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Original Research Articles

Comparison of the Effectiveness of Lumbar Transforaminal Epidural Injection with Particulate and Nonparticulate Corticosteroids in Lumbar Radiating Pain

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Abstract

Objective. Lumbar transforaminal epidural steroid injections are procedures often utilized in the treatment of low back pain associated with radicular pain. Particulate steroids have been known to play a role in embolism. It is, unknown whether nonparticulate steroids are as effective as particulate steroids. To investigate the effect of an epidural steroid injection on back pain, we conducted a randomized, controlled trial comparing nonparticulate steroid with particulate steroid to treat lumbar disc herniation.

Design. One hundred-six patients were randomized to receive lumbar transforaminal epidural steroid injections (N = 53) with either dexamethasone 7.5 mg, or with triamcinolone acetate 40 mg (N = 53). Measurement were taken before treatment and one month after treatment using a visual analog scale, short McGill pain questionnaire, and revised Oswertry Back Disability Index.

Results. There was a statistically significant difference in the visual analog score between those treated with dexamethasone and those given triamcinolone. The two groups did not differ significantly on the McGill Pain Questionnaire, or the Oswestry Disability Index before and after treatment.

Conclusion. In this study, dexamethasone and triamcinolone treatments were shown to have different effects on low back pain with sciatica, with triamcinolone being more effective than dexamethsone in lumbar radiculopathy.

Key Words. Transforaminal Epidural Injection; Corticosteroid; Dexamethasone; Triamcinolone; Lumbar Disc Herniation

Introduction

When nerve roots exiting the spinal column are compromised, pain may occur that radiates into lower extremity. This is known as lumbar radiculopathy [1]. Transforaminal injection of steroids is a procedure used to treat radicular pain [2–5]. The injection of steroid is thought to be integral in decreasing inflammation around the affected nerve tissue [6,7], leading to a reduction in pain.

However, particulate corticosteroids carry a risk for embolic infarction [8–11]. Houten and Errico [8] reported paraplegia in three patients after lumbosacral nerve root block using either betamethadone or methylprednisolone acetate. He suggested that the mechanism was spinal cord infarction caused by the presence of an unusually low origin of the artery of Adamkiewicz and an undetected intra-arterial penetration of the needle and embolization of particulate steroid into the artery. Kennedy et al. [9] reported that two patients' suffered paraplegia following image-guided transforaminal lumbar epidural steroid injections with betamethasone and methylprednisolone,

respectively. A nonparticulate steroid, on the other hand, should not result in embolic infarction of the spinal cord; however, soluble steroids are rapidly cleared from the spinal canal, theoretically resulting in a shorter duration of effect [12] making them less effective than a particulate steroids when used for transforaminal injections [13]. Some work has been done to compare the use of particulate and nonparticulate steroids in patients with cervical radicular pain [14,15]. The authors reported that dexamethasone was slightly less effective than triamcinolone.

There is no available literature on the comparative effectiveness of particulate and non-particulate steroids in treating lumbar radicular pain. The aim of the present study was to determine whether nonparticulate steroids are any less effective than particulate steroids.

Methods

The study was conducted with the full approval of the Institutional Review Board and written informed consent was obtained from all subjects. One hundred and six consecutive patients were enrolled in the study, and were followed for four weeks in a randomized, single center study. Included were patients aged between 18 and 80 years, with a diagnosis of lumbar radicular pain based on an appropriate distribution of pain, and MRI showing nerve root compromise. Exclusion criteria were: chronic use of oral steroid medication, oral, peripheral, or epidural steroid use in the last three months, having an oral temperature greater than 100.4°F, pregnancy, cognitive impairment, inability to give consent, use of aspirin, plavix, coumadin, or heparin use in the previous two weeks, a history of bleeding disorders, a history of lumbar surgeryand, axial pain.

Patients were randomly allocated to one of two groups. Those in the first group received 7.5 mg of dexamethasone disodium phosphate (Dexamethasone, Huons, South Korea) and those in the second group received 40 mg of triamcinolone acetonide (Triam, Shinpoong, South Korea).

All injections were performed by the same anesthesiologist. Each subject was placed in the prone position. Under fluoroscopic guidance and, after sterile preparation, draping, and local anesthesia, a 23-gauge, 3.5-inch spinal needle was gently advanced on oblique view to the safe-triangle, which is formed by the pedicle, a tangential base that corresponds to the exiting nerve root, and the lateral border of the vertebral body. Both anteroposterior and lateral fluoroscopic projections confirmed proper needle placement. At each level, 0.5 mL of contrast medium (iohexol) was injected to confirm the position. Once an adequate flow of contrast to the target area was documented using real-time fluoroscopy and no blood or cerebrospinal fluid was aspirated. And in the absence of intravascular injection, the physician injected the allocated steroid diluted with 1 mL of 1% lidocaine.

Table 1 The demographic and clinical features of patients with lumbar radicular pain treated with transforaminal injections of either dexamethasone or triamcinolone

	Dexamethasone (N = 53)	Triamcinolone (N = 53)
M : F	26:27	24:29
Age (year)	55.5 ± 14.9	62.5 ± 10.8
Male	58.4 ± 17.6	59.2 ± 13.4
Female	53.1 ± 12.1	63.6 ± 9.4
Affected level		
L4	11	9
L5	25	29
S1	17	13

By Mann-Whitney *U* test.

