TREATMENT OF LUMBAR DISC HERNIATION: EPIDURAL STEROID INJECTION COMPARED WITH DISCECTOMY

A PROSPECTIVE, RANDOMIZED STUDY

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Background: Epidural steroid injection is a low-risk alternative to surgical intervention in the treatment of lumbar disc herniation. The objective of this study was to determine the efficacy of epidural steroid injection in the treatment of patients with a large, symptomatic lumbar herniated nucleus pulposus who are surgical candidates.

Methods: One hundred and sixty-nine patients with a large herniation of the lumbar nucleus pulposus (a herniation of >25% of the cross-sectional area of the spinal canal) were followed over a three-year period. One hundred patients who had no improvement after a minimum of six weeks of noninvasive treatment were enrolled in a prospective, nonblinded study and were randomly assigned to receive either epidural steroid injection or discectomy. Evaluation was performed with the use of outcomes scales and neurological examination.

Results: Patients who had undergone discectomy had the most rapid decrease in symptoms, with 92% to 98% of the patients reporting that the treatment had been successful over the various follow-up periods. Only 42% to 56% of the fifty patients who had undergone the epidural steroid injection reported that the treatment had been effective. Those who did not obtain relief from the injection had a subsequent discectomy, and their outcomes did not appear to have been adversely affected by the delay in surgery resulting from the trial of epidural steroid injection.

Conclusions: Epidural steroid injection was not as effective as discectomy with regard to reducing symptoms and disability associated with a large herniation of the lumbar disc. However, epidural steroid injection did have a role: it was found to be effective for up to three years by nearly one-half of the patients who had not had improvement with six or more weeks of noninvasive care.

Level of Evidence: Therapeutic study, Level I-1a (randomized controlled trial [significant difference]). See Instructions to Authors for a complete description of levels of evidence.

The treatment of lumbar disc herniation remains controversial. Although, in some studies, lumbar discectomy for the treatment of large disc herniations accompanied by severe symptoms was found to produce excellent short-term results[1], other researchers have found less optimal results, a disparity that may be related to patient selection[2]. Epidural steroid injection is a low-risk alternative to surgical intervention in some patients for whom noninvasive treatment has failed[3,4]. It has been advocated because it modulates the body's response to inflammatory stimuli, such as those related to a disc herniation[5-8]. Epidural steroid injection has been found to be beneficial in animal models[9], but its clinical efficacy for the treatment of lumbar disc herniation has not been proven, to my knowledge[10,11]. Furthermore, as far as I know, it has not been determined whether epidural steroids have an effect on various factors related to a disc herniation, such as the duration of pain, weakness, and sensory deficits and the size of the herniation. If one could identify which patients are likely to respond to an epidural steroid injection, the cost associated with the treatment would probably be decreased.

The purpose of this prospective study was to compare the results of epidural steroid injection with those of discectomy in patients with a lumbar disc herniation encompassing >25% of the cross-sectional area of the spinal canal and who

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had continuous, disabling symptoms after six or more weeks of noninvasive treatment. The criterion for the size of the herniation was selected because a prior study had suggested that patients with disc herniation encompassing <25% of the cross-sectional area of the spinal canal typically could be treated nonoperatively[12].

Materials and Methods

One hundred and sixty-nine patients who were referred to me for treatment of a lumbar disc herniation that encompassed >25% of the cross-sectional area of the spinal canal (as determined on axial magnetic resonance or computed tomography images) were prospectively followed over a three-year period from September 1995 to September 1998. This group did not include patients who were younger than eighteen years of age or older than seventy years of age; were pregnant; or had cauda equina syndrome, a pars defect at the level of the disc herniation, a far-lateral disc herniation, multilevel symptomatic disc herniations, or a recurrent disc herniation. Also, it did not include sixteen patients who were seen during the study period but had an exceptional case or refused to participate in the study. Two of those sixteen patients had a true cauda equina syndrome and underwent emergent discectomy. One had recovery of bowel and bladder function and nearly complete resolution of the lower-extremity neurological deficit. The other had partial recovery of bowel, bladder, and lower-extremity function. Two other patients had saddle anesthesia in addition to lower-extremity neurological deficits (impending cauda equina syndrome) and underwent urgent discectomy. These four patients all had massive disc herniation, and thus, although they met the radiographic criteria for inclusion in the study, they underwent early discectomy and were not part of the randomized, prospective trial comparing epidural steroid injection with discectomy. Twelve additional patients who were eligible on the basis of radiographic criteria at presentation declined to participate in the study. They elected not to wait six weeks before invasive treatment or not to have randomized treatment; eight of the twelve went elsewhere for treatment.

All other patients met the inclusion criteria and were asked to participate in this study. Institutional review board approval and consent from all patients were obtained. Patients were prospectively followed and if their condition did not improve with noninvasive treatment (physical therapy, chiropractic treatment, rest, and/or pain medication) after six weeks, they were randomly assigned (by computer) to one of two treatment groups: epidural steroid injection or discectomy. Patients were enrolled until there were fifty participants in each treatment arm. During the study period, sixty-nine patients who met the criterion for the size of the disc herniation obtained improvement during the first six weeks of noninvasive treatment.

