

Treatment of cauda equina syndrome due to lumbar disc herniation with percutaneous endoscopic lumbar discectomy

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Research article

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Abstract

Background: Throughout the last decades, endoscopic techniques to treat lumbar disc herniation (LDH) have gained popularity in clinical practice. However, there is little literature on the treatment of Cauda Equina Syndrome (CES) due to lumbar disc herniation with percutaneous endoscopic lumbar discectomy (PELD). This study aims to evaluate the feasibility and clinical efficacy of PELD for CES caused by disc herniation.

Methods: Between October 2012 and April 2017, 15 patients CES caused by LDH at the early and intermediate stages of Shi's classification were selected as the objects of study, who underwent PELD. All patients were followed up for at least two years. The patients' lumbar pain and limb pain were evaluated using visual analogue scale (VAS) scores. Patient's satisfaction was evaluated using the MacNab outcome scale. Clinical outcomes were measured preoperatively, at 3 days, 3 months, 6 month and the last follow-up.

Results: The VAS score for lumbar pain was 6.67 ± 1.05 preoperatively and 3.27 ± 0.96 , 2.73 ± 0.46 , 2.40 ± 0.51 , and 1.80 ± 0.41 , at 3 days, 3 months, 6 months and the last follow-up postoperatively respectively. The VAS score for limb pain was 7.13 ± 1.19 preoperatively and 2.93 ± 0.80 , 2.60 ± 0.51 , 2.20 ± 0.56 , and 1.47 ± 0.52 , at 3 days, 3 months, 6 months and the last follow-up postoperatively respectively. These postoperative scores were all significantly different when compared with preoperative scores ($P < 0.01$). According to the modified MacNab outcome scale, excellent was obtained in 8 of 15 patients, good was obtained in 5 patients, and fair was obtained in 2 patients, and 86.67% of these patients had excellent and good outcomes at the final follow-up. Complications included one patient of cerebrospinal fluid leakage, and one patient developed recurrent herniation and who finally acquired satisfactory result after reoperation.

Conclusion: PELD could be used as an alternative surgical method for the treatment of CES due to lumbar disc herniation in properly selected cases and appropriate patient selection. However, the operator should pay attention to foraminoplasty to enlarge the working space.

Background

Cauda equina syndrome was firstly reported in 1934 by Mixter and Barr, which is a rare consequence of lumbar disc herniation [1]. It is widely accepted that the critical feature in CES is compression of the Cauda equina with resultant autonomic dysfunction [2]. Clinically, symptoms and signs include low back pain, saddle anaesthesia, unilateral or bilateral sciatica, and motor weakness of the lower extremities with bladder and bowel dysfunction [3]. Its incidence is 1 in 33,000 to 100,000, and it occurs with 2% of all lumbar disk herniations [4]. CES is classified into incomplete CES and complete CES, and the recovery rate of bladder or bowel function of patients with incomplete CES after surgery was reported to be higher than that of patients with complete CES [5]. Based on clinical symptoms and physiological dysfunction, CES can be classified into 4 stages in clinical practice: preclinical, early, middle, and late [6], and for early-

and middle-stage patients nerve root decompression should be performed as early as possible. Most common surgical method to the cauda equina was a laminectomy and discectomy, and there were other studies that predominantly performed surgery via a microdiscectomy [7]. However, traditional operation usually brings relatively large trauma to patients and may also damage the patient's spinal stability and induce complications. In fact, now there is an increase in the popularity of endoscopic lumbar discectomy procedure which adds to the range of procedures available when dealing with CES secondary to disc herniation [8, 9]. So this study aims to evaluate the feasibility and clinical efficacy of percutaneous endoscopic lumbar discectomy for CES caused by disc herniation.

