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Study of outcome of fluoroscopic guided transforaminal lumbar epidural steroid injection in patients with low back pain with radiculopathy

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Abstract

Objectives: Evaluation of the outcome and the effects of fluoroscopic transforaminal epidural steroid injections in long term in patients having back pain with radicular leg pain.

Background Data: Many studies have evaluated the efficacy of traditional trans sacral (caudal) or translaminar (lumbar) administration of epidural steroids, no studies have assessed specifically the therapeutic value of fluoroscopic transforaminal epidural steroids.

Study Design: A prospective study that investigated the outcome of patients with radicular leg pain due to lumbar herniated disc who were injected with fluoroscopic transforaminal epidural steroid injections.

Methods: All the patients included in our study received contrast-enhanced, fluoroscopically guided, transforaminal epidural injection of steroid at the documented pathological site. Patients' evaluation was done by the independent observer. All the patients received sequential questionnaires pre-and post-injection, documenting pain, activity, and patient satisfaction.

Results: 20 patients taken in this study and follow up taken for an average 52 weeks; 14 patients had a good outcome, reporting at least a >50% reduction between pre-injection and post-injection pain scores, as well as an ability to return to their activity of daily living after only 1.5 injections per patient. Out of 20 patients 16 were happy with their outcomes.

Conclusions: Fluoroscopic transforaminal epidural injection of steroids are an effective conservative treatment option for patients with lumbar disc prolapse and radiculopathy when other conservative treatments are not so effective and before undergoing surgical intervention.

Keywords: fluoroscopic guided, transforaminal lumbar, epidural steroid, low back pain, radiculopathy

Introduction

The first report of therapeutic spinal injections to treat low back pain and sciatica was published in 1901 and reported on the use of cocaine. In 1925, Viner^[2] administered epidural injections of procaine, Ringer's solution, and saline to treat intractable sciatica. Robecchi and Capra in 1952 were the first to advocate corticosteroid injections into the lumbar epidural space for the management of low backache. These injections are now widely used to treat low back and leg pain.

More than forty papers have described clinicians' experiences with epidural steroid injections^[4]. The success rates reported have varied from 20% to 100%, with an average success rate of 67%. Usually, the effect is short and diminishes with time.

The two major criticisms of these previous studies are (1) that the majority of the studies had a mixed patient population (ie, disc herniations, spinal stenosis, spondylolisthesis, postsurgical); and (2) that the techniques used to administer the epidural steroids were not target specific (techniques used were the traditional trans lumbar or trans sacral techniques, not transforaminal at the level and side of their symptoms). Furthermore, none of the studies used fluoroscopic guidance with preinjection contrast to document the epidurogram and proper flow to the target tissue. There have been noticed that inexperienced surgeons, the epidural injectate may be misdirected in up to 30% of the cases^[11]. This has led to the recent emphasis on the use of fluoroscopically guided epidural steroid injections^[12].

Recent studies^[5] have indicated that pain factors such as substance P, calcitonin gene-related peptide, and c-fos and inflammatory factors such as phospholipase A2⁵ are present in abnormal quantities after disc herniation, causing a chemical radiculitis^[6].

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Corticosteroids have been shown to inhibit prostaglandin synthesis" and impair the cell-mediated and humoral immune responses" [9] in addition to blocking nociceptive C fiber conduction [20]. Based on this, it makes intuitive sense to deliver the highest concentration of steroid injectate to the perceived target site of pathology. If we perceive that target as the posterior annulus and ventral aspect of the nerve root sleeve, it would seem incongruous that delivery of adequate concentrations of medication would be achieved with the traditional trans sacral or translaminar approaches. For these reasons, Derby and colleagues [2] developed the fluoroscopically guided transforaminal injection techniques for diagnostic and therapeutic purposes for precise delivery of the injectate at the desired pathological site.

The aim of this study was to prospectively evaluate the therapeutic efficacy of fluoroscopically guided transforaminal epidural steroid injections in a series of patients with lumbar disc prolapse and radiculopathy in whom other conservative measures were not effective.

Methods

We prospectively followed 20 patients (average age, 40 years; 14 men, 6 women) with lumbar disc prolapse and radiculopathy for an average follow-up of 52 weeks. Patients were taken from the tertiary healthcare center, and all parameters were defined in this prospective clinical case series before the study. Every patient in our case series had documented magnetic resonance imaging (MRI) findings that showed disc herniation with nerve root compression at the level and side of the clinical symptoms and signs.