Two patients, after consenting to be part of the group to be treated with epidural steroid injection, decided to proceed with a discectomy. In addition, two patients who had been initially assigned to the discectomy group elected to undergo epidural steroid injection and were thus placed in that group. The results of the statistical analysis of the fifty patients in each group were not different from those of the analysis of the intention-to-treat groups of forty-eight patients each.

The epidural steroid injections were performed by either a radiologist or an anesthesiologist, who administered as many as three injections one week apart. If a patient subjectively reported a decrease in pain within one week after a single injection, no more injections were administered. If the patient did not have improvement within a week, a second (or third) injection was performed. All injections were performed at one level cephalad to the disc herniation, with the needle placed between the laminae; thirty-eight (76%) of the fifty patients were given the injection under fluoroscopic guidance. The dose of the corticosteroid (betamethasone) was 10 to 15 mg.

I performed all of the discectomies. The duration of hospitalization for the discectomy group averaged less than twenty-four hours (range, less than one to three days). All patients in whom the epidural steroid injection failed were subsequently treated with a discectomy, and those twenty-seven patients constituted the crossover group. The decision to proceed with discectomy in the crossover group was made by the patient.

The demographic and radiographic characteristics of the epidural steroid injection, discectomy, and crossover groups were similar (see Appendix). The mean ages were forty-one, forty, and thirty-nine years old, respectively; the mean durations of symptoms were 3.3, 3.8, and 4.5 months; the percentages of smokers were 30%, 36%, and 33%; and the mean sizes of the disc herniations were 42%, 43%, and 41% of the axial cross section of the spinal canal. All but five disc herniations occurred at the L4 or L5 level.

All patients in each of the three groups were prospectively assessed with an examination and a questionnaire. I performed a neurological examination, which included documentation of motor strength on a scale of 0 to 5 (with 5 indicating normal strength), at each clinical encounter. The self-assessment questionnaire, which has been previously described[13], is reliable and valid. It included a visual analog scale of 0 to 10 for assessment of current back and lower-extremity pain. A pain drawing was used to indicate the distribution of the pain (with a high score representing a greater area of bodily pain), and an Oswestry Disability Scale was employed to quantitate the level of function (on a 0 to 100-point scale, in which a higher score represented greater disability). With the numbers available, the initial questionnaire scores did not differ significantly among the groups, and no significant differences were noted between the group treated with epidural steroid injection and the discectomy group with regard to the initial distribution of the neurological deficits ($p > 0.05$) for motor, sensory, deep tendon reflex, and nerve root tension sign (Table I). The patients also indicated the types of pain medication that they used and the frequency with which they used it, provided a self-assessment of the treatment success, stated whether they would undergo the treatment again under similar circumstances, and indicated whether they would recommend the treatment to others with a similar condition.

The questionnaire and examination were completed at

TABLE I Findings of the Neurological Examination at Presentation and the Two to Three-Year Follow-up Interval*

	Study Group†		
	Epidural Steroid Injection	Discectomy	Crossover
Motor deficit			
At presentation	82	88	78
At follow-up	9	4	11
Sensory deficit			
At presentation	70	74	59
At follow-up	9	20	11
Reflex deficit			
At presentation	54	56	52
At follow-up	14	17	22
Root tension sign			
At presentation	82	84	81
At follow-up	0	0	0
Normal neurological findings			
At presentation	0	0	0
At follow-up	74	68	63

*The severity of the deficits is not indicated. The severity of the motor deficits is described in text. The subjective severity of the sensory deficits routinely decreased. †The values are given as the percentage of patients.

presentation and at every subsequent clinical visit, and additional surveys were completed by mail. Follow-up was carried out at one to three months after treatment, at four to six months, at seven to twelve months, at one to two years, and at two to three years. Only three patients were not assessed at the final three-year follow-up interval: two patients in the discectomy group and one patient in the crossover group were lost to follow-up at two years. Only one patient, who had been treated with the epidural steroid injection, did not have a final follow-up neurological examination.

The size of the disc herniation was determined in all 169 patients (including those who had improvement within the first six weeks) on axial images of the affected level: 145 magnetic resonance images and thirty computed tomography scans were assessed, with six patients having both types of scans. The digital images were examined to determine the ratio of the area of

