

Epidural versus intravenous steroids application following percutaneous endoscopic lumbar discectomy

Annan Hu, MD, Xin Gu, MD, Xiaofei Guan, MD, Guoxin Fan, MD, Shisheng He, PhD, MD*

Abstract

Retrospectively study.

The purpose of this study was to compare the effects of intraoperative epidural steroids and single dose intravenous steroids following a percutaneous endoscopic lumbar discectomy (PELD).

Inflammatory irritation of dorsal root ganglia or sensory nerve roots may cause postoperative pain. Epidural steroids have been applied after a lumbar discectomy for more than 20 years. Epidural steroid application after a PELD is easier to perform and safer because the operations are under observation of the scope.

We retrospectively reviewed the medical records of patients with lumbar intervertebral disc herniation who had undergone transforaminal PELD at our department. There are 60 patients in epidural steroid group, intravenous steroid group, and control group, respectively. Visual analog scores (VAS) and the Oswestry Disability Index (ODI) were collected. Successful pain control is defined as 50% or more reduction in back and leg pain (VAS scores).

VAS scores (back and leg) and ODI showed a significant decrease in all groups when comparing pre- and postoperatively. Epidural steroid group had a significant improvement in successful pain control compared with the control group at 2 weeks of follow-up. VAS scores (leg) in the epidural steroid group showed a significant decrease compared with the intravenous steroids group at 1, 3, and 7 days after the surgery, but this difference had no statistical significance at 1, 6, and 12 months of follow-up. All groups did not show a significant difference in ODI at 1, 6, and 12 months follow-up.

Epidural application of steroid has a better effect on controlling the postoperative pain of PELD in the short term. The epidural application of steroid did not show a tendency to cause infection.

Abbreviations: ODI = Oswestry Disability Index, PELD = percutaneous endoscopic lumbar discectomy, VAS = visual analog scores.

Keywords: endoscopic, epidural steroids, lumbar disc herniation, lumbar discectomy

1. Introduction

Back pain and leg pain after lumbar disc herniation generally occur because of compression and the inflammatory process initiated by the herniation.^[1] A surgery can remove the herniated disc and the physical pressure on the nerves, but the inflammatory reaction may continue after surgery.^[2] Thus inflammatory irritation of dorsal root ganglia or sensory nerve roots may cause postoperative pain.^[3] To relieve the pain, epidural steroids have been applied after a lumbar discectomy for more than 20

years.^[4] Some studies in recent years have revealed that intraoperative epidural steroids application is effective in reducing postoperative pain in the early stage.^[5-9] Intravenous steroids are also used with acceptable results.^[10-13]

However, the type of steroid and route of administration are still in debate. Percutaneous endoscopic lumbar discectomy (PELD) is widely performed by spine surgeons as well as by interventional pain physicians in China because it requires no general anesthesia or admission to a hospital. Up to now, only 1 study focused on the administration of intraoperative epidural steroids after PELD.^[14] The authors conducted this retrospective study to compare the effects of intraoperative epidural steroids and single-dose intravenous steroids following a PELD.

2. Materials and methods

2.1. Patient selection

The ethics committee at School of Medicine, Tongji University reviewed and approved this project. This study was given a waiver of consent by the ethics committee. We retrospectively reviewed the medical records of patients with lumbar intervertebral disc herniation who had undergone PELD between January 2013 and September 2014 at our department.

Inclusion criteria include symptom lasted more than 6 weeks and conservative treatment was ineffective; single-level soft disc herniation which was paracentral or central type; low-grade

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Department of Spinal Surgery, Shanghai Tenth People's Hospital, Tongji University School of Medicine, Shanghai, China.

* Correspondence: Shisheng He, Department of Spinal Surgery, Shanghai Tenth People's Hospital, Tongji University School of Medicine, 301 Yanchang Road, Shanghai 200072, China (e-mail: hss1974418@163.com).

