Transforaminal Epidural Steroid Injection for Discectomy Candidates: An Outcome Study with a Minimum of Two-Year Follow-up

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Background: The efficacy of epidural steroid injection for sciatica due to herniated disc is controversial. This study evaluates the therapeutic effect of an alternative technique that uses a modified approach of epidural steroid injection for the above mentioned disease. The aim was to determine whether this procedure can reduce the need of surgery among discectomy candidates.

Methods: Twenty-one eligible patients who had suffered from sciatica with unilateral symptoms for 2 to 24 months received injections of betamethasone in combination with xylocaine. The treatment outcome was evaluated by direct questioning and examination using the JOA score (the criteria for low back pain syndrome of Japanese Orthopaedic Association) before the procedure and at the final follow-up visit. The final analysis comprised 19 patients with a minimum of 24-month follow-up.

Results: The overall JOA score increased significantly from 14.26 $\pm$ 3.25 before injection to 23.38 $\pm$ 4.46 after injection showing improvement. In terms of subcategories, the JOA score for sciatica increased significantly from 0.69 $\pm$ 0.48 before infection to 2.13 $\pm$ 0.72 after injection and the JOA score for daily activity increased significantly from 7.44 $\pm$ 2.16 before injection to 12.19 $\pm$ 2.23 after injection). In the end, three treated patients received surgical decompression for intractable recurrent pain.

Conclusions: Transforaminal epidural steroid injection is a relatively simple, effective and low-risk alternative to surgical decompression for the treatment of lumbar disc herniation in selected cases. The procedure significantly alleviates the severity of sciatica due to a herniated disc and improves the patient's daily activity; this reduces the need for surgical decompression.

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Key words: epidural steroid injection, sciatica, lumbar disc herniation, discectomy.

Epidural steroid injection has been employed as an adjunctive treatment for sciatica for more than half a century; however, the therapeutic efficacy remains controversial.[1-8] A number of recent studies have demonstrated that fluoroscopically guided transforaminal epidural steroid injection (TFESI) is an important tool in the non-surgical management of the lumboscral radiculopathy due to a herniated

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disc.[9-14] Most of the studies suggest that TFESI has certain efficacy, but offers only short-term relief.[8,10,15]

Conventional TFESI places the needle next to the presumed affected nerve root under fluoroscopic guidance, resulting in delivery of drug to the vicinity of the inflamed nerve root.[11,16] The limitation of this approach is that the exact pathology, the herniated disc that elicits the inflammatory factors, is not targeted directly. We assumed that TFESI would be more effective if the needle could be advanced precisely onto the herniated disc and allow delivery of the medicines directly to reduce the inflammatory process and relieve the pain. This study evaluated the therapeutic effect of this alternative technique and determined whether the procedure can reduce the need for surgical intervention in patients who are candidates for surgery.

METHODS

Between April 2001 and April 2003, 21 patients who met the criteria and who were candidates for surgical intervention were enrolled in the study. All patients had clinical symptoms due to discogenic lumbar nerve root compression. The criteria included: (1) single level lumbar disc herniation visualized by computerized tomography (CT) and/or magnetic resonance imaging (MRI); (2) signs and symptoms consistent with the nerve root exiting the adjacent neural foramen, radicular leg pain and a positive straight leg raising test; (3) failure after a minimum of 8 weeks of conservative treatment; (4) no history of lumbar surgery; and, (5) hernation with the outer border of annulus fibrosus still intact (protrusive type); or, herniation with extrusion of nucleus pulposus under the longitudinal ligament, but occupying less than 50% of the spinal canal (extrusive type). Conservative treatments had included non-steroidal anti-inflammatory medication, activity modification and participating in a standard physical therapy and exercise programs. No patient had received oral steroids or epidural steroid injection before. Discectomies were indicated for all patients.

The exclusion criteria of study included: a migrated or sequestered herniation on imaging; motor deficits; cauda equina syndrome; segmental instability; medical problems that contraindicated the procedure; history of an allergic reaction to local anesthetics or corticosteroids; psychogenic disorders; workman compensation claims and/or associated tumors, malformations, deformities, posttraumatic root compression or infectious etiologies.