Subjects were asked to fill out two questionnaires (short form McGill Pain Questionnaire and Revised Oswestry Low Back Pain Disability Index) and a visual analog scale score (VAS) at baseline (prior to procedure) and at four weeks after the procedure.

To compare the pain score, within and between groups, we used a Mann-Whitney *U*-test. All statistical analyses were performed using statistical software program (SPSS 17). A *P* value that is equal or less than 0.05 was considered statistically significant.

Results

The 106 patients were randomized into equal groups of 53. Before treatment, the two groups did not differ significantly with respect to age, gender, or segment treated (Table 1). The mean values of pain scores before treatment were not significantly different between the two groups (Table 2). But the trimacinolone group had significantly more patients with higher scores, and fewer with mid-range scores (Table 3).

At one month after treatment, both groups significantly lower than improved their mean pain scores, but the triamcinolone group achieved a score that was significantly lower than that of the dexamethasone group (Table 2). As well, the proportion of patients who obtained relief from their pain was significantly greater in the group treated with triamcinolone than in the group treated with dexamethasone ($P = 0.000$) (Table 3). For the dexamethasone group, the reduction of pain score was 40%, whereas that of the triamcinolone group was 71% (Table 4).

Notwithstanding these improvements and difference between pain scores, the scores after treatment for the McGill Pain Questionnaire and the Oswestry Disability Index were not significantly different between the groups.

Table 2 Mean scores (SD) for VAS, McGill Pain Questionnaire and Oswestry Disability Index before and one month after treatment of patients with lumbar radicular pain treated with transforaminal injection of dexamethasone or triamcinolone

	Baseline	1 month
Dexamethasone (N = 53)		
VAS	7.4 ± 1.4	4.1 ± 1.9*
McGill		
Sensory	10.7 ± 6.1	10.4 ± 7.8
Affective	3.7 ± 3.0	3.0 ± 3.3
Sum	14.9 ± 8.7	13.3 ± 10.5
RODI	51.7 ± 13.8	45.3 ± 21.2
Triamcinolone (N = 53)		
VAS	8.3 ± 0.9	2.4 ± 0.9*,**
McGill		
Sensory	11.0 ± 7.8	14.7 ± 9.8
Affective	2.4 ± 3.1	5.0 ± 3.8
Sum	13.4 ± 10.3	20.0 ± 13.2
RODI	57.6 ± 14.7	58.9 ± 16.5

* $P < 0.05$ compared with baseline, ** $P = 0.000$ compared with dexamethasone.
RODI = Revised Oswestry Low Back Pain Disability Index.

Discussion

A systematic review of seven controlled trials found level II-1 evidence that transforaminal injection of steroids is effective for short term relief of radicular pain [5]. Our results are consistent with this previous evidence. Significant improvement in pain was achieved irrespective of agent used. However, our study demonstrated that for the relief of lumbar radicular pain, transforaminal injections using triamcinolone were more effective than transforaminal injections using dexamethsaone.

This result is similar to that of Dreyfuss et al. [14], who found triamcinolone to be slightly more effective than dexamethasone for the treatment of cervical radicular pain, It is also consonant with the theoretical expectation that particulate steroids should be more effective because of their accumulative nature, whereas non-particulate steroids are rapidly cleared from the spinal canal [12,13]. In contrast, one study reported there was no significant difference between dexamethasone or triamcinolone in cervical transforaminal injections [15] and other authors proposed that it would be reasonable to considerer using non-particulate steroids, because of the risk of embolization associated with particulate steroid [8–11].

Betamethasone (Celestone), methylprednisolone (Depomedrol), and triamcinolone (Kenalog) have particles, or form aggregates, that are larger than red blood cells [16] This means that they could act as emboli in arterioles, metarterioles, or some arteries, if injected into a radicular artery. Dexamethasone sodium phosphate has particles smaller than red blood cells, and these do not aggregate [16]. The particle size of dexamethasone sodium phosphate is approximately 10 times smaller than red blood cells and the particles do not appear to aggregate even when mixed with 1% lidocaine HCl solution and with contrast medium [16]. In the light of this information, practitioners might still choose to use the ostensibly safer agent, but our result suggest that doing so significantly compromises the outcomes achieved. For the treatment of lumbar radicular pain, transforaminal injection of triamcinolone achieves greater reductions in pain in a greater proportion of patients.