Inclusion criteria were

1. Complaint of radicular leg pain which did not resolve with at least a 4-week trial of conservative treatment with a combination of oral NSAIDs and an oral narcotic for extreme pain, an initial 2 days of bed rest, followed by a 2 to 3-week physiotherapy program.
2. History, physical examination, and pain drawing consistent with lumbar radiculopathy; and
3. MRI results documenting a herniated lumbar nucleus pulposus.

Exclusion criteria were prior spinal surgery at the same level, an MRI-documented large protruded or sequestered disc with severe spinal canal stenosis, progressive worsening of neurology, or recent history of epidural steroid injections. Data collection was performed preinjection; postinjection at 7 days and 30 days; and then every 3 to 6 months by an observer with preformed questionnaires and on call follow-up. If the patient's pain level at follow-up was a 4 or greater on a visual numerical pain scale (0-no pain; 10-severe pain) [24] they were reinjected at an interval of approximately 2 weeks. The pain data were reported as averages of preinjection and post injection pain scores. The pain data was also compiled as 75th, 50th, and 25th percentiles before and after injection. Statistical evaluation of preinjection and post injection pain scores was performed using paired Wilcoxon signed-rank, as well as demographics of patients performed by χ^2 analysis (significance defined as $p < .05$).

Once enough pain control was taken place, proper functional restoration program consists of exercise and education emphasizing lumbar stabilization training was prescribed for a period of 3 months. Patients were asked to rate their functional level as follows: (1) excellent, able to return to work and athletic activities; (2) good, able to return to work and limited athletic activities, (3) fair, able to return to work part-time with no athletic activity; and (4) poor, unable to return to work.

For lumbar disc prolapse at or above the L4-5 level, we used a double-needle paramedian technique. After the usual sterile precaution and local anesthesia, a 20-gauge spinal needle was advanced to the transverse process, then redirected 1 cm inferior and anterior. A 25-gauge 6-inch spinal needle was advanced through the 20-gauge introducer needle into the so-called "safe triangle" area [2]. The "safe triangle" is composed of a roof made up of the pedicle, a tangential base that corresponds to the exiting nerve root, and a side that is made by the lateral border of the vertebral body [2]. Both anterior-posterior and lateral fluoroscopic projections confirmed proper needle placement. On the lateral view, the needle should be positioned just below the pedicle in the ventral aspect of the intervertebral foramen. On the anterior-posterior view, the needle is placed just beneath the midportion of the corresponding pedicle. At the S1 level, we used a single-needle technique. A 25-gauge 3.5-inch spinal needle is advanced into the upper outer quadrant of the first sacral foramen under fluoroscopic guidance. Once the adequate flow of contrast to the target area was identified, 1.5 ccs of Methyl Prednisolone acetate and 1.5 cc of plain lignocaine and 7 cc distilled water were injected.

Criteria for a successful outcome were at least a $> 50\%$ reduction in pretreatment and posttreatment pain scores and were continued throughout the follow-up time and an ability to return to previous levels of daily activity.

Statistical analysis of pretreatment and posttreatment visual numerical pain scores was done using paired Wilcoxon signed-rank, and demographics of patients were analyzed using χ^2 analysis ($p < .05$).