Methods

Clinical data

Between October 2012 and April 2018, 852 patients underwent PELD. Bae on Shi's classification, 15 patients with CES at the early and middle stages caused by LDH were enrolled into this study. Shi's classification of CES [6]: Preclinical: Low back pain with only bulbocavernosus reflex and ischiocavernosus reflex abnormalities. Early: Saddle sensory disturbance and bilateral sciatica. Intermediate: Saddle sensory disturbance, bowel or bladder dysfunction, motor weakness of the lower extremity, and reduced sexual function. Late: Absence of saddle sensation and sexual function in addition to uncontrolled bowel function. Among these patients, 9 patients were male and 6 patients were female. The age of these patients ranged within 24–58 years old, with an average of 39.73 ± 10.54 years old. The lesions were located at L4/5 in 5 patients, at L5/S1 in 10 patients. All patients had complete radiological assessments with preoperative and follow-up radiographs which included X ray and Magnetic resonance imaging (MRI) and computed tomography (CT). The diagnosis was confirmed when combined with the clinical performance. Patients with complete CES, lumbar instability, tumors, infection were excluded.

Surgical Methods

Surgical instruments

The transforaminal endoscopic system provided by jiomax (Germany), and the radio-frequency electrode system provided by Ellman (USA).

Surgical procedures

To perform the PELD, the patient was placed in the lateral position. After local anesthesia, percutaneous puncture was performed under the guidance of C-arm, and a guide needle was placed. The ideal needle point was between the spinous process and medial margin of the vertebral arch on the anteroposterior X-ray film, while the needle was positioned at the upper edge of the inferior vertebral body on the lateral

film. The needle was adjusted according to the position of disc herniation. Under fluoroscopy with a C-arm x-ray machine, the facet of the superior articular process was removed with an eccentric trepan towards the dorsal root as far as possible to expand the intervertebral foramen. Next, the trepan was removed, and a working cannula was placed along the guide rod. An intervertebral foramen mirror light source, camera and washing fluid were connected. The operation for the extirpation of the protruded intervertebral disc, decompression of the nerve root, intradiscal electrothermal annuloplasty, and hemostasis were performed using an endoscope. When the patient's self-feeling symptoms were relieved and the nerve beat was well after decompression, the surgical access was pulled out and the wound was sutured (Fig .1, Fig .2).

Postoperative care

Patients had bed rest for 6 h after the surgery and got out of bed to perform appropriate activities with the aid of a waistline. Bending and weight-bearing activities should be avoided within 6 weeks after surgery, and excessive physical activity and strenuous physical exercise should be avoided within 3 months.

Efficacy evaluation

Lumbar pain and Limb pain were evaluated using visual analogue scale (VAS) scores at 3 days, 3 months, 6 months, and last follow-up postoperatively. The recovery of lumbar function after the surgery was evaluated using the modified MacNab score at the final follow-up.

Statistical analysis

Data were statistically analyzed using statistical software SPSS 22.0. All results were expressed as mean \pm standard deviation ($x \pm SD$). The obtained data were processed by statistical analysis and evaluated using t test. $P < 0.05$ was considered statistically significant.

Results

All 15 patients were successfully operated. The operation time was 90–120 min, bleeding was 10–20 ml, and the hospital stay was 3–5 days. All patients were followed up for more than 2 years. One patient had CSF leakage, and one patient developed recurrent herniation and who finally acquired satisfactory result after reoperation. The lumbar pain and limb pain scores were significantly improved after operation compared with those before operation ($P < 0.01$), and the difference was statistically significant (Table 1). At the last follow-up, the modified MacNab score was excellent in 8 cases, good in 5 cases, fair in 2 case, and the excellent and good rate was 86.67%.

Table 1
VAS scores of limb pain and ODI scores in different time among 15 cases

time	VAS scores (x ± S)	
	Lumbar pain	Limb pain
Before surgery	6.67 ± 1.05	7.13 ± 1.19
3 days after surgery	3.27 ± 0.96	2.93 ± 0.80
3 months after surgery	2.73 ± 0.46	2.60 ± 0.51
6 months after surgery	2.40 ± 0.51	2.20 ± 0.56
last follow-up	1.80 ± 0.41	1.47 ± 0.52
compared with , P < 0.01		