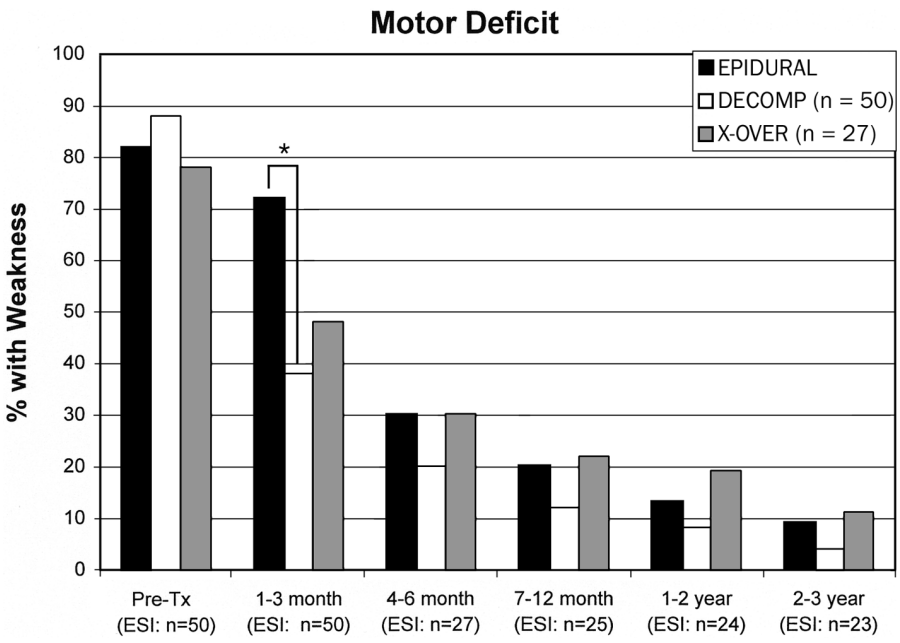

Fig. 1

The rates of neurological motor deficits before treatment (Pre-Tx) and at the various follow-up intervals. (The severity of the deficits is not shown.) EPIDURAL and ESI = group treated with epidural steroid injection, DECOMP = discectomy group, and X-OVER = crossover group. An asterisk indicates a significant difference between groups ($p < 0.05$).

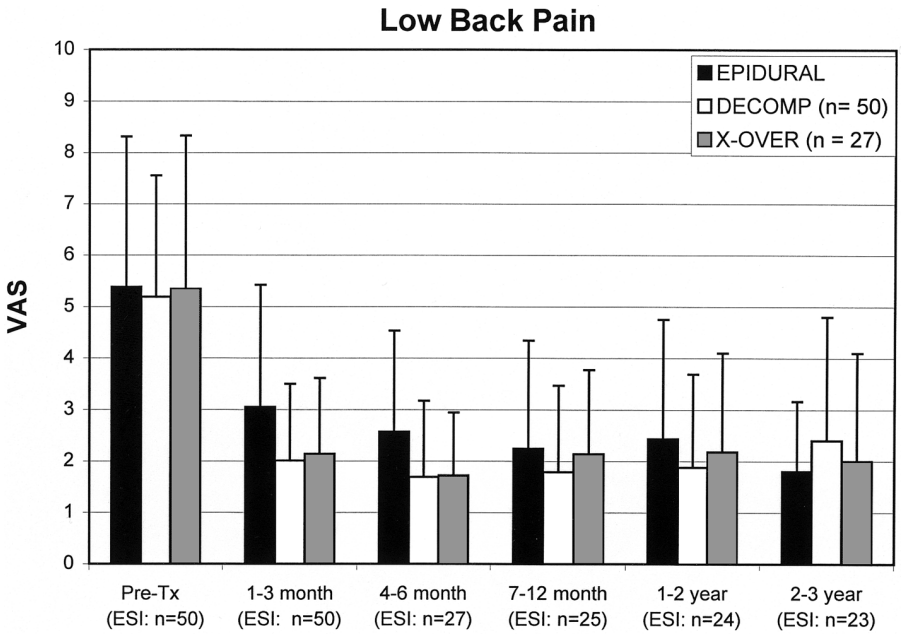

Fig. 2-A
The scores for severity of back pain, as measured on a visual analog scale (VAS), before treatment (Pre-Tx) and at the various follow-up intervals. EPIDURAL and ESI = group treated with epidural steroid injection, DECOMP = discectomy group, and X-OVER = crossover group.

the disc herniation to the area of the spinal canal[13]. Other radiographic parameters that were analyzed were the presence of lateral recess stenosis (none was severe) at the level of the disc herniation, inflammatory end-plate (Modic type-I[14]) changes, the total number of lumbar levels with disc degeneration, and the relative degree of hydration of the herniated disc on T2-weighted magnetic resonance images.

Statistical Methods

Statistical analysis was performed with use of univariate chi-square analyses of all relevant pairs of variables, analysis of variance, and the Student t test for the scores on the visual analog, pain-drawing, and Oswestry Disability scales. The change in the use of pain medication was analyzed with the Fisher exact test. Comparisons of disc hydration on magnetic resonance images were performed with the exact Wilcoxon test. Intention-to-treat analysis was also performed, and no appreciable differences were found. A p value of <0.05 was considered significant.