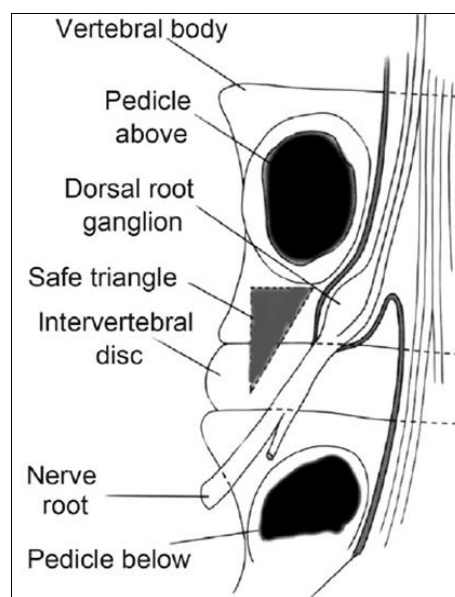


Fig 1: Safe triangle

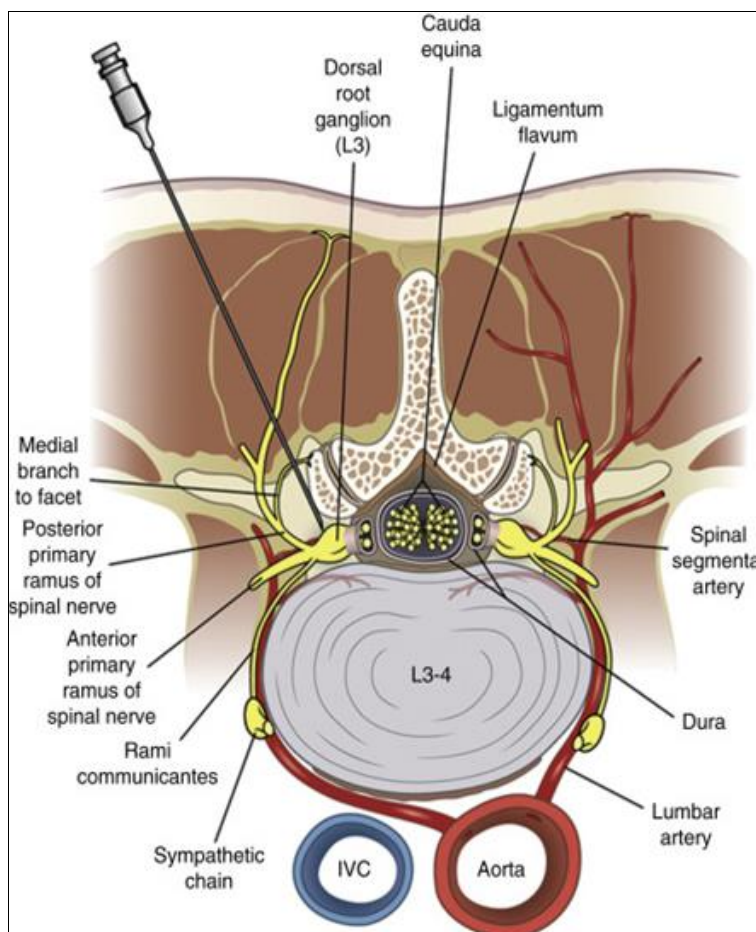


Fig 2: Schematic diagram showing site of epidural injection



Fig 3: Patient positioning



Fig 4: Prerequisites

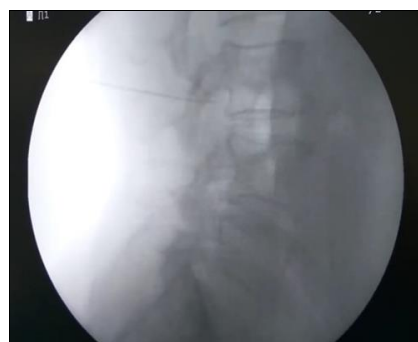


Fig 6: Lateral view



Fig 7: Image showing dye exiting through foramina on L3 right side

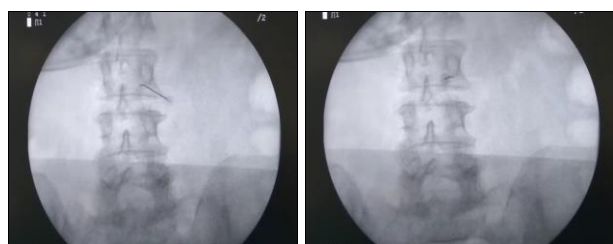


Fig 5: Example of right sided L3 transforaminal epidural injection (AP view)

Results

A successful outcome was reported by 14 of the 20 patients (70% at an average follow-up of 52 weeks). Our follow-up rate was 100%. 80% percent of the patients were happy with their treatment. Only 2 patients with less than a 50% reduction in pain

scores were able to report good or excellent function and satisfaction with their outcomes. To achieve a successful outcome, only 1.5 injections per patient were required. Of the patients who had successful outcomes, 42.9% (6 of 14) required only 1 injection, 42.9% (6 of 14) required 2 injections, 7.1% (1 of 14) required 3 injections, and 7.1% (1 of 14) required 4 injections. There were no any complications.

The average duration of symptoms pretreatment was average 6 months. The average pretreatment pain score was 8. The pretreatment scores were 8.9, 7.8, and 6.8 at the 75th, 50th, and 25th percentiles, respectively. The average posttreatment pain score was 2. The posttreatment pain scores were 4.3, 2.5, and 1.2 at 75th, 50th, and 25th percentiles. In our patient population, 30% of the treated pathology was at the L5 level, 40% was at the S1 level, 20% at the L4 level, and 10% was at the L3 level. The difference between average pretreatment and posttreatment pain scores was determined to be statistically significant (p .05, Wilcoxon signed-rank). There was no significant difference between patients who responded and not responded in age, sex, level of disc herniation, or pretreatment pain level ($p > .05$, y^2 test). There was a significant difference ($p < .05$, y^2 test) between those patients with a pretreatment symptom duration of fewer than 9 months and those with a symptom duration longer than 9 months. Patients with a pretreatment symptom duration of fewer than 9 months ($n = 10$) had a 78.8% successful outcome. Patients with a pretreatment symptom duration of more than 9 months ($n = 4$) had 64.7% successful outcomes.