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extruded disc herniation; and for L5-S1, disc herniation should be shoulder type. Exclusion criteria include history of spinal surgery, epidural injection, or lumbar fracture; active infection, immunocompromise, or severe obesity; foraminal narrowing which needed endoscopic foraminoplasty; and disc herniation was associated with spinal canal stenosis, spondylolisthesis, or spinal instability.

A total of 258 patients' records were reviewed, and 180 patients who fulfilled the above criteria were identified. Patients (N=60) in the epidural steroid group had been administered a mixture of dexamethasone (5 mg) with saline (5 mL). Patients (N=60) in the intravenous steroid group had been administered a mixture of dexamethasone (40 mg) with 5% glucose injection 250 mL. The administration method was selected by patients after receiving an explanation about the pros and cons of the 2 methods. Patients (N=60) in control group had undergone PELD but without steroid administration.

2.2. Surgical procedure and steroid application

The typical transforaminal PELD technique was performed in all patients by the same surgeon. The technique of PELD has been described in earlier literatures.^[15] Briefly, a transforaminal approach 7 mm work tube was placed with subsequent intradiscal decompression using both manual extraction of nucleus pulposus and radio frequency bipolar disc destruction was used. For the epidural steroid group, after sufficient decompression, epidural pulsation was identified and the equipment for the application of epidural steroid was prepared (Fig. 1A). Thereafter, a solution made by mixing dexamethasone (5 mg) with 5 mL of saline was loaded into a syringe. The solution did not contain preservatives. The epidural injection needle was guided to the epidural space through the working channel with a visual check on the screen, followed by aspiration (Fig. 1B). Lastly, the surgeon injected the solution around the nerve root and dural sac (Fig. 1C). For the intravenous steroid group, the surgeon irrigated the surgical zone with saline after the decompression and identification of epidural pulsation. The patients in this group were administered a mixture of dexamethasone (40 mg) with 5% glucose injection 250 mL. For the control group, only PELD was

performed but without steroid administration. After the decompression of nerve root, the solution was used through an intravenous drip. The incision was closed with subcutaneous sutures and then the patient was taken out of the operating room. One and half gram of cefuroxime sodium was normally used as an antibiotic prophylaxis half hour before the procedure.

2.3. Review of clinical data

Using a retrospective study design, we reviewed collected clinical pain and function data on a consecutive sample of 180 patients underwent PELD. Pain (back and leg) was measured by visual analog scores (VAS). We checked the data 1, 3, and 7 days after surgery and a follow-up interview in a hospital visit 1, 6, and 12 months after surgery. In terms of categorical data at each point of follow-up, we defined 50% or more reduction in VAS scores (back and leg) as successful pain control and provide percentage of patients with successful pain control in each group at each time point along with 95% confidence intervals.^[16] We use the Oswestry Disability Index (ODI) to access how patients' daily life had been affected. We collected the data preoperatively and 1, 6, and 12 months follow-up. The data of intraoperative and postoperative (4 weeks) pain medication consumption were collected.

Independent variables were documented in the medical records. The data collected for analysis were sex, age, steroids application method, duration of symptoms, and involved level.

2.4. Statistical analysis

Clinical outcomes were analyzed by SPSS 19.0. Proportions were compared by using Chi-square test. Analysis of measurement data was carried out by *t* test. $P < .05$ was considered statistically significant.