Results

The crossover group consisted of twenty-seven patients who considered the treatment with the epidural steroid injection a failure and had a subsequent discectomy. Continued pain was the predominant reason mentioned by the pa-

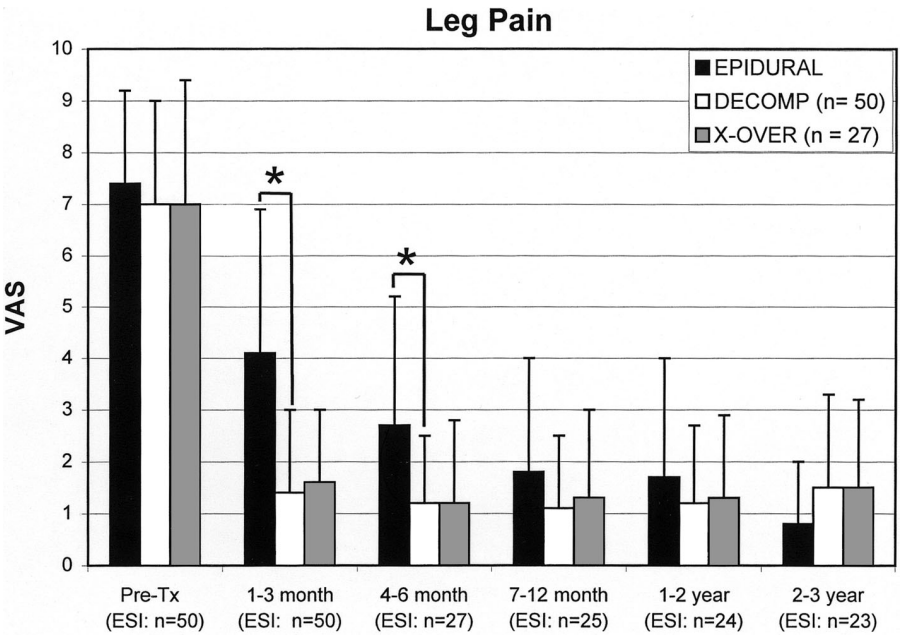

Fig. 2-B
The scores for severity of lower-extremity pain, as measured on a visual analog scale (VAS), before treatment (Pre-Tx) and at the various follow-up intervals. EPIDURAL and ESI = group treated with epidural steroid injection, DECOMP = discectomy group, and X-OVER = crossover group. An asterisk indicates a significant difference between groups ($p < 0.05$).

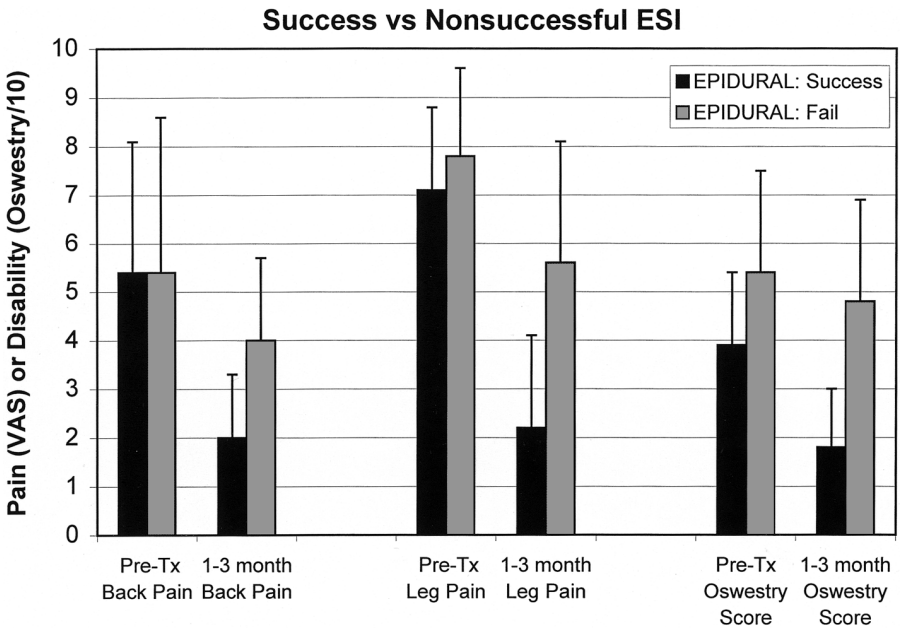

Fig. 3

The scores for severity of back and lower-extremity pain, as measured on a visual analog scale (VAS), and the degree of disability, according to the Oswestry Disability Scale, before treatment (Pre-Tx) and at the early follow-up interval for patients who had a successful epidural steroid injection (EPIDURAL: Success) compared with those in whom it failed (EPIDURAL: Fail). All follow-up values were significantly improved, but the patients with a successful injection had significantly greater improvement on all scales ($p < 0.002$).

tients for the failure of the injection; however, six of the twenty-seven patients stated that a persistent neurological deficit in the form of either weakness or a sensory deficit was also an important factor in their decision to proceed with the discectomy. The average time from the onset of symptoms to the epidural steroid injection in the crossover group was 3.3 months, and the average time from the onset of symptoms to the discectomy was 4.5 months. The time period between the failure of the epidural steroid injection and the discectomy ranged from one to thirteen months.