4 of 20 patients (20%) did not report satisfactory outcomes. 3 of 4 patients in whom injection therapy was not effective required surgical intervention. 2 of 3 patients underwent a single-level microdiscectomy, and 1 patient required a single-level fusion with instrumentation.

Discussion

In this prospective case series, we studied the effects and outcome of patients with lumbar disc prolapse and radicular leg pain to fluoroscopic transforaminal epidural steroid injections in long term. We studied patients with subacute or chronic radicular pain in whom at least a 4-week trial of oral medications, physiotherapy, and activity modification had been ineffective. Higher success rates with nonoperative treatment of lumbar disc prolapse can be achieved if the patients with oral medications and effective physiotherapy had been included. In many patients, these conservative interventions fail, and the patients are then considered for surgical interventions. We achieved a success rate of 80%.

A drawback of this study is that there is no control group. This is a prospective case series depicting our clinical experience with what we believe is a comparatively new, safe, and effective technique for administering epidural steroids. Prospective, double-blind, controlled, randomized studies comparing different injection techniques, medications, doses, and different patient populations, are needed to further validate the results of this study. Although we acknowledge the lack of a control group. Our study proves that reliable radicular pain relief can be achieved by fluoroscopically guided and contrast-enhanced target-specific application of a small dose of corticosteroid directly at the site of MRI-documented pathology with correlative physical examination findings.

If we compare our results with other authors' experiences using the more traditional trans sacral (caudal) or translaminar (lumbar) epidural steroid injection techniques, two noticeable trends can be justified.

Our 80% success rate compares favorably with those of other

reported [7]. Our results are also in contrast to those of studies that reported unfavorable outcomes. We used only an average of 1.5 injections per patient to achieve a therapeutic effect. This is much less than the standard 3 to 4 injections per patient that are traditionally prescribed.

We believe there are several explanations for our long-term successful outcome. Caudal or lumbar epidural steroid injections typically use 6 to 10 cc volume, thus diluting the potential therapeutic effect of the corticosteroid necessary to treat the chemical radiculitis [27]. In contrast, using a transforaminal technique the volume of injectate was only 3 cc (1.5cc Methyl Prednisolone acetate and 1.5cc plain lignocaine). Without fluoroscopic guidance, there may be up to a 30% chance of misplacing the steroid, even in experienced hands. The caudal and lumbar techniques are also dependent on normal epidural anatomy to reach the target tissue. If there is stenosis, epidural scarring, or a midline raphe, the medication may not even reach the target site [28]. The success of the injection depends on the precise delivery of high concentrations of medication directly to pathological site. This can only be done on a reliable basis by using a fluoroscopically guided transforaminal approach directly at the side and level of involvement with pre-injection contrast documenting flow to the foramina.

One drawback of epidural steroid injections is that their benefit is short term. Ridley and associates reported that the therapeutic benefits disappeared within 6 months of treatment. We, however, had a long-term success rate of 80% at an average follow-up of 12 months.

We added active exercise and education in our program after satisfactory pain relief. Injection of epidural steroids has a role in pain control in the early stages, but this should be followed by progressive lumbar stabilization exercises to treat the underlying segmental micro-instability resulting from disc disease.

It appears from this study, as well as from other studies [2], that patients with concomitant moderate to severe lateral recess stenosis respond less favorably and are more likely to require surgery to decompress the area of stenosis. Perhaps these patients are to be considered earlier for surgery to reduce the disability period. In addition, patients with a pre-injection symptom duration of more than 6 months did not respond as favorably as those with a pre-injection symptom duration of fewer than 6 months. Irreversible neurophysiologic changes may take place with chronic neural compression and inflammation that become refractory to management with the local application of steroids after a period. This shows that in treatment of the patients with radiculopathy, we should be more cognizant and aggressive in the use of these treatments that may ultimately change a patient's long-term outcome.

We conclude that in patients with lumbar disc prolapse and radicular lower limb pain, the fluoroscopic transforaminal epidural steroids are an effective nonsurgical conservative management option. They should be considered prior to surgery. It is only after adequate pain relief that rehabilitation can be effective and function restored. Lower success rates are seen in patients with a pre-injection symptom duration longer than 6 months; therefore, earlier use of this technique may improve long-term outcomes.

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