Discussion

CES is a rare but serious condition, defined as “a spectrum of low back pain, uni or bilateral sciatica, saddle anesthesia and motor weakness in the lower extremities with variable rectal and urinary symptoms” [10]. Different stages of CES show different clinical characteristics, and should be treated differently. For patients with CES at the late stage, wide laminectomy may be the first choice for those patients. Patients at the preclinical and early stages have better functional recovery than patients in later stages after surgical decompression [6]. Surgical goals are to relieve the local compression as soon as possible, to reduce the degeneration and death of the sensory neurons in the ganglia. However, traditional surgery usually brings relatively large trauma to patients and may also damage the patient's spinal stability and induce complications. How to reduce surgical trauma, maintain the integrity and stability of spine is a difficult point for the treatment of lumbar disc herniation. With the rapid development of modern spine surgery technology, percutaneous endoscopic lumbar discectomy have gained popularity in clinical practice. But some investigators did not recommend transforaminal endoscopic discectomy for CES as it was considered to be potentially high-risk with complications [11]. Recent meta-analyses and systematic reviews have reported that the transforaminal PELD is comparable or superior to the conventional open discectomy in terms of the effectiveness and minimal invasiveness for soft LDH [12, 13]. Cong et al. [14] pooled results comparing endoscopic discectomy versus open microdiscectomy and found a significantly higher satisfaction rate in patients who underwent endoscopic discectomy. PELD is a minimal invasive surgery under local anesthesia, known as endoscopic and provides huge expectancies for the treatment of CES. Li X et al. [8] reported that PELD could be used as an alternative surgical method for the treatment of CES in properly selected cases.

In this study, we only took patients with CES at the early and middle stages according to Shi's classification as the objects of study. Unlike Li X study, all of our patients were treated with PELD by transforaminal lumbar approach. The good and excellent outcome of PELD in our study was 86.67%,

corresponding closely to the results of previous studies of conventional open surgery for incomplete CES. These 15 patients with CES treated with PELD techniques showed that such a procedure is safe and effective.

In the transforaminal lumbar approach, the landing on the disc should be as near as possible to the target and as far as possible from the exiting nerve root, which is the first key to surgical success. Second, we should have beforehand performed sufficient foraminoplasty using an eccentric trepan for avoiding further compression of the nerve root by the placement of the working channel. Because the disc herniation which can cause CES is huge, if the intervertebral foramen is not fully formed during the operation, it will cause iatrogenic nerve injury. Recently, several authors have emphasized the significance of foraminoplasty [15, 16]. Even during the operation, if considered necessary, foraminoplasty should definitely be performed again to enlarge the working space. Finally, herniated fragment should be completely removed after adequate releasing process, and the surgeon should not be in a hurry for directly removing the herniated fragment.

Conclusions

According to our results, the lumbar pain and limb pain scores improved significantly after PELD. Based on our research, PELD is an effective and safe surgical method in treating CES caused by lumbar disk herniations. However, the sample of patients was relatively small, which could affect the results of this study, and this is a retrospective analysis. Further prospective studies versus open surgery are required to evaluate its feasibility and safety in a large number of patients.

Abbreviations

LDH: Lumbar disc herniation; CES: Cauda Equina Syndrome; PELD: percutaneous endoscopic lumbar discectomy; VAS: Visual analogue scale; MRI: Magnetic resonance imaging; CT: Computed tomography

Declarations

Availability of data and materials

We declared that the materials described in the manuscript, including all relevant raw data, will be freely available to any scientist wishing to use them for non-commercial purposes, without breaching participant confidentiality.

Ethics approval and consent to participate

I confirm that I have read the Editorial Policy pages. This study is a retrospective study, which conducted with approval from the Ethics Committee of Affiliated Dongyang Hospital of Wenzhou Medical University.

This study was conducted in accordance with the Declaration of Helsinki.

Consent for publication

Written informed consent for publication of their clinical details and clinical images was obtained from the patient.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

Hai-Chao He carried out the studies and drafted the manuscript. All authors participated in the design of the study and performed the statistical analysis. Yong-jin Zhang revised it critically for important intellectual content. All authors read and approved the final manuscript.