3. Results

3.1. Patients

There were 36 men and 24 women in the epidural steroid group. The patients' average age was 41.3 ± 8.7 years with mean

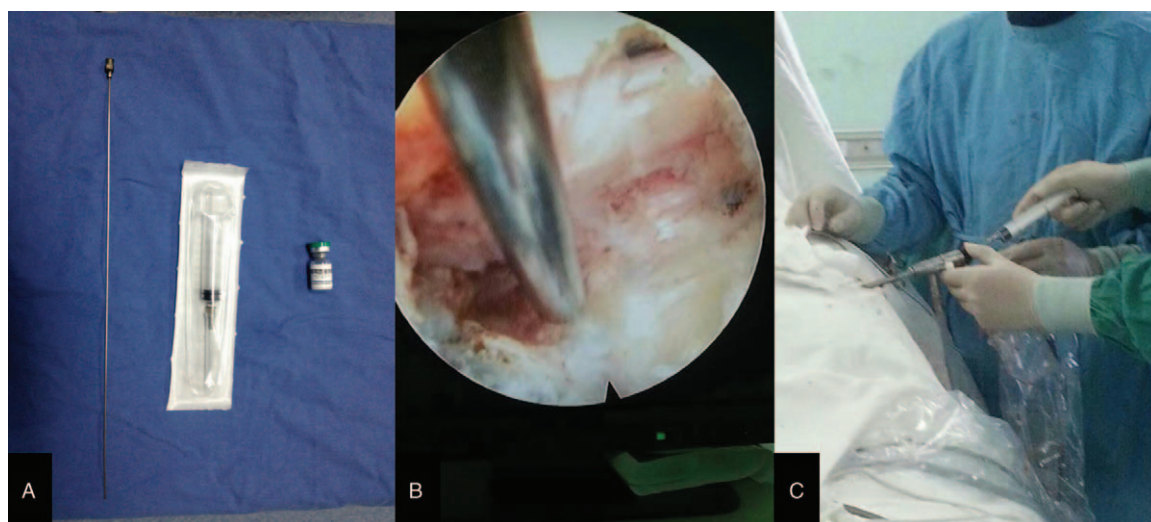


Figure 1. A, Equipment for epidural steroid application. B, Intraoperative view on the screen. It was helpful to control the syringe needle. C, Injection of solution around the nerve root and dural sac.

Table 1**The demographic and clinical characteristics of the patients.**

Parameter	Epidural steroids group (A)	Intravenous steroids group (B)	Control group (C)	P value (A vs B)	P value (A vs C)	P value (B vs C)
Sex (male/female)	36/24	39/21	35/25	NS	NS	NS
Age (yr)	41.3±8.7	39.2±9.5	40.5±9.1	NS	NS	NS
Symptom duration (wk)	22.5±11.2	24.7±10.6	22.9±9.8	NS	NS	NS
Level of surgery				NS	NS	NS
L3–4	9 (15%)	7 (12%)	7 (12%)			
L4–5	32 (53%)	35 (58%)	34 (57%)			
L5-S1	19 (32%)	18 (30%)	19 (31%)			

NS = nonspecific.

symptom duration of 22.5 ± 11.2 months. L3–4, L4–5, and L5-S1 involved 9, 32, and 19 patients, respectively. The intravenous steroid group consists of 39 men and 21 women. The average age of this group was 39.2 ± 9.5 years. Their mean symptom duration was 24.7 ± 10.6 months. In this group L3–4, L4–5, and L5-S1 involved 7, 35, and 18 patients, respectively. For the control group, 35 patients were men and 25 patients were women. The patients' average age was 40.5 ± 9.1 years and their mean symptom duration was 22.9 ± 9.8 months. L3–4, L4–5, and L5-S1 involved 7, 34, and 19 patients, respectively. The demographic data of the 3 groups have no statistically significant differences (Table 1).