A limitation of our result is that the significant improvements in pain were not corroborated by any secondary

Table 3 The distribution of visual analog scores (VAS) for radicular pain before and after treatment of patients treated with transforaminal injection of dexamethasone or triamcinolone

	Dexamethasone (N = 53)				Triamcinolone (N = 53)			
	Baseline		1 month		Baseline		1 month	
VAS	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	0	0	2	3.8	0		10	18.9
2	0	0	12	22.6	0		20	37.7
3	0	0	5	9.4	0		16	30.2
4	4	7.5	15	28.3	0		7	13.2
5	1	1.9	3	5.7	0			
6	23	43.4	12	22.6	2	3.8		
7	2	3.8	1	1.9	4	7.5		
8	20	37.7	3	5.7	25	47.2		
9	2	3.8	0	0	18	34.0		
10-	1	1.9	0	0	4	7.5		

Table 4 The number, and proportion of patients who obtained the percentage improvement of pain (ΔVAS%) following treatment with transforaminal injection of either dexamethasone or triamcinolone

Total N = 106	Dexamethasone (N = 53)		Triamcinolone (N = 53)	
ΔVAS%	N	Proportion	N	Proportion
91–100	0	0	0	0
81–90	1	1.9	10	18.9
71–80	4	7.5	18	34.1
61–70	8	18.9	17	32.1
51–60	6	11.3	8	15.1
41–50	1	3.8	0	0
31–40	13	24.5	0	0
21–30	13	15.1	0	0
11–20	2	3.8	0	0
1–10	0	0	0	0
0	7	13.2	0	0

outcomes. For neither the McGill Pain Questionnaire nor the Oswestry Disability Index did patients show any significant improvements. Several possible explanations arise. There may have been confusion about how the patients interpreted or used the questionnaires for secondary outcomes. Despite relief of radicular pain their responses may have reflected persistent back pain. It may be that the Oswestry Disability Index, which was designed for back pain, is not sensitive to improvements in radicular pain, but this should not apply to the McGill Pain Questionnaire. On the other hand, the possibility remains that treatment with transforaminal injection of steroid is not as successful as the pain scores in isolation suggest. Our results therefore would not need to be corroborated, using appropriate and sensitive secondary outcome measures before they can be generalized.

Conclusion

For the short-term relief of lumbar radicular pain, transforminal injection of triamcinolone is more effective than transforaminal injection of dexamethasone, but this apparent superiority still needs to be corroborated by improvement in function and other secondary outcomes.

References

1 Howe JF, Loeser JD, Calvin WH. Mechanosensitivity of dorsal root ganglia and chronically injured axon: A physiological basis for the radicular pain of nerve root compression. Pain 1977;3:25–41.

2 Vad VB, Bhat AL, Lutz GE, Cammisa F. Transforaminal epidural steroid injections in lumbosacral radiculopathy: A prospective randomized study. Spine 2002;27:11–6.

3 Thomas E, Cyteval C, Abiad L, et al. Efficacy of transforaminal versus interspinous corticosteroid injectionin discal radiculalgia—A prospective, randomised, double-blind study. Clin Rheumatol 2003;22:299–304.

4 Riew KD, Yin Y, Gilula L, et al. The effect of nerve-root injections on the need for operative treatment of lumbar radicular pain. A prospective, randomized, controlled, double-blind study. J Bone Joint Surg Am 2000;82-A:1589–93.

5 Buenaventura RM, Datta S, Abdi S, Smith HS. Systematic review of therapeutic lumbar transforaminal epidural steroid injections. Pain Physician 2009;12:233–51.

6 McLain RF, Kapural L, Mekhail NA. Epidural steroid therapy for back and leg pain: Mechanisms of action and efficacy. Spine J 2005;5:191–201.

7 Saal JS, Franson RC, Dobrow R, et al. High levels of inflammatory phospholipase A2 activity in lumbar disc herniations. Spine 1990;15:674–8.

8 Houten JK, Errico TJ. Paraplegia after lumbosacral nerve root block: Report of three cases. Spine J 2002;2:70–5.

9 Kennedy DJ, Dreyfuss P, Aprill CN, Bogduk N. Paraplegia following image-guided transforaminal lumbar spine epidural steroid injection: Two case reports. Pain Med 2009;10:1389–94.

10 Glaser SE, Falco F. Paraplegia following a thoracolumbar transforaminal epidural steroid injection. Pain Physician 2005;8:309–14.

11 Huntoon MA, Martin DP. Paralysis after transforaminal epidural injection and previous spinal surgery. Reg Anesth Pain Med 2004;29:494–5.

12 Benzon HT, Chew TL, McCarthy RJ, Benzon HA, Walega DR. Comparison of the particle sizes of different steroids and the effect of dilution: A review of the relative neurotoxicities of the steroids. Anesthesiology 2007;106:331–8.

13 Cole BJ, Schumacher HR Jr. Injectable corticosteroids in modern practice. J Am Acad Orthop Surg 2005;13:37–46.

14 Dreyfuss P, Baker R, Bogduk N. Comparative effectiveness of cervical transforaminal injections with particulate and nonparticulate corticosteroid preparations for cervical radicular pain. Pain Med 2006;7:237–42.

15 Lee JW, Park KW, Chung SK, et al. Cervical transforaminal epidural steroid injection for the management of cervical radiculopathy: A comparative study of particulate versus non-particulate steroids. Skeletal Radiol 2009;38:1077–82.

16 Derby R, Lee SH, Date ES, Lee JH, Lee CH. Size and aggregation of corticosteroids used for epidural injections. Pain Med 2008;9:227–34.