) back pain and leg pain.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	VAS back pain	6.90	272	.772	.047
	Post Injection VAS	3.51	272	.815	.049
Pair 2	VAS leg pain	7.16	272	.677	.041
	Post Injection Leg Pain	3.58	272	.596	.036

Table 2: Post injection- caudal steroid v/s interlaminar steroid.

	Mode	N	Mean	Std. Deviation	Std. Error Mean
Post Injection VAS back pain	Caudal Injection	131	3.83	0.725	0.063
	Interlaminar Injection	141	3.22	0.785	0.066
Post Injection VAS Leg Pain	Caudal Injection	131	3.73	0.538	0.047
	Interlaminar Injection	141	3.44	0.614	0.052

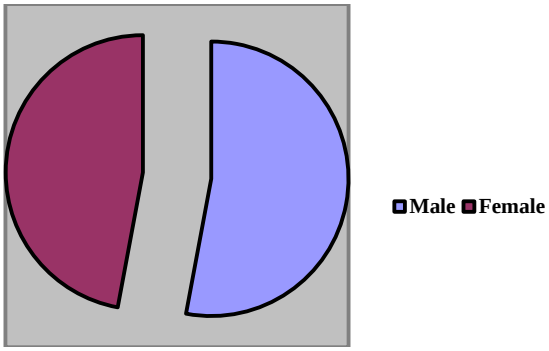

Figure 1:???

Oswestry Disability Index (ODI) Scoring:

- 0% to 20% (minimal disability): Patients can cope with most activities of daily living. No treatment may be indicated except for suggestions on lifting, posture, physical fitness and diet. Patients with sedentary occupations (ex. secretaries) may experience more problems than others.
- 21%-40% (moderate disability): Patients may experience more pain and problems with sitting, lifting and standing. Travel and social life are more difficult. Patients may be off work. Personal care, sleeping and sexual activity may not be grossly affected. Conservative treatment may be sufficient.
- 41%-60% (severe disability): Pain is a primary problem for these patients, but they may also be experiencing significant problems in travel, personal care, social life, sexual activity and sleep. A detailed evaluation is appropriate.
- 61%-80% (crippled): Back pain has an impact on all aspects of daily living and work. Active treatment is required.
- 81%-100%: These patients may be bed bound or exaggerating their symptoms. Careful evaluation is recommended.

Table 3: Oswestry disability index (ODI) percentage.

ODI %	Pre injection (mean)	Post injection (mean)
Caudal injection group	46.14± 11.65	14.54± 14.38
Interlaminar Epidural group	44.46± 9.21	13.89± 13.76

The change in pain scores were rated as mild, moderate and excellent. The interlaminar steroid injection results were excellent in early period and moderate at 12 weeks. The caudal steroid injection produced moderate relief at 1 week, 3 weeks, 6 weeks and 12 weeks. Typically patients of interlaminar epidural injections felt relief of pain after about 2 - 3 hours of injection, which reached its peak at about 3 days to 7 days and then gradually the patients had moderate pain relief after the 3rd week period. However, the caudal injection patients had injection site pain on the day of injection and peak relief occurring after 2 to 3 days and remaining constant throughout the period till about 12 weeks. In the present study 131 patient in group I had moderate pain relief and 141 patients in group II had excellent early pain relief and moderate midterm pain relief.

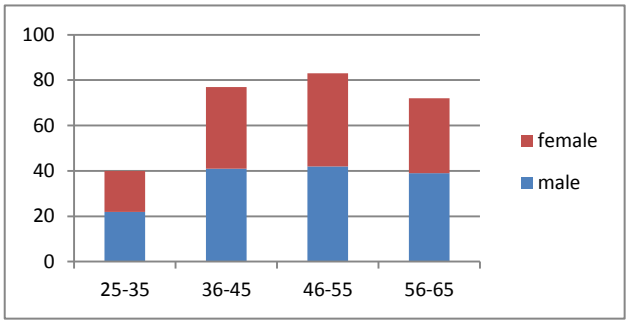

Figure 2: Age group from 25 to 65 years with a mean age of 47.2 years.