3.2. Follow-up outcomes

All groups showed a significant decrease in VAS scores (back and leg) and ODI when comparing pre- and postoperatively ($P < .01$). Both epidural steroid group and intravenous steroid group showed a significant decrease in VAS scores (back and leg) compared with the control group at 1, 3, and 7 days after the surgery, but there was no statistically significant difference in VAS scores (back and leg) at 2 weeks, 1, 6, and 12 months of follow-up and ODI at all examinations (Table 2). The categorical data at 2 weeks of follow-up showed that there was a statistical significant difference in percentage of patients achieved successful outcomes of pain relief between epidural steroid group and control group (Table 2). When comparing epidural steroid group and intravenous steroid group, the VAS scores (back) had no statistically significant differences (Fig. 2A). The VAS scores (leg) in the epidural steroid group showed a significant decrease compared with the intravenous steroid group at 1, 3, and 7 days after the surgery ($P = .016$, $P = .019$, $P = .005$) (Fig. 2B), but this difference was not statistically significant at 1, 6, and 12 months of follow-up. The ODI did not show a significant difference between the 2 experimental groups at 1, 6, and 12 months follow-up examination ($P = .092$, $P = .387$, $P = .249$) (Fig. 3). Table 3 reflected the overall intraoperative and postoperative (4 weeks) pain medication use and revealed the proportion of patients in the use of each drug and the average dose of each drug among these groups have no statistic significance.

3.3. Complications

One patient in intravenous steroid group had uncontrolled bleeding during the surgery. During the follow-up at 12 months, 1 patient in the epidural steroid group had a recurrent disc herniation and thus underwent a repeat PELD. No patient in the 3 groups had a postoperative complication or dural tear. No

patient developed a postoperative infection or other complication related to the use of steroids.

4. Discussion

Clinical application of local steroids in lumbar discectomy is still controversial. Local application of steroids in spinal surgery has a long history. In many cases, steroids are administrated alone.^[15,9] Most of the studies confirmed the efficiency of epidural steroids on pain relief after spinal surgery. Some studies use steroids in combination with other medications, mainly nonsteroidal anti-inflammatory drugs and analgesics, and they found that nonsteroidal anti-inflammatory drugs and analgesics could not achieve satisfying results without steroids.^[6–8] A recent randomized controlled trial also revealed that epidural steroids after a PELD can reduce postoperative pain (back and leg) and improve patients' daily life in the early stage.^[14] Some surgeons, however, worried that epidural steroids may make infection susceptible.^[17] A survey involved 112 Canadian neurosurgeons in 2009 showed that 61% of the surgeons did not choose epidural steroids application in lumbar discectomy.^[18] Complications of intravenous steroids application in lumbar surgery are rarely reported when compared with local steroids application. For such kind of controversy, evidence-based medicine can give us some help. Akinduro et al^[19] analyzed 17 studies, which assessed epidural application of steroids after lumbar discectomy. These studies reported some cases of complications after epidural steroids application and seemed to show a tendency that epidural steroids increase the rate of complications. The difference, however, did not have statistical significance. Elsamadicy et al^[20] retrospectively reviewed 1200 patients and draw a conclusion that intraoperative steroids reduced infection rates after spine surgery when compared with no-steroid group. There is no hard evidence that epidural steroids application is associated with postoperative infection.

Epidural steroids are effective in reducing postoperative pain. Jamjoom and Jamjoom^[21] conducted a systemic review which indicated that intraoperative local steroids application is effective in controlling early postoperative pain and reducing consumption of analgesic. In our study, epidural application of steroids on the exposed nerve root following PELD has a better effect on decreasing the postoperative mean VAS scores (leg) than that of intravenous use in the short term. Meanwhile, we should be aware of that although statistically significant differences were found between the 2 experimental groups, those differences were small and perhaps not clinically meaningful. In addition, the significant reduction of pain intensity on day 1 could be largely due to the PELD. Except for statistical difference in VAS scores, the epidural steroid group achieved better outcome of successful pain control. Mean data may not reflect individual patients adequately because of the absence of normal distribution of data.