Neurological function at the time of presentation and at the final follow-up examination is summarized in Table I. The discectomy group had earlier motor recovery than did the group treated with the epidural steroid injection—i.e., significantly fewer patients in the discectomy group still had a motor deficit at one to three months following treatment ($p = 0.001$; Fig. 1). However, at the two to three-year follow-up point, there was no significant difference between the two groups with regard to the percentage of patients who still had weakness ($p = 0.201$). At the time of presentation, six patients—three in the discectomy group and three in the injection group—exhibited a profound motor weakness (less than grade 3, with 5 being the highest grade possible). Two of the three patients in the discectomy group had full recovery of motor strength and the other patient had mild weakness (grade-4 strength) at the time of final follow-up. In the injection group, two of the three patients with profound weakness subsequently underwent discectomy (became part of the crossover group); one had the discectomy at two months and the other, at nine months. One of those two patients had full recovery of grade-5 strength, and the other had improvement to grade-4 strength. The third patient in the injection group who had profound weakness did not undergo discectomy; that patient also demonstrated a peroneal nerve deficit on electromyography in addition to an L5 radiculopathy and had only minimal recovery at the time of final follow-up.

The responses to the questionnaire demonstrated a significant decrease in both back and lower-extremity pain, compared with the baseline, in all groups at all follow-up periods ($p < 0.0001$). The decrease in lower-extremity pain in the discectomy group was significantly greater than that in the group treated with the epidural steroid injection at the one to three-month and the four to six-month follow-up intervals ($p < 0.0001$ and $p = 0.03$, respectively; Figs. 2-A and 2-B). However, the decrease in pain in the patients who had a successful epidural steroid injection was similar to that in the discectomy group in the early follow-up period (Fig. 3).

The size of the painful area, as measured on the pain drawing, was significantly decreased, compared with the baseline, in each group at all follow-up periods ($p < 0.0001$). The only difference among the groups with regard to the degree of improvement was that the discectomy group had a greater decrease in the painful area than did the injection group at the one to three-month follow-up examination ($p < 0.0001$; Fig. 4). However, the patients who had a successful epidural steroid injection had the same decrease in the painful area in the early follow-up period as did the discectomy group.

Function, as assessed with the Oswestry Disability Scale, also improved significantly, compared with the baseline, in all groups at all follow-up periods ($p < 0.0001$). The only difference among the groups with regard to the degree of improvement was that the discectomy group had a greater decrease in disability than did the injection group at the one to three-month follow-up evaluation ($p = 0.015$; Fig. 5). However, those with a successful epidural steroid injection had the same decrease in disability in the early follow-up period as did the discectomy group (Fig. 3).

Comparison of the patients in the discectomy group and those in the subgroup that had a successful epidural steroid

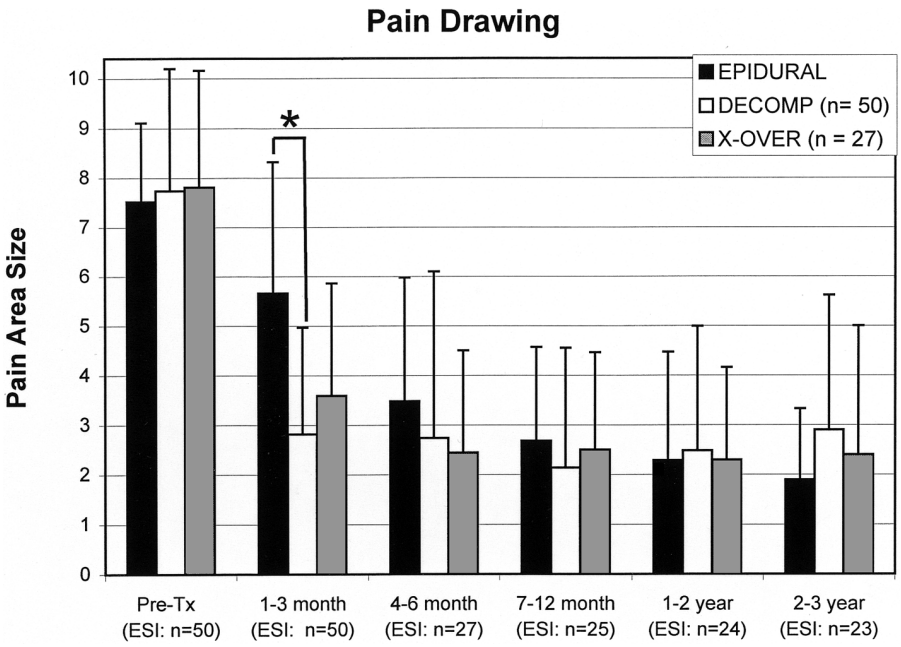

Fig. 4

The scores for the size of the painful area as indicated on the pain drawing before treatment (Pre-Tx) and at the various follow-up intervals. EPIDURAL and ESI = group treated with epidural steroid injection, DECOMP = discectomy group, and X-OVER = crossover group. An asterisk indicates a significant difference between groups ($p < 0.05$).

injection (the twenty-three patients who did not undergo discectomy) revealed no significant difference in the outcome scores for back or lower-extremity pain as measured on the visual analog scale, for the size of the painful area as indicated on the pain drawing, or on the Oswestry Disability Scale ($p > 0.23$ for all scales). At the early follow-up interval (one to three months), the patients with a successful epidural steroid injection had the same relatively rapid decrease in pain as was seen in the discectomy group (Fig. 3).

