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Original Contribution

Effectiveness of Transforaminal Epidural Steroid Injections in Low Back Pain: A One-Year Experience

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Transforaminal epidural steroid injections under fluoroscopy are an alternative treatment for lower back pain with radiculopathy. We followed 82 patients with a standardized telephone questionnaire at 2, 6, and 12 months after the first injection, in order to assess their effectiveness.

Ninety-two patients with radiculopathic back pain due to spinal stenosis, herniated discs, spondylolisthesis, and degenerated discs, underwent transforaminal epidural steroid injections under fluoroscopy. Eighty-two patients were followed with a standardized telephone questionnaire. The population was divided into four groups: Group I, previous back surgery (16%); Group II, discogenic abnormalities: herniations, bulges, or degeneration, (42%); Group III, spinal stenosis (32%); Group IV, those without MRI (11%).

Age ranged between 24 to 99 years, mean 64.5. Forty-seven were female, 35 male. Thirteen patients (16%) underwent one procedure, 27 patients (33%) two, 37 patients (45%) three, and five patients (6%) four, an average 2.4 procedures per patient. The pain scores for all patients improved significantly at all three time points (2, 6 and 12 months) compared to the initial mean pain score of 7.3 to mean pain scores of 3.4, 4.5 and 3.9 respectively. After one year, 36 patients did not take any pain medications. Greater than 50% improvement after one year was seen in 23% of Group I; 59% in Group II; 35% in Group III and 67% in Group IV.

Transforaminal epidural steroid injections can offer significant pain reduction up to one year after initiation of treatment in patients with discogenic pain and possibly in patients with spinal stenosis.

Keywords: Chronic low back pain, chronic, epidural injection, pain management, transforaminal epidural injection

Low back pain is the most costly disease in the United States and the incidence is increasing. The lifetime prevalence of low back pain in the general population is approximately 80% (1) and it is responsible for 14 billion dollar a year expenditure in the United States alone (2).

Several approaches have been tried in the treatment of low back pain including anti-inflammatory medications, muscle relaxants, opioids, and medications used for neuropathic pain, all with varied degrees of effectiveness. In addition, transcutaneous electrical nerve stimulation, acupuncture, chiropractic manipulations and epidural steroid injections are therapeutic alternatives that are offered to patients with disabling back pain. A different approach to treat radiculopathic lower back pain, namely the transforaminal approach done under fluoroscopy is performed at our Institution. The dorsal root ganglion presumably responsible for radiculopathic pain is reached more selectively and medication is administered at a higher concentration than with midline approach (3). Effectiveness of transforaminal epidural steroids has been reviewed (3).

This study was undertaken to assess the effectiveness of transforaminal epidural steroid injections for radiculopathic low back pain.

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METHODS

Ninety-two patients underwent transforaminal epidural steroid injections for radiculopathic low back pain, due to spinal stenosis, herniated discs, spondylolisthesis, degenerated discs, or a combination of the above.

A single pain management physician performed the procedures in the Outpatient Surgery Center at University Hospitals of Cleveland.

The level of the transforaminal injection was chosen depending on magnetic resonance imaging (MRI) findings and physical exam. Before being brought to the operating room the patients were offered mild sedation with midazolam 0.5 to 2 mg intravenously prior to the procedure. All procedures were performed with the patient in prone position and under fluoroscopic guidance. After positioning the patient in the optimal position and washing the skin with betadine solution the skin overlying the target area was anesthetized with lidocaine 1%.

A 22- or 23-gauge spinal needle was then advanced under fluoroscopy aiming the needle at the superior and anterior part of the foramen. The needle placement was confirmed after injecting omnipaque, demonstrating the contrast going through the foramen. At any session, the transforaminal injection was performed at a single level. Also, the confirmation of the needle position with contrast reduced the possibility of misplacement or intravascular placement of the needle, which is always a risk in epidural steroid injections performed without fluoroscopy (5). After reaching the target, 60-80 mg methylprednisolone acetate (DepoMedrol ®), 1 ml lidocaine 1.5% (with epinephrine 1:200,000) and 1 ml of bupivacaine 0.25% were injected.

The spinal needle then was withdrawn and the patients were transferred to the recovery area, where they were observed for 30 to 60 minutes prior to discharge home.

All patients were followed with a standardized telephone questionnaire at two, six and twelve months after their first transforaminal epidural steroid injection. The telephone questionnaire was obtained from a recent publication on outcome measures for low back pain (4).

Of all patients, nine were lost to follow-up and one died during the study period of unrelated causes. The remaining 82 patients were divided into four major diagnostic groups. The criterion for inclusion into the different groups was based on MRI findings or post-surgical status.