Table 2**Preoperative and postoperative clinical features of the 3 groups.**

Parameter	Epidural steroids group (A)	Intravenous steroids group (B)	control group (C)	P value (A vs B)	P value (A vs C)	P value (B vs C)
Preop						
VAS (back)	6.6±1.8	6.3±2.3	6.6±2.0	NS	NS	NS
VAS (leg)	7.4±1.9	7.6±2.1	7.7±2.1	NS	NS	NS
ODI (%)	57.8±17.5	60.3±15.7	59.5±15.9	NS	NS	NS
Postop 1d						
VAS (back)	2.4±1.1	2.5±1.0	3.0±1.2	NS	.003	.007
VAS (leg)	1.9±0.9	2.3±1.1	2.8±1.3	.016	<.001	.012
Pain relief (CI)	82% (75%–89%)	72% (62%–82%)	57% (46%–68%)	NS	<.05	NS
Postop 3d						
VAS (back)	2.6±1.3	2.5±1.5	3.2±1.2	NS	.005	.003
VAS (leg)	2.2±1.2	2.7±1.4	3.2±1.6	.019	<.001	.036
Pain relief (CI)	80% (72%–88%)	67% (57%–77%)	55% (44%–66%)	NS	<.05	NS
Postop 7d						
VAS (back)	2.5±1.1	2.7±1.2	3.1±1.3	NS	.004	.041
VAS (leg)	2.2±1.3	2.8±1.2	3.2±1.1	.005	<.001	.030
Pain relief (CI)	85% (77%–93%)	70% (60%–80%)	65% (55%–75%)	NS	<.05	NS
Postop 2w						
VAS (back)	2.1±0.8	2.3±1.1	2.4±1.0	NS	NS	NS
VAS (leg)	2.0±1.3	2.3±1.1	2.3±1.2	NS	NS	NS
Pain relief (CI)	88% (81%–95%)	78% (69%–87%)	70% (60%–80%)	NS	<.05	NS
Postop 4w						
VAS (back)	1.9±1.0	2.2±1.3	2.1±1.1	NS	NS	NS
VAS (leg)	1.8±1.4	2.1±1.5	2.0±1.5	NS	NS	NS
ODI (%)	32.5±18.6	37.3±20.7	35.8±20.1	NS	NS	NS
Pain relief (CI)	92% (82%–97%)	88% (81%–95%)	83% (75%–91%)	NS	NS	NS
Postop 6m						
VAS (back)	2.0±1.2	2.1±0.9	2.1±1.3	NS	NS	NS
VAS (leg)	1.8±1.2	1.8±1.1	1.9±1.1	NS	NS	NS
ODI (%)	20.1±14.1	19.4±12.5	21.4±11.5	NS	NS	NS
Pain relief (CI)	93% (84%–98%)	90% (84%–96%)	93% (84%–98%)	NS	NS	NS
Postop 12m						
VAS (back)	1.9±0.9	2.0±1.1	2.0±1.3	NS	NS	NS
VAS (leg)	1.7±1.1	1.9±1.3	1.8±1.1	NS	NS	NS
ODI (%)	12.7±9.5	13.9±9.8	13.5±10.0	NS	NS	NS
Pain relief (CI)	92% (82%–97%)	88% (81%–95%)	90% (84%–96%)	NS	NS	NS

CI = 95% confidence interval, NS = nonspecific, ODI = Oswestry Disability Index, pain relief = percentage of patients with 50% or more reduction in VAS scores (back and leg), VAS = visual analog scale.

Therefore, categorical data are considered to be more valid. All things considered, application of epidural steroid is superior to intravenous steroid. No patient in the 3 groups developed an infection. This may benefit from continuous irrigation, which provides surgeons with clear operation field during surgery. The pressure of irrigation also can reduce blood loss. We used prophylactic antibiotics in all cases to decrease the risk of postoperative infection. Furthermore, the concept that topical medication has precedence over systemic medication is generally accepted in medicine. Thus epidural steroids may be a better way to reduce postoperative pain if the surgeon is concerned about the risk of infection.