The use of pain medication decreased after treatment in all three study groups (Table II). Approximately one-half of the patients in the injection group were using the same amount of pain medication before and after the injections, and the vast majority of those patients subsequently underwent discectomy (became part of the crossover group). At the early, one to three-month follow-up point, the reduction in the use of pain medication was significantly greater in the discectomy group than it was in the injection group ($p < 0.001$).

The percentage of patients who considered their treatment to have been successful was highest in the discectomy group, with a range of 92% to 98% during the various follow-up periods. The success rates in the crossover group ranged from 82% to 93%, and 42% to 56% of the original fifty patients who had received an epidural steroid injection consid-

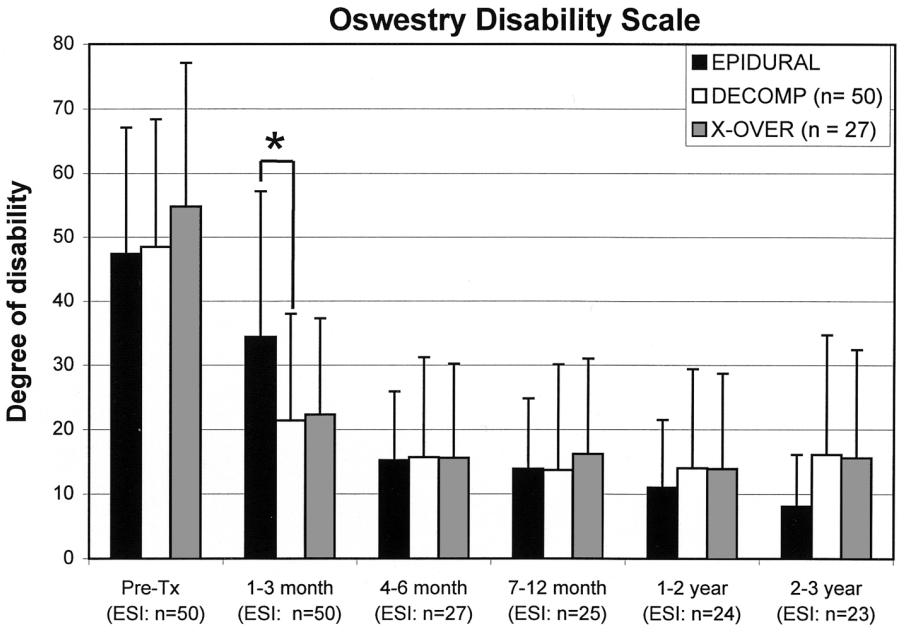

Fig. 5

The degree of disability, according to the Oswestry Disability Scale, before treatment (Pre-Tx) and at the various follow-up intervals. EPIDURAL and ESI = group treated with epidural steroid injection, DECOMP = discectomy group, and X-OVER = crossover group. An asterisk indicates a significant difference between groups ($p < 0.05$).

TABLE II Change in Usage of Pain Medication

	Study Group			
	Epidural Steroid Injection	Discectomy	Crossover	Epidural Steroid Injection Compared with Discectomy
At presentation				
No. of patients	50	50	27	
Using narcotic pain medication*	52	44	44	p = 0.548
At 1-3 mo after treatment				
No. of patients	50	50	27	
Using narcotic pain medication*	24	14	15	p = 0.308
Not using pain medication*	18	48	30	p = 0.003
Change in medication use*				p < 0.001
Much less	16	24	19	
Less	34	66	77	
Same	48	6	4	
More	2	4	0	
Much more	0	0	0	
At 2-3 yr after treatment				
No. of patients	23†	47†	27	
Using narcotic pain medication*	0	2	7	p = 1.000
Not using pain medication*	57	53	65	p = 0.994
Change in medication use*				p = 0.121
Much less	57	32	31	
Less	39	64	65	
Same	4	4	4	
More	0	0	0	
Much more	0	0	0	

*The values are given as the percentage of patients. †Twenty-three patients remained in the epidural steroid injection group after twenty-seven dropped out and became part of the crossover group. ‡Forty-seven patients remained in the discectomy group after one had a fusion and two were lost to final follow-up.

ered it to have been successful. No further treatment was required for the patients who considered the epidural steroid injection to have been successful, except for two who, despite a reduction in pain, had a continued neurological deficit and desired surgery (placing them in the crossover group). The percentages of patients who responded that they would have the treatment again under similar circumstances or that they would recommend it to others were similar in the discectomy and crossover groups (range, 86% to 96% during the various follow-up periods). The percentages ranged from 42% to 66% in the group treated with epidural steroid injection.