Each eligible patient was requested to sign an informed consent form. The study was not randomized or blinded because of legal restrictions imposed by the patient's right to know. The advantages and disadvantages of TFESI were carefully explained to the patients and their families. The mean duration of symptoms was 8 months (range, 2 to 24 months). Final examination was performed on 19 patients with a minimum of 24-month follow-up (range, 24 to 38 months); two patients were lost during follow up. A range of patient data was collected including age, gender, duration of symptoms, herniated disc level, duration of follow-up, imaging study, pre-injection and post-injection JOA scores, and final recovery rates (Table 1).

Technique

Injection together with infiltration of steroid-xylocaine mixture onto the herniated disc and along the inflamed nerve root was performed by an experienced surgeon (T.S. Fu). Access to the disc herniation site was achieved by employing a posterolateral extrapedicular approach on the symptomatic side using an 18-gauge spinal needle. This approach is similar to that used for standard lumbar discography. The patient is put in prone position on a radiolucent frame. Under fluoroscopic guidance, the target site was located and the entry site was marked on the skin at a point between 8 cm and 12 cm from the midline (Fig. 1). After sterile preparation, draping, and local anesthesia, the spinal needle was inserted directly into the triangular working zone as described by Kambin (Fig. 2).[17] Both anteroposterior and lateral fluoroscopic projections confirmed the proper needle position. Once the tip of the needle was placed on the outer surface of the annulus fibrosus, 1 ml to 2 ml of Isovist-300 (Schering AG, Berlin, Germany) was injected to visualize the posterior annular boundary and the corresponding nerve root (Fig. 3). After an adequate flow of contrast medium to the target area had occurred and no blood or cerebrospinal fluid was aspirated, 1 ml of betamethasone acetate mixed with 1ml 1% xylocaine was injected.

Evaluation of patients

Patient outcome was evaluated by direct ques-

Table 1. Patient Demographic Data

Case number	Gender	Age (years)	Duration of symptom (months)	Level	Duration of followup (months)	Imaging study	Pre-injection JOA	Post-injection JOA	Recovery rate	Back pain pre-injectionly	Back pain post-injectionly	Sciatica pre-injectionly	Sciatica post-injectionly	ADL pre-injectionly	ADL post-injectionly
1	M	72	13	Lt L4-5	38	MRI	15	27	85.70%	2	2	1	3	7	14
2	M	49	2	Lt L5-S1	26	MRI	11	23	66.70%	1	2	0	2	5	13
3	M	48	24	Lt L4-5	30	MRI	16	18	15.40%	1	1	1	1	8	10
4	M	50	3	Lt L4-5	26	MRI	16	23	53.80%	1	1	1	2	9	12
5	M	30	2	Lt L4-5	32	CT	16	26	76.90%	2	2	1	2	8	14
6	M	61	18	Rt L4-5	28*	MRI	14	28	93.30%	2	2	1	3	7	14
7	M	54	2	Rt L4-5	32*	CT	10	10+	0.00%	2	2	0	0	4	4
8	M	39	2	Rt L4-5	34	CT	10	28	94.70%	3	2	0	3	4	14
9	M	39	18	Rt L4-5	30	MRI	16	16	0.00%	2	2	1	1	9	9
10	M	31	3	Rt L4-5	32	CT	18	27	81.80%	2	2	1	2	10	14
11	M	40	5	Lt L4-5	28	MRI	16	28	92.30%	2	2	1	3	9	14
12	F	59	2	Rt L5-S1	32	CT	11	11+	0.00%	1	1	0	0	5	5
13	F	47	2	Lt L5-S1	31	MRI	18	28	90.90%	2	3	1	3	10	13
14	F	47	24	Lt L4-5	33	MRI	12	21	52.90%	1	1	0	2	7	12
15	F	58	12	Lt L4-5	31	MRI	10	23	68.40%	2	2	0	2	4	14
16	F	50	2	Rt L4-5	28*	MRI	19	19+	0.00%	2	2	1	1	10	10
17	F	60	6	Rt L4-5	24	MRI	17	19	16.70%	2	2	1	2	8	8
18	F	62	6	Rt L4-5	30	MRI	17	24	58.30%	1	2	1	2	10	12
19	F	54	6	Lt L4-5	26	MRI	9	15	30.00%	1	1	0	1	4	8

Abbreviations: JOA: The Japanese Orthopaedic Association's Evaluation System for Lower Back Pain Syndrome; ADL: activities of daily living; Rt: right; Lt: left; MRI: magnetic resonance imaging; CT: computerized tomography.