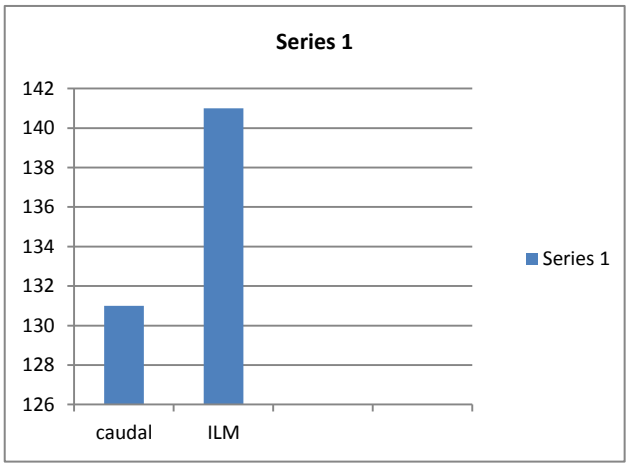

Figure 3: Out of 272 patients 131 were managed with caudal steroid injection and 141 were managed with interlaminar steroid injection.

DISCUSSION

Image-guided and blind injection procedures are commonly used to diagnose or treat spine-related pain (the facets, sacroiliac joint, exiting nerve root, and the disc).[9] The anesthetic injection, in combination with steroid or either alone, serves as a diagnostic and therapeutic block. Patient's pain response depends upon the accurately target of the drug in the region from where the pain is generated. Usually, most injection procedures, the short, intermediate and long-term pain relief and response depend upon detailed clinical evaluation (history or physical examination) and also to the confirmatory nature of the pain response to the diagnostic block. Interlaminar steroid injection and caudal steroid injection are often used for both specific symptoms like disc prolapse along with radiculopathy, spinal canal stenosis, and lateral recess impingement and also for nonspecific or multifocal low back pain, where targeting is less accurate and specific due to the complex clinical

presentation and morphologic pain presentation. Steroids are injected along with local anesthetic and / or saline, but the volume used varies according to the location.

In interlaminar steroid injections, the more specific targeting of painful region is done in contrast to caudal steroid injections, in which large volume of injection are used to infiltrate the spinal canal, so that diffusion occurs slowly. Prolapsed intervertebral disc is known to have a significant acute inflammatory effect on epidural tissues, nerve roots, and the Dorsal Root Ganglion (DRG).[10] Inflammatory mediators such as phospholipase A2, tumor necrosis factor- alpha, interleukin-6, interleukin-8, and prostaglandin E2 have been found in degenerative as well as acutely prolapsed disc material.[11]

Increased intradiscal cytokines have been demonstrated in patients with discogenic low back pain as well as in radiculopathy due to disc prolapse in sciatica.[12] Direct action of prolapsed disc on the epidural space, nerve root, and DRG have demonstrated varying histologic changes suggestive of hyperemia, nerve root edema, hemorrhage around the nerve root, epidural thrombus formation and injury to nerve fibers, causing changes in nerve function, due to which there is increased pain sensitivity, due to alteration in conduction velocity of nerve fiber, altered blood flow, increased endoneural pressure and spontaneous discharges. Direct action of selected inflammatory mediators and cytokines has also been demonstrated.[13] Acute nerve root compression and / or DRG compression induces inflammatory reaction along with alteration in nerve function.[14] The DRG is extremely sensitive to compression, causing increased in nerve discharge rate. There is development of nerve root edema which results in alteration in the permeability of intraneural and perineural tissues, increased intraneural pressure, and reduced neural blood flow. Subsequently causing Ischemic injury and compressive injury of the nerve fiber and resulting in development of long-term intraneural fibrosis. In long term chronic nerve root compression, inflammatory cell infiltration, edema, and intraneural fibrotic changes are more prevalant.[15] A combination of compression and inflammatory change has been shown by several groups to be synergistic in causation of pain.[16]