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Figures

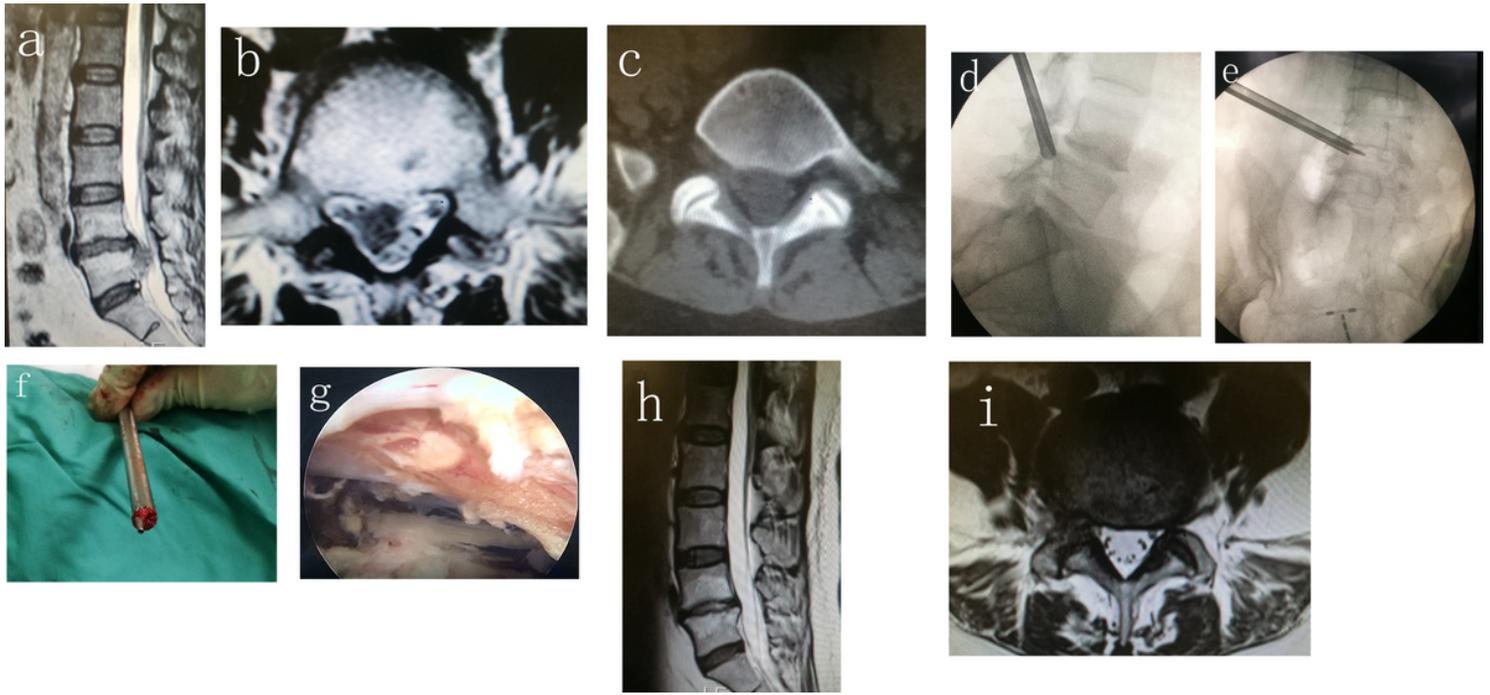


Figure 1

A 52-year-old female patient underwent PELD for disc herniations at L4-5 level. The preoperative MRI and CT scans showed lumbar disc herniation at L4-5 level and dissociation to the caudal side (a-c). Intraoperative C-arm showing the eccentric foraminoplasty with the first stage guide rod and red circular saw to enlarge the working space (d, e). The photograph of the large bone fragment that had been removed with an eccentric trepan (f). Postoperative intraoperative endoscopic images showed that the nerve was completely relaxed and the protrusion was completely removed (g). Postoperative MRI after 5 months (h-i) showing no disc herniation.