Group I included all patients with previous back surgery, regardless of the MRI findings (13 patients, 16%).

Group II was patients with discogenic abnormalities such as herniations, bulging discs or degenerative discs, with or without other coexisting MRI findings (34 patients, 42%).

Group III consisted of those with MRI findings of spinal stenosis, central or foraminal stenosis, without any disc abnormalities (26 patients, 32%).

All other patients and those without a MRI were assigned to Group IV (9 patients, 11%).

We selected a linear, verbal numerical pain score (0-10) as the primary outcome at two, six and twelve months after the first transforaminal epidural injection was done. Following a descriptive analysis of the data, significance of results was evaluated. Differences in pain scores at the various time points for all patients were compared with the paired t-test. Differences between time points and diagnostic groups were compared with an ANOVA for repeated measures, with a Bonferroni correction applied. For all statistical calculations the computer program StatView 4.57 by Abacus Concepts, Inc.® was used. The precision and statistical significance of the differences in the pain scores are indicated by the 95 percent confidence interval and $p<0.05$.

RESULTS

The study population included only patients with low back pain and radiculopathy, who were then treated with transforaminal epidural steroid injection done under fluoroscopic guidance. Demographic data is illustrated in Table 1. Seventy-five (92%) patients had a previous MRI study. The number of injections performed varied.

Thirteen patients (16%) underwent one transforaminal epidural steroid injection, 27 (33%) underwent two injections, 37 (45%) underwent three injections and five (6%) underwent four injections during a one-year period. The average number of injections for all patients was 2.4. The duration of symptoms prior to entering the study varied between 3 weeks and a maximum of 30 years (a 99-year-old patient with spinal stenosis) with a mean of 33 months and a median of 12 months.

Table 1. *Demographic characteristics*

	All Patients	Previous Surgery	Discogenic	Spinal Stenosis	Others
Age (mean)	64.5 years	62.8 years	59.7 years	74.8 years	54.9 years
Gender	47 female 35 male	7 female 6 male	16 female 18 male	18 female 8 male	6 female 3 male
Duration of symptoms (median)	12 months	27 months	9.5 months	12.5 months	19 months
Number of injections (mean)	2.4 injections	2.5 injections	2.4 injections	2.6 injections	2.2 injections

Seventy-six patients were on various types of medications including anti-inflammatory agents, opioids, antidepressants, and anticonvulsant, at the time of their initial assessment. Sixteen patients were not on any pain medication at this time.

Tables 2 and 3 illustrate results of assessment of pain. There was a significant decrease in the numerical pain score in the study population. The initial mean pain score for all patients was 7.3 with a mean pain score at two months of 3.4 ($p<0.001$). Similar results were seen at 6 and 12 months, with mean numerical pain scores of 4.5 and 3.9 respectively ($p<0.001$).

The most significant improvement in the pain score was seen in patients with discogenic back pain, while the least benefit was noted in patients with previous back surgery.

The difference in pain score ratings between patients with discogenic back pain and patients with either previous back surgery or spinal stenosis was significant ($p=0.0012$ and $p=0.002$).

After one year, 36 patients did not require any pain medications compared to 16 patients at the beginning of the study.

Thirty-eight patients (46%) rated their pain, one year after the first injection as more than 50% improved compared to their initial pain score. Two months after the first injection, 56% had a better than 50% improvement of there pain score ratings (Table 3).

In postlumbar laminectomy patients, no significant improvement was seen. In spinal stenosis patients, a decrease in mean pain score from 7.8 to 4.1 at two months ($p<0.001$) was seen. Similar results were seen at 6 and 12 months after the first injection, showing a mean numerical pain score of 5.8 and 5.1 respectively ($p=0.0063$ and $p=0.0026$).

DISCUSSION

High levels of phospholipase A_2, an enzyme involved in the production of prostaglandin and leukotrienes during

Table 2. *Results of pain assessment*

Diagnosis (Number of patients)	Initial pain scores + SD	2 Month pain scores + SD	6 Month pain scores + SD	1 Year pain scores + SD
All patients (82)	7.26 + 1.81	3.35 + 2.86	4.45 + 3.13	3.88 + 3.14
Disc herniation (34)	6.94 + 2.00	2.32 + 2.53	3.18 + 2.85	2.73 + 2.84
Spinal stenosis (26)	7.81 + 1.81	4.08 + 2.78	5.85 + 2.77	5.08 + 3.32
Previous back surgery (13)	6.85 + 1.46	5.00 + 2.80	6.08 + 2.53	5.31 + 2.25
Others (9)	7.44 + 1.24	2.78 + 3.03	2.89 + 3.44	2.56 + 2.96