Analysis of various radiographic parameters revealed that the presence of lateral recess stenosis at the level of the disc herniation had no appreciable effect on outcome scores in any group or in all groups combined. Patients with multiple levels of lumbar disc degeneration had slightly lower scores for back and lower-extremity pain on the visual analog scale, compared with those with only one level of degeneration (at the level of the disc herniation), at the follow-up examinations performed more than three to six months after treatment ($p = 0.03$), and they had a greater mean age (forty-two compared with thirty-six years; $p = 0.001$). At follow-up points subsequent to the one to three-month interval, patients in the discectomy group who did not have Modic-type-I inflammatory end-plate changes on magnetic resonance images demonstrated significantly greater decrease in back and lower-extremity pain on the visual analog scale than did patients who did have such changes ($p < 0.005$ and $p < 0.03$, respectively).

The numbers of patients with a sequestered or extruded disc varied among the study groups (see Appendix). The sixty-nine patients who had improvement with six weeks of non-invasive treatment had the highest rate of sequestered and extruded herniated discs (54%; thirty-seven patients). The 100 patients with persistent symptoms (the discectomy and epidural steroid injection groups) had a combined rate of sequestered and extruded discs of 37% (thirty-seven patients). Patients in whom the epidural steroid injection failed (the crossover group) had the lowest rate (26%; seven patients); however, because of the small number of patients, the difference was not significant ($p = 0.41$). Evaluation of the relative

hydration of the herniated disc, as assessed on the T2-weighted magnetic resonance images, revealed similar findings. Fifty-two percent (thirty-six patients) who had improvement with six weeks of noninvasive treatment had a high or moderately high signal in the herniated disc on T2-weighted magnetic resonance images; this rate was significantly higher than that in the other groups ($p = 0.001$), and the rate was lowest in the crossover group (7%; two patients).

The patients who had a successful epidural steroid injection tended to be older than those for whom the injection failed (mean age, forty-four compared with thirty-nine years; $p = 0.12$); they were also twice as likely to have an extruded or sequestered disc (57% compared with 26%, $p = 0.036$), were more likely to have a hydrated herniated disc (a high signal on the T2-weighted magnetic resonance image, $p = 0.0075$), and had less disability at the time of presentation (Oswestry score, 39 compared with 55 points; $p = 0.003$). With the numbers available, there were no differences between the patients who had a successful and a failed epidural steroid injection with regard to the average size of the disc herniation, level of disc herniation, number of lumbar levels with degeneration, presence of inflammatory end-plate changes on magnetic resonance images, occupation of the patient, duration of symptoms prior to the epidural steroid injection, percentage of smokers, percentage of patients involved in Workers' Compensation claims or litigation, back or lower-extremity pain score on the visual analog scale at presentation, or pain-drawing score at presentation.

Complications and reoperations were recorded for all groups. Of the fifty patients treated with the epidural steroid injection, two had an incidental dural puncture. Three patients had recurrent disc herniation at the same level, which was indicated by recurrence of symptoms and repeat (third) magnetic resonance images demonstrating a larger disc herniation at the site at which previous follow-up magnetic resonance images had shown regression of the original herniation. These repeat herniations occurred at eight, ten, and forty-four months after the initial disc herniation. Two of these patients subsequently had a discectomy (became part of the crossover group). Of the seventy-seven patients who underwent discectomy (the discectomy and crossover groups), two (3%) had incidental durotomies. A seroma developed in one patient and was treated with oral antibiotics. There were no deep infections. There were four recurrent disc herniations (5%), all of which were treated with revision discectomy. Persistent severe low-back pain (a score of >5 on the visual analog scale) was identified in five patients in the discectomy group and in two patients in the crossover group. Two patients in the discectomy group had a spinal arthrodesis at one and three years after the discectomy, and three others were contemplating fusion surgery to relieve disabling low-back pain. One patient in the crossover group had a new disc herniation at another level.

Discussion

A number of studies have compared epidural steroid injections with control injections for the nonoperative treatment of lumbar disc herniation. Some investigations, including a number of randomized, prospective, and blinded studies in which patients were followed for periods ranging from weeks to one year[15-19], showed epidural steroid injection to be beneficial. However, other comparative randomized and prospective studies of epidural steroid injection demonstrated no substantial effect on the clinical outcome[20-24]. A common problem with many of the preceding studies is that the entry criteria usually consisted of subjective findings; rarely were findings on imaging studies used in conjunction with symptoms and signs as entry criteria. The discrepancies among the preceding studies may also be related to the timing of the epidural steroid injection; the injection may have little beneficial effect in the first few weeks after the onset of symptoms since many patients have spontaneous improvement (along with a decrease in the size of the disc herniation)[13,25-31]. If one can identify the patients who have not had improvement in the first few weeks, then epidural steroid injection may have a better-defined role.