* two injections

† surgical decompression

tioning and physical examination using the JOA score criteria (the criteria for low back pain syndrome of Japanese Orthopaedic Association) before the procedure and at the final follow-up. The patients were evaluated at least every 3 months to determine whether to continue conservative treatment or switch to surgical intervention. The normal JOA score is 29 points. Results after injections were assessed according to the rate of improvement and were classified into a four-grade scale: excellent, improvement of 90%; good, 75-89% improvement; fair, 50-74%; and poor, below 49%. Patients who underwent discectomy during the follow-up period were defined as having a poor outcome.

Overall outcomes were assessed and differences between preoperative symptoms and postoperative outcomes were statistically analyzed. The differences in the JOA score for the whole patient group were assessed using a Student's paired *t*-test that compared before treatment with the situation at final follow-up. A value of a $p < 0.05$ was considered statistically significant.

RESULTS

The pre-injection JOA score increased significantly from 14.26 ± 3.25 before treatment to 23.38 ± 4.46 at follow-up ($p < 0.001$) (Table 2). No complications such as dural puncture, excessive bleeding, headache or infection occurred. Three patients received 2 injections and 2 patients finally underwent surgery for persistent radiculopathy.

The overall clinical outcome was excellent in four patients (21.1%), good in 3 patients (15.8%), fair in five patients (26.2%), and poor in seven patients (36.9%). Among the seven patients who had poor outcomes, the intensity of sciatica decreased in two patients and it was suggested that the other five patients underwent surgery. Finally, three patients underwent surgical decompression for intractable recurrent pain. The other two patients reported that they could tolerate residual discomfort and received follow-up at an outpatient clinic.

No statistically significant difference for back pain score ($p = 0.33$) was identified comparing

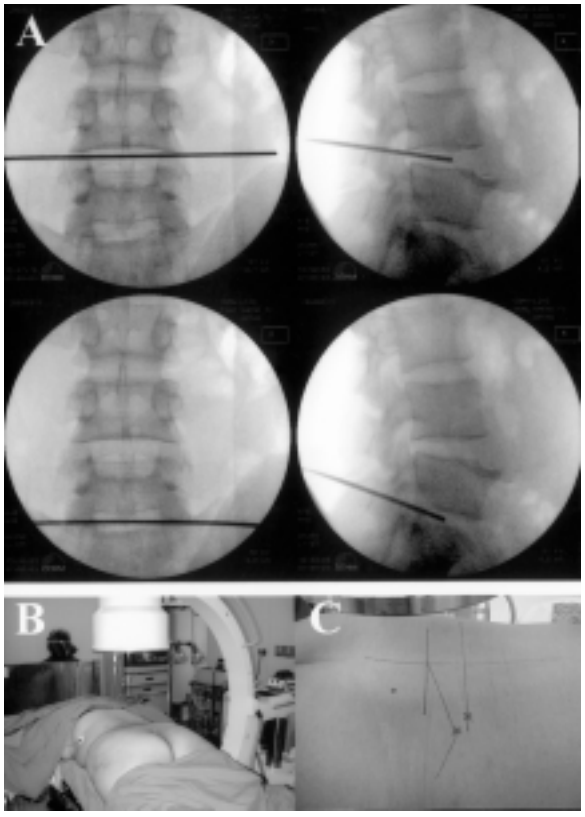

Fig. 1 (A) Anteroposterior and lateral fluoroscopy to mark the target site and the entry point at the L4-5 and L5-S1 disc levels; (B) Patient position during the procedure; (C) The target site and the entry site marked on the skin at a point between 8 and 12 cm from the midline.