Epidural steroid application after a PELD is easier to perform and safer because syringes are used through obturator cannulation and under observation of the scope. Epidural steroids are injected into the ventral epidural space at the level of the removed herniated disc. Proper steroid concentration and injection into the ventral epidural space may be 2 key points of epidural steroid application in decreasing postoperative pain.^[22] For patients with lumbar disc herniation, injection into the ventral epidural space is superior to injection into the dorsal epidural space in controlling the symptoms.^[23] PELD has a natural advantage in reaching the

ventral epidural space by its surgical approach. Surgery using a posterior approach does not have this advantage. Epidural steroid application can provide prolonged exposure time of drugs for no loss of drug through drainage tubes. It has a longer anti-inflammatory effects compared with open procedure and intravenous application. Wound healing will, however, slow down because of the anti-inflammatory effects and inhibition of fibroplasias, which may increase the risk of recurrent disc herniation.^[24] Therefore, the patients included in the study should be followed up for longer periods to find out the long-term effects of epidural steroids on the wound healing of PELD. In addition, epidural steroids did not show a positive effect on the prevention of failed back surgery syndrome and epidural scar formation.^[25]

We set 3 groups in this study, because steroids can be administrated to patients in either epidural or intravenous way. Dexamethasone, triamcinolone, methylprednisolone, and beta-methasone are frequently used steroids in transforaminal epidural injection and no evidences showed that dexamethasone was not inferior to the other steroids.^[26,27] For this reason, combined with price and availability, we chose dexamethasone as a suitable steroid for epidural application. Intravenous injection