Although there have been studies of the effect of epidural steroid injection on nonoperatively treated patients, to my knowledge no one has previously determined whether epidural steroids can be used as an alternative to surgery. In the present prospective, randomized study, I compared the effects of epidural steroid injection with those of discectomy in patients who fulfilled strict study entry criteria and who were experiencing severe symptoms despite an average of more than three months of noninvasive treatment. The present study differs from many earlier studies in that the entry criteria included the morphology of the disc herniation in addition to clinical signs and symptoms. The study did have limitations, particularly because the injections were not completely standardized (the steroid dose and the use of fluoroscopy varied), and the types of noninvasive management varied among the treating therapists. This reflected restrictions by third-party payers in this community-based study, which required patients to have the epidural steroid injection and therapy performed by different practitioners.

Because most of the patients were referred, this study does not truly define the natural history of disc herniation. However, it does support the notion that a minimum of six weeks of noninvasive treatment is reasonable prior to invasive treatment. In fact, a study involving follow-up magnetic resonance imaging of patients who had improvement within six weeks demonstrated a substantial decrease in the size of the disc herniations[13]. In the present study, the total number of patients who did not undergo discectomy was ninety-two (sixty-nine who had improvement within six weeks without invasive treatment and twenty-three who had a successful epidural steroid injection), and the total number in whom the epidural steroid injection failed was twenty-seven. Because the treatment with epidural steroid injection or discectomy was randomly assigned, it can be assumed that the same percentage of patients would have responded to epidural steroid injection in the discectomy group. Thus, the rate of failure of nonoperative treatment during the course of the present study was 31%, which is similar to the 26% rate predicted in a previous report[24].

The present study supports the use of epidural steroid injection in patients with continued severe symptoms after six weeks of noninvasive treatment because nearly one-half of the patients who received such an injection had a fairly rapid decrease in the symptoms. The degree of improvement was similar to that for patients who underwent discectomy. The patients in whom the epidural steroid injection failed and who subsequently underwent discectomy (the crossover group) had the same degree of improvement on all outcome scales as did both the discectomy group and the patients with a successful epidural steroid injection. On the average, the patients in the crossover group received their surgical treatment more than one month later than did those in the discectomy group; however, this delay did not appear to adversely affect the outcome.

Neurological findings at the final follow-up evaluation were similar among the three treatment groups (Table I, Fig. 1). In the discectomy group, two (4%) of the fifty patients still had mild (grade-4) muscle weakness. This result compares favorably with those in prior studies, in which a residual motor deficit was found in approximately 30% of patients (twenty-eight of 116 and twenty-five of seventy-eight) and, as was the case in the present study, was more common in patients in whom the weakness was more severe initially[32,33]. Ten patients (20%) treated with discectomy had mild residual altered sensation, which is a somewhat higher rate than that noted in previous reports[34,35]. In the present study, 56% (twenty-eight) of the patients in the discectomy group had a loss of deep-tendon reflexes, and it was persistent in eight (16%); however, nerve-root-tension signs resolved in all patients.

A comparison between the epidural steroid injection, discectomy, and crossover groups suggests that delaying surgical treatment after an initial trial of epidural steroid injection has no significant effect on the final neurological deficits ($p = 0.201$). In other words, this study failed to show, with the number of patients available, that a delay in decompression due to an initial trial of epidural steroid injection was detrimental to neurological recovery at the time of follow-up. Recent studies of patients with a nonoperatively treated disc herniation also showed neurological improvement with regard to motor, sensory, and reflex changes, although up to one-half of the patients who presented with sensory or reflex changes still had some abnormalities at one year[36,37].

In this study, I sought to determine whether epidural steroid injection in selected patients reduces the need for surgical intervention and whether it increases or accelerates pain relief in patients who would eventually have improvement anyway (but in a delayed fashion). Characteristics of the patients who had a successful response to epidural steroid injection were identified. Clinically, these included less severe disability, as demonstrated by the Oswestry Disability Score, at presentation and a somewhat older age. Findings on magnetic resonance images were partially predictive in that successfully treated patients were more likely to have a sequestered or extruded disc herniation (as were patients who had spontaneous improvement within six weeks), whereas those in whom the epidural steroid injection failed usually had a poorly hydrated herniated disc (a low signal on T2-weighted magnetic resonance images). Follow-up magnetic resonance images of the patients in the epidural steroid injection group, to assess changes in disc morphology and the possible effects of the injection[13], may be valuable. Such a study could help us to understand whether the success of epidural steroid injections is related to resorption of the herniated disc or whether the patients still have a sizable disc herniation and their clinical improvement is due to modulation of the inflammatory response to the herniation.

Appendix

eA Tables showing the clinical characteristics and radiographic characteristics of all three patient groups are available with the electronic versions of this article, on our web site at www.jbjs.org (go to the article citation and click on "Supplementary Material") and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM). ■

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