Sustained pain improvement after interlaminar steroid injection and caudal steroid injection are related to the anti-inflammatory effects of the injected steroid on symptomatic structures in the epidural space, including the disc, dura, peridural tissues, and neural structures. The injected steroid has several actions on inflamed and sensitive tissue, which includes membrane stabilization, reduction of neural tissue edema, along with a direct anti-inflammatory effect of steroids. The steroids also inhibit neural peptide synthesis and its action, apart from causing reduced prostaglandin synthesis. The steroids are believed to suppress neuronal inflammatory discharges and suppression of sensitized dorsal horn neurons along with altered neuronal blood flow.[17] The potential anti-inflammatory effect related to the injected local anesthetic augments and complements the steroid efficacy possibly. Recent studies have shown that, there is presence of interferon-gamma in epidural lavage samples, and interlaminar steroid injection and caudal steroid injection response may equate to the level of interferon-gamma reduction.[18] The immediate pain reduction by interlaminar steroid injection and caudal steroid injection response is likely due to local anesthetic action on the active epidural, neural, or perineural pain generator(s) tissues or their immediate neural supply. If the patient's pain is related to irritation from inflammatory by-products like disc or inflammation of the epidural structures like dura, annulus, epidural vessels, epidural fat, the injected local anesthetic might be affecting these sensitized regions directly, causing immediate pain reduction. The direct response could also be amplified by potential dilution or limited "washout" of the locally active epidural inflammatory mediators.[19] Alternatively if pain is related to structures adjacent to the epidural space, direct anesthetic applied to the structure surface or nerve supply via sinuvertebral nerve might be helpful in reducing or abolishing the pain.

The immediate interlaminar steroid injection and caudal steroid injection response could therefore be a "targeting" indicator of the location responsible for the patient's pain, potentially serving as a predictor of a sustained interlaminar steroid injection and caudal steroid injection treatment response.

In a cohort study of 44 patients with low back and leg pain showed no significant improvement when compared with 40 mg of methylprednisolone. However, the procedures were not done under fluoroscopy.[20] In another study[21] 23/34 (68%) of patients experienced at least a temporary or partial response to the initial unscreened caudal epidural injection and of the eight patients who were given either two or three epidural injections, four obtained sustained relief from their leg pain. In our study 80 mg of methylprednisolone was injected under fluoroscopy and the results were significant improvement of pain in both the group.

Reports in literature suggests that blind caudal injection without fluoroscopic control results in 30-40% of needle misplacement, such as needle tip placement outside the epidural space, intravascular injection and not at the presumed level of pathologic process. Therefore it is desirable that caudal steroid injections be performed under fluoroscopic for appropriate placement in order to improve the safety, accuracy and potential efficacy of caudal steroid injections. There is a potential risk of dural puncture with the interlaminar epidural injection.

Predisposing factors to Dural puncture in caudal epidural steroid injections:

- Short stature (height less than 5 feet)
- Short sagittal dimension of sacrum

- Blind injection without fluoroscopic guidance
- Inexperienced operator
- Tip of the needle above the level of the anterior foramen of S1 in anteroposterior view
- Atypical anatomy within the sacral canal, including presence of a tethered cord

Potential causes of difficulty entering the caudal epidural space:

- Acute angle of sacral dorsal convexity
- Inability to identify anatomic landmarks
- Deformity of sacral coccygeal area secondary to previous trauma or birth defect
- Sealed sacra; hiatus (rare)
- Relatively long coccyx with "superior" location of sacral hiatus
- Developmental fusion of sacral canal

CONCLUSION

In the current study, interlaminar epidural steroid injection group has better symptomatic improvement for short term pain relief and moderate pain relief at medium term as compared to caudal steroid injection group, which had moderate pain relief all throughout. The maximum benefit usually lasted up to 12 weeks and this interventional pain relief could be termed as a means to possibly avoid spinal surgery in painful radiculopathy of lower limbs if the relief is substantial enough.

However, the caudal steroid injection is cost effective, easy to administer and is having much less complications as compared to interlaminar steroid injection.

Both these procedures are safe, well tolerated procedures, and can be performed as outpatient procedures

Limitations:

While comparing VAS pain scores is an established measure of symptom change, pre procedure cognitive/psychologic factors (ie, depression, anxiety, catastrophizing) and other factors related to the patient's post procedure function level have not been evaluated but might be important. Duration of the effect was not tested and might be important to understand.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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