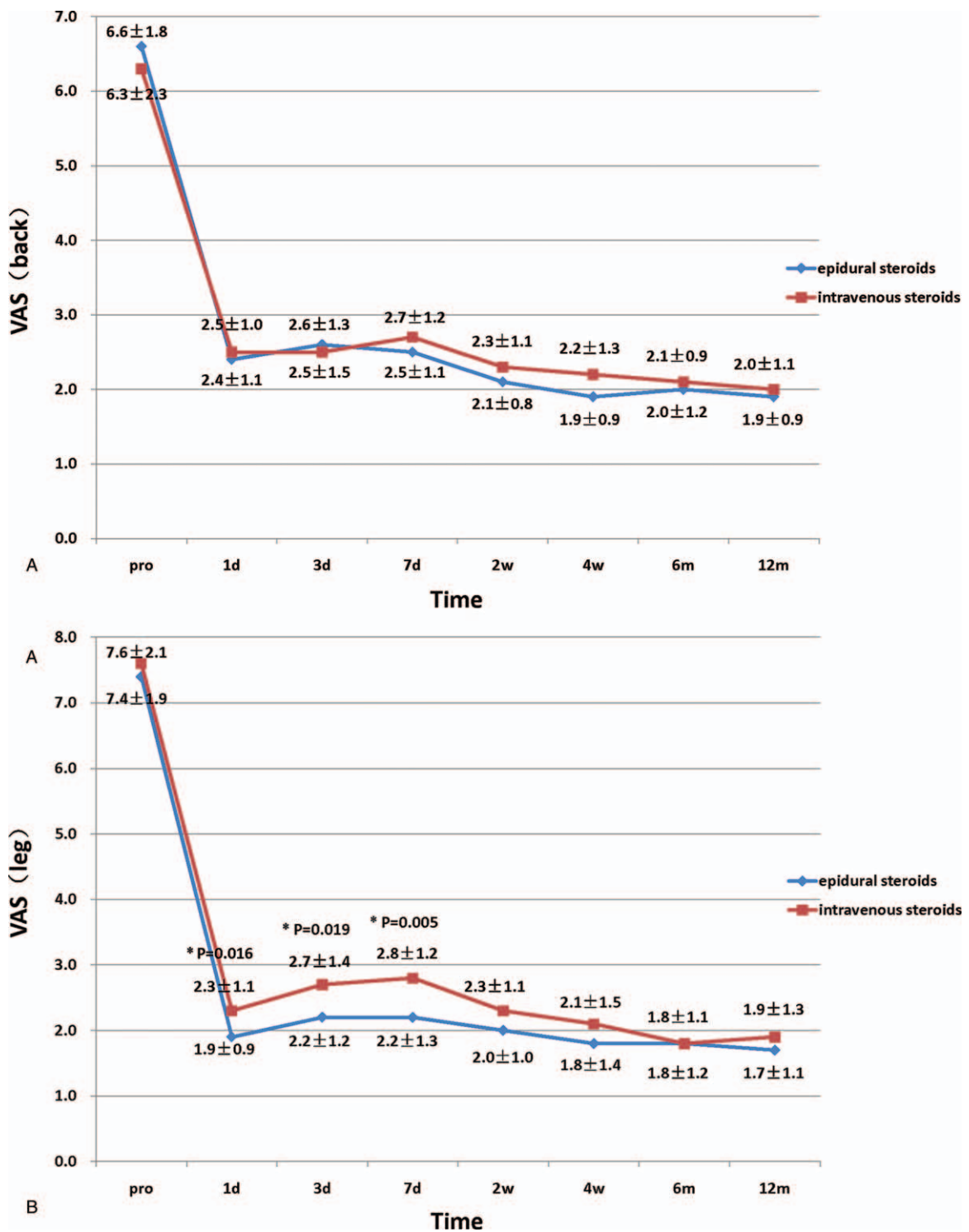


Figure 2. Mean values of VAS of pain before and after percutaneous endoscopic lumbar discectomy. VAS indicates visual analogue scale. Back (A) and leg (B). *Significant difference between the 2 groups ($P < .05$). VAS = visual analog score.

of dexamethasone has a long history of more than 30 years.^[10] Both intraoperative and postoperative application of dexamethasone could effectively reduce postoperative pain.^[11,13] We tried a single-dose intraoperative intravenous injection of dexamethasone based on the method described by Aminmansour.^[12]

This study has some limitations. The sample size was relatively small and follow-up periods were short, which may limit the

comparability and long-term outcomes. Analgesics obtained by patients were not collected because it's difficult to have a record of analgesic use when patients are at home. Socioeconomical variables were not included in this study.

In conclusion, compared to intravenous injection of steroid, epidural application of steroid on to the exposed nerve root after PELD has a better effect on decreasing the postoperative pain in the