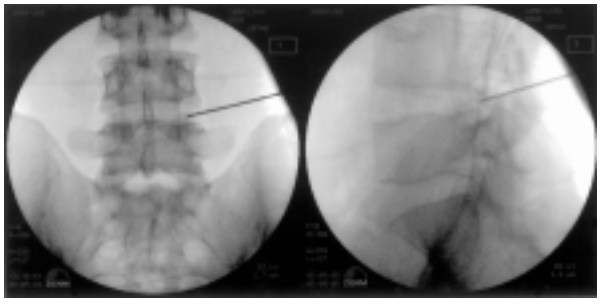

Fig. 2 An 18-gauge spinal needle was introduced directly into the triangular working zone.

before and after injection. The leg pain score increased significantly from 0.69 ± 0.48 before injection to 2.13 ± 0.72 after injection ($p < 0.001$). The daily living activity score also increased significantly from 7.44 ± 2.16 before injection to 12.19 ± 2.23 after injection ($p < 0.001$) (Table 2).

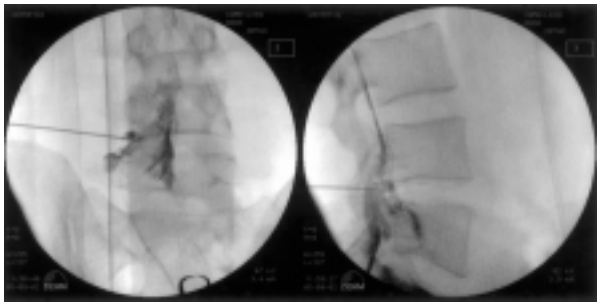

Fig. 3 Once the tip of the needle was placed on the outer surface of the annulus fibrosus, contrast medium was injected to visualize the posterior annular boundary and the corresponding nerve root.

Table 2. Comparison of JOA Score for the Subsets of Back Pain, Sciatica, and Daily Living Activities, Before and After Injection

Score	Before injection	After injection	*p*
JOA	14.26 ± 3.25	23.38 ± 4.46	< 0.001
Back pain	1.69 ± 0.60	1.81 ± 0.54`	0.33
Sciatica	0.69 ± 0.48	2.13 ± 0.72	< 0.001
ADL	7.44 ± 2.16	12.19 ± 2.23	< 0.001

Abbreviations: JOA: The Japanese Orthopaedic Association's Evaluation System for Lower Back Pain Syndrome; ADL: activities of daily living.

DISCUSSION

Surgical decompression is a well-established acceptable procedure for lumbar disc herniation after failed conservative treatment.[2,18,19] However, this procedure still entails high cost to the society and poses significant risks to the patient. With this modified injection technique and the aid of an advanced image tool, a herniated disc can be targeted precisely and a reduction in root inflammation can be achieved. This study revealed that epidural steroid injection over the herniated disc decreased the need for surgical intervention in 14 patients (73.7%) who were discectomy candidates. We suggest that before surgical decompression, TFESI can be an alternative when conservative treatment has failed.

Inflammation of the herniated disc tissue may be induced by direct chemical irritation of the nucleus pulposus, or may be secondary due to an autoimmune response to the nucleus prolposus by the surrounding tissue.[20-23] The potent anti-inflammatory properties of steroids are the presumed mechanism of

action in this procedure and have been well discussed in literature.[7,14] The injection method proposed in this study allows for precise delivery of the medicines to the exact pathology, approaching the interface between the herniated disc and the ventral aspect of the irritated nerve root. The injected drugs were infiltrated outward. Both the steroid and xylocaine solution have nociceptive and nerve membrane stabilizing properties; this is in addition to the solution's washout effect, which will decrease regional levels of inflammation mediators.[14,23] The direct effects of the technique could explain why the majority of patients who experienced excellent or good results had received only one injection (Fig. 4).