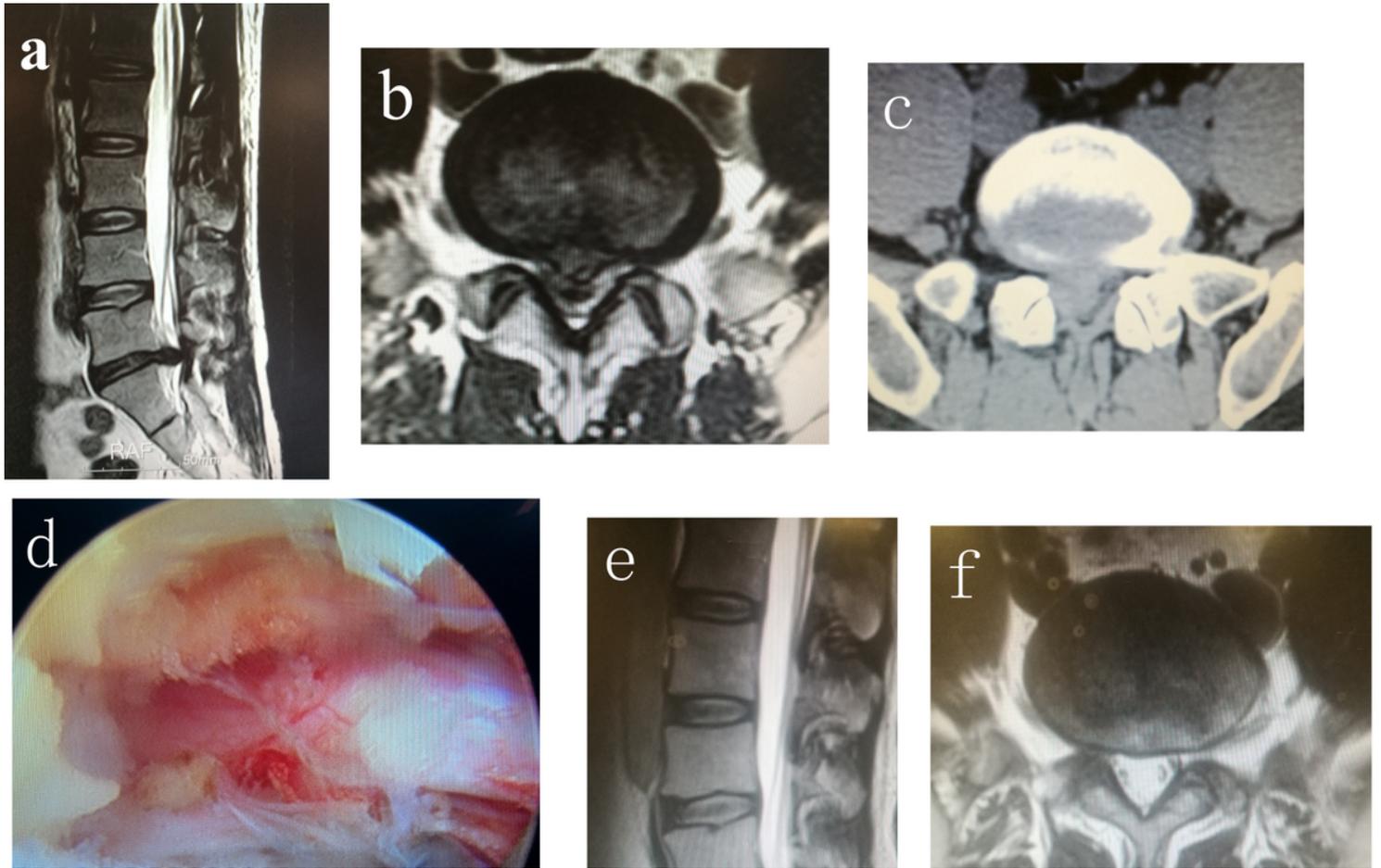


Figure 2

A 40-year-old male patient underwent PELD for disc herniations at L5-S1 level. Preoperative MRI (a, b) and CT (c) scans demonstrating a huge herniation at L5-S1 level. Postoperative intraoperative endoscopic images showed that the nerve was completely relaxed and the protrusion was completely removed (d). Postoperative MRI after 4 months (e, f) showing no disc herniation.