Table 3. *Improvement in the pain score rating of more than 50% on the linear pain score at two month, six and twelve month follow up after the first transforaminal epidural injection*

Diagnosis (Number of patients)	2 Months proportion of patients (N)	6 Months proportion of patients (N)	12 Months proportion of patients (N)
All patients (82)	56% (46)	39% (32)	46% (38)
Disk herniation (34)	68% (23)	56% (19)	59% (20)
Spinal stenosis (26)	54% (14)	19% (5)	35% (9)
Previous back surgery (13)	23% (3)	23% (3)	23% (3)
Others (9)	67% (6)	56% (5)	67% (6)

inflammation, have been found in herniated discs, and may be involved in the generation of radiculopathic pain (3, 5). Also, mechanical irritation of the dorsal root ganglia has been shown to decrease the thermal nociceptive threshold, and to correlate with c-*fos* expression, as well as the appearance of pain related behaviors (6). It also has been shown that mechanical compression alone may not be directly associated with the onset of pain, and resolution of symptoms may not correlate with the resolution of the compression (3, 7-11). Moreover, several studies have shown abnormal MRI findings in those without back pain (12-14). In addition other factors such as substance P, calcitonin gene-related peptide, nitrous oxide, and phospholipase A2 may be released from the disc. Any or all of these may play a role in the pathogenesis of inflammatory radiculopathy (3).

Epidural steroid injections have been widely used to treat radiculopathic pain, with varying degrees of effectiveness (15-17). The translaminar approach does not ensure the passage of the injected medication into the anterior epidural space, which is in proximity with the dorsal root ganglion, the nerve root, and the disc. Epidural steroid injections not done under fluoroscopy may fail to reach the target area in up to 30% of cases, even in experienced hands (3, 15-19). Results of studies with transforaminal epidural injections have been encouraging (20-28).

Our experience confirmed beneficial effects in patients with radiculopathic low back pain similar to the previous studies. Patients with proven disc herniations showed a more than 50% pain reduction of 68% of patients after 2 months. The pain relief obtained from transforaminal epidural steroid injections, showed a clear difference between diagnostic groups, with patient who underwent back surgery in the past showing the least improvement of pain, improvement, and patients with disc disorders, but without previous surgeries showing the best improvement, 59% claiming a more than 50% pain relief one year after the first injection. The patients with spinal stenosis showed moderate benefit, with improvement not as significant as in the discogenic group.

Spinal degenerative disease, including spinal stenosis, is more prevalent in the elderly, a segment of the population that is expected to increase. Oral medications used for the treatment of back pain with radiculopathy are often not enough to control the pain, and can expose patients to untoward side effects such as gastrointestinal bleeding, fluid retention, renal failure, constipation, central nervous system side effects and the potential for drug addiction. Transforaminal epidural steroid injections under fluoroscopy are outpatient procedures with a potential high benefit/risk ratio that can dramatically help some patients in severe pain, potentially preventing not only emergency rooms visits, but also hospitalizations. Our study showed a beneficial effect in decreasing the pain scores and a decrease in analgesic medications. Differences in pain score improvement were seen in different diagnostic groups.

The patient population in this report is neither homogeneous nor randomized, but reflected the usual patient population seen by our anesthesia pain service. Due to the varying effect of the transforaminal injections in each patient with pain relief lasting from only a few days to several months, the decision for an additional injection was made based on the patients condition. Therefore some patients received more injections than other patients did in the same time interval and a standardization of the number of injections or the time interval was neither possible nor planned. The purpose

of this study is not to prove the superiority of transforaminal epidural injections, rather than to share our positive experience with this approach to treat radiculopathic low back pain.

CONCLUSION

Transforaminal epidural steroid injections were shown to be significantly effective and safe in discogenic low back pain, and moderately effective in spinal stenosis. Further studies are necessary to determine which post lumbar laminectomy patients may benefit from this treatment.