Analyses of the results for each criterion of the JOA evaluation system indicated that low back pain was not significantly improved after the treatment with TFESI. However, the score for sciatica and activities of daily living improved significantly. The therapeutic role of TFESI for sciatica and activities of daily living was of considerably more value the effect of back pain. In patients with intervertebral disc herniation, sciatica is the principal complaint and the cause of a need for surgical intervention. If pain can be reduced, patients might feel that they have enough control over any residual discomfort and thus an operation is avoided

A substantial proportion of intervertebral disc herniations have the potential to resolve spontaneously.[18] The patient's symptoms may improve along with the reduction in the size of the herniated disc. Although the mechanical effect of the herniated disc cannot be resolved by TFESI, patients may benefit from a slow regression of disc herniation after epidural steroid injections.[24] At least 12 (63.2%) patients who received injections had symptoms relief

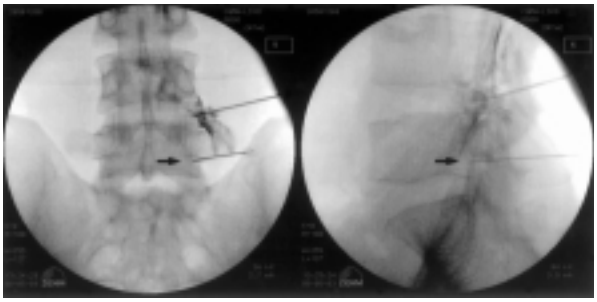

Fig. 4 These photographs showed a comparison of the needle position in a conventional transforaminal selective nerve block (arrow) and the modified TFESI technique.

in this study during 24-month follow-up. The absence of complications, such as dural puncture and excessive bleeding, verify the safety of the fluoroscopic transforaminal approach.

There are several limitations in this study. The patients eligible for enrollment in the study may have disproportionately refused surgery. The enrolled patients were screened by strict criteria and were self-selected. These patients may have expected an acceptable outcome by non-surgical treatment. Most patients with sciatica do not have constant intractable pain, but rather intermittent or varying degrees of pain and may experience sporadic intolerable pain while performing daily activities. This new alternative, in addition to existing treatment regimens, may be helpful in pain control and reduce the necessity of surgery. Furthermore, there were strict entry criteria for the enrolled patients in that they had disc herniation only and this may have led to a better outcome than that for other degenerated disorders with complications.

In conclusion, TFESI is a relatively simple, effective and low-risk alternative to surgical decompression when treating lumbar disc herniations in selected cases. The procedure significantly alleviated the symptoms of sciatica, improved patient's daily activity and reduced the need for surgical decompression. Based on the results of this study, we recommend that TFESI should be considered before surgical intervention for lumbar disc herniation.

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對預定椎間盤切除之病患施行經椎間孔硬腦膜上類固醇注射：至少兩年追蹤的結果研究

楊士階 傅再生 賴伯亮 牛自健 陳力輝 陳文哲

背 景： 以經椎間孔硬腦膜上類固醇注射來治療因椎間盤突出所造成的坐骨神經痛，仍有爭論。我們報告一種經過改良的經椎間孔硬腦膜上類固醇注射技術，並且評估其是否有降低外科椎間盤切除手術的效果。

方 法： 21 位有單側坐骨神經痛的患者接受 betamethasone-xylocaine 的注射治療，我們以日本骨科醫學會低背疼痛症候群之要件 (JOA) 評分表來檢查並記錄治療前後患者的情形，最後共有 19 位患者接受 24 個月以上的追蹤分析。

結 果： JOA 評分表的分數從注射前的 14.26 ± 3.25，增加到注射後的 23.38 ± 4.46（*p* 值小於 0.001）。其中關於坐骨神經痛的項目，從 0.69 ± 0.48 增加到 2.13 ± 0.72（*p* 值小於 0.001），關於日常生活活動的項目，從 7.44 ± 2.16 增加到 12.19 ± 2.23（*p* 值小於 0.001），最後只有 3 個患者接受椎間盤切除的減壓手術。

結 論： 經椎間孔硬腦膜上類固醇注射相較於椎間盤切除手術，是一項簡單、有效、及低風險的技術。它可以減輕坐骨神經痛的症狀，改善患者的生活品質，並且降低外科手術的必要性。

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關鍵字： 經椎間孔硬腦膜上類固醇注射，坐骨神經痛，腰椎間盤突出症，椎間盤切除手術。

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