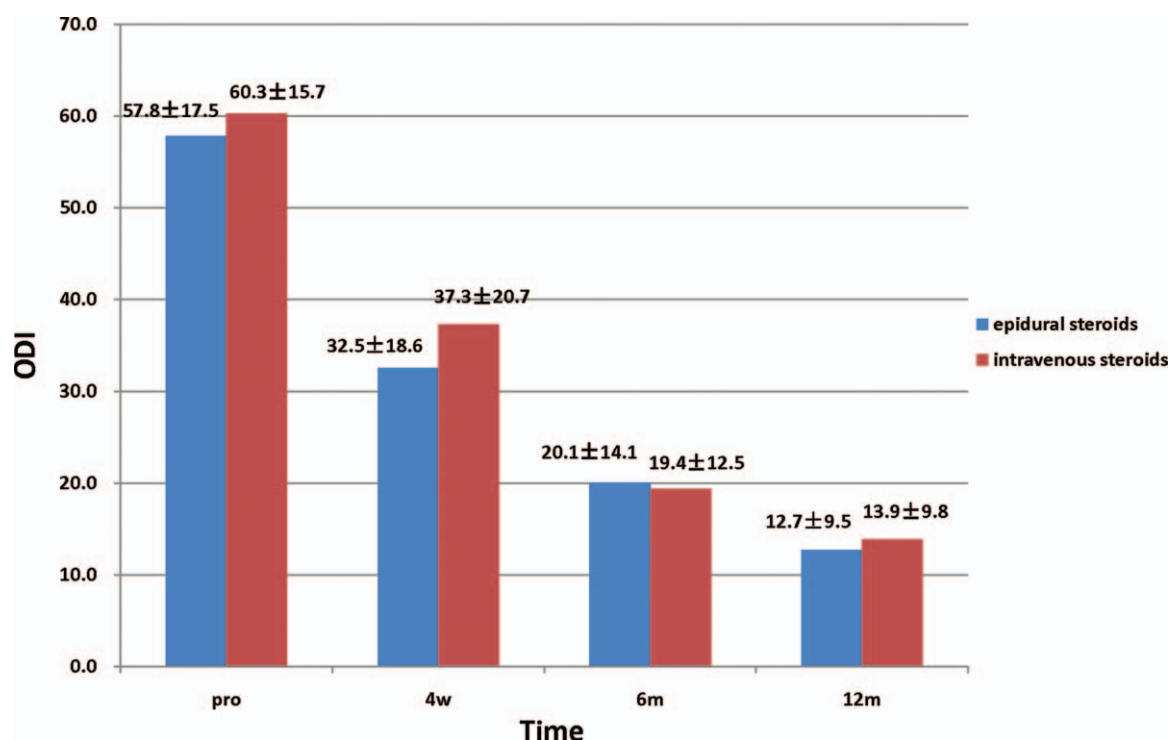


Figure 3. Mean values of ODI scores after percutaneous endoscopic lumbar discectomy at follow-up. ODI = Oswestry Disability Index.

Table 3

Intraoperative and postoperative (4 wk) pain medication consumption.

Medication	Epidural steroids group (A)	Intravenous steroids group (B)	Control group (C)	P value (A vs B)	P value (A vs C)	P value (B vs C)
Opioids						
Meperidine injection, n (%)	2 (3.3)	1 (1.7)	1 (1.7)	.559	.559	NS
Meperidine injection, mean, mg	10	10	10	NS	NS	NS
Tramadol oral, n (%)	3 (5)	4 (6.7)	3 (5)	.697	NS	.697
Tramadol oral, mean, mg	183.3 ± 85.0	137.5 ± 74.0	133.3 ± 47.4	.549	.507	.945
Nonsteroidal anti-inflammatory						
Celecoxib oral, n (%)	52 (86.7)	54 (90)	57 (95)	.570	.114	.298
Celecoxib oral, mean, mg	625 ± 244.9	624.1 ± 270.8	631.6 ± 272.2	.985	.896	.886
Parecoxib injection, n (%)	7 (11.7)	9 (15)	6 (10)	.591	.769	.408
Parecoxib injection, mean, mg	68.6 ± 28.0	62.2 ± 19.9	73.3 ± 27.5	.628	.782	.413
Flurbiprofen injection* n (%)	60 (100)	60 (100)	60 (100)	NS	NS	NS
Flurbiprofen injection, mean, mg	100	100	100	NS	NS	NS
Muscle relaxant						
Eperisone oral, n (%)	60 (100)	60 (100)	60 (100)	NS	NS	NS
Eperisone oral, mean, mg	678.5 ± 288.5	690 ± 336.7	729.2 ± 338.2	.842	.383	.530

* Flurbiprofen injection was routinely used intraoperatively with a dose of 100 mg.

short term. Categorical data also show that application of epidural steroid increases the percentage of patients who had successful outcomes for pain relief. We can conclude that application of epidural steroid is superior to intravenous steroid. The local application of steroid did not show a tendency to cause infection.

Author contributions

Conceptualization: Annan Hu, Shisheng He.
 Data curation: Xiaofei Guan.
 Formal analysis: Annan Hu, Xiaofei Guan.
 Investigation: Xin Gu.
 Methodology: Annan Hu, Xin Gu, Guoxin Fan.

Project administration: Guoxin Fan.
 Software: Xiaofei Guan.
 Supervision: Shisheng He.
 Validation: Shisheng He.
 Visualization: Guoxin Fan.
 Writing – original draft: Annan Hu.
 Writing – review and editing: Shisheng He.

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