REFERENCES

1. Cassidy D, Carroll L, Cote P. The Saskatchewan Health and Back Pain Survey. *Spine* 1998; 23:1860-1867.
2. Guo HR, Tanaka S, Halperin WE et al. Back pain prevalence in US industry and estimates of lost work days. *Am J Public Health* 1999; 89:1029-1035.
3. Manchikanti L. Transforaminal lumbar epidural steroid injections. *Pain Physician* 2000; 3:374-398.
4. Deyo, RA, Battie M, Beurshens AJ et al. Outcome measures for low back pain research. A proposal for standarized use. *Spine* 1998; 18:2003-2013.
5. Spaccarelli KC. Lumbar and caudal epidural corticosteroid injections. *Mayo Clin Proc* 1996; 71:169-178.
6. Koes BW, Scholten RJPM, Mens JMA et al. Efficacy of epidural steroid injections for low back pain and sciatica: A systematic review of randomized clinical trials. *Pain* 1995; 63:279-288.
7. Carrette S, Leclaire R, Marcoux S et al. Epidural corticosteroid injections for sciatica due to herniated nucleus pulposus. *N Engl J Med* 1997; 336:1634-1640.
8. Saal JS, Franson RC, Dobrow R et al. High inflammatory phospholipase A2 activity in lumbar disc herniations. *Spine* 1990; 7:674-678.
9. Chatani K, Kawakami M, Weinstein JN. Characterization of thermal hyperalgesia, c-fos expression, and alterations in neuropeptides after mechanical irritation of the dorsal root ganglion. *Spine* 1995; 3:277-290.
10. Hasue M. Pain and the nerve root. *Spine* 1993; 14:2053-2058.
11. Saal JA, Saal JS, Herzog RJ. The natural history of lumbar intervertebral disc extrusions treated nonoperatively. *Spine* 1990; 15:683-686.
12. Bush K, Cowan N, Katz DE et al. The natural history of sciatica associated with disc pathology: A prospective study with clinical and independent radiologic follow-up. *Spine* 1992; 17:1205-1210.
13. Jensen MC, Bran-Zawadzki MN, Obucjowski N et al. Magnetic resonance imaging of the lumbar spine in people without back pain. *N Engl J Med* 1994; 331:69-73.
14. Weisel SW. A study of computer assisted tomography. The incidence of positive CAT scans in an asymptomatic group of patients. *Spine* 1986; 9:549-551.
15. Manchikanti L, Rivera J, Pampati V et al. Effectiveness of clinical guidelines in interventional pain management. *Pain Physician* 2002; 5:127-132.
16. Singh V, Manchikanti L. Role of caudal epidural injections in the management of chronic low back pain. *Pain Physician* 2002; 5:133-148.
17. Manchikanti L, Pakanati RR, Pampati VS. Comparison of three routes of epidural steroid injections in low back pain. *Pain Digest* 1999; 9:277-285.
18. El-Khouri GY, Ehara S, Weinstein JN et al. Epidural steroid injection: A procedure ideally performed with fluoroscopy control. *Radiology* 1988; 168:554-557.
19. Renfrew DL, Moore TE, Kathol MH et al. Correct placement of epidural steroid injections: Fluoroscopic guidance and contrast administration. *Am J Neuroradiol* 1991; 12:1003-1007.
20. Riew KD, Yin Y, Gilula L, et al. Can nerve root injections obviate the need for operative treatment of lumbar radicular pain? A prospective, randomized, controlled, double-blind study. *J Bone Joint Surg* 2000, 82A:1589-1593.
21. Kraemer J, Ludwig J, Bickert U et al. Lumbar epidural perineural injection: A new technique. *Eur Spine J* 1997; 6:357-361.
22. Vad V, Bhat A, Lutz G et al. Transforaminal epidural steroid injections in lumbosacral radiculopathy; A prospective randomized study. *Spine* 2002; 27:11-16.
23. Lutz GE, Vad VB, Wisneski RJ. Fluoroscopic transforaminal lumbar epidural steroids: An outcome study. *Arch Phys Med Rehabil* 1998; 79:1362-1366.
24. Kikuchi S, Hasue M, Nishiyama K. Anatomic and clinical studies of radicular symptoms. *Spine* 1984; 9:23-30.
25. Devulder J. Transforaminal nerve root sleeve injection with corticosteroids, hyaluronidase, and local anesthetic in the failed back surgery syndrome. *J Spinal Disord* 1998; 11:151-154.
26. Weiner BK, Fraser RD. Foraminal injection for lateral lumbar disc herniation. *J Bone Joint Surg* 1997; 79-B:804-807.
27. Karppinen J, Malmivaara A, Kurunlahti M et al. Periradicular infiltration for sciatica. A randomized controlled trial. *Spine* 2001; 26:1059-1067.
28. Karppinen J, Ohinmaa A, Malmivaara A et al. Cost Effectiveness of Periradicular Infiltration for Sciatica: Subgroup Analysis of a Randomized Controlled Trial. *Spine* 2001; 26:2587-2595.