Factors and re-treatment for recurrent lumbar disc herniation after percutaneous endoscopic lumbar discectomy

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Abstract

Background

Percutaneous endoscopic lumbar discectomy (PELD) has become the most common treatment for lumbar disc herniation (LDH). However, the risk of recurrence after PELD is inevitable. Therefore, clarifying the factors for recurrent LDH is necessary to improve the success rate and reduce the postoperative recurrence rate. The study aimed to investigate the postoperative recurrence rate, factors and re-treatment of recurrent LDH after PELD.

Methods

A total of 685 LDH patients who underwent PELD in our hospital from January 2015 to December 2017 were enrolled in this retrospective study. Postoperative recurrence rate was calculated. Outcomes for re-treatment of recurrent LDH were assessed by comparing VAS and JOA scores before the first surgery, after recurrence and at the final follow-up in patients with recurrent LDH. The factors for recurrent LDH were analyzed by univariate and multivariate analysis.

Results

Recurrent LDH was observed in 23 (3.35%) patients, including 21 cases of ipsilateral recurrent herniation, and 2 cases of contralateral recurrent herniation. Mean recurrence time was 5.4 ± 2.6 months (range, 0.5–11 months). VAS score was decreased, while JOA score was increased at the final follow-up compared with the scores measured before the first surgery and after recurrence. Univariate analysis revealed that body mass index (BMI), the types of disc herniation and postoperative activity levels were correlated with postoperative recurrence, while no correlation was found between sex, age, smoking history, the levels and position of herniated disc and recurrent LDH. Multivariate analysis showed that high BMI, the types of disc herniation (i.e. extrusion, sequestration) and high-intensity postoperative activity levels were risk factors for recurrent LDH.

Conclusions

High BMI, the extrusion and sequestration types of disc herniation, and high-intensity postoperative activity levels may significantly increase the incidence of recurrent LDH. All patients with recurrent LDH had satisfactory results after re-treatment.

Introduction

Lumbar disc herniation (LDH) is a common and frequently occurring disease in orthopedics, and is one of the most common degenerative diseases that cause low back and leg pain. The symptoms of most

patients can be relieved by systematic conservative treatment, but poor outcomes of conservative treatment was observed in a small number of the patients, and surgical treatment is needed. Many surgical methods that can effectively treat LDH have been reported. Percutaneous endoscopic lumbar discectomy (PELD) has become the most common treatment because of its advantages such as less trauma, less bleeding, and quick recovery.

Most of the patients treated with PELD had satisfactory postoperative results, and a few of them had complications such as dural tear, nerve root injury and postoperative recurrence. The recurrence rate after PELD is 0–12%.[1–7] The definition of recurrence after PELD has not been completely unified. Most scholars believe that after a period of complete pain free, the intervertebral disc at the same level protrudes again, and leads to the corresponding radiculopathy symptoms, which is defined as recurrent LDH after PELD. The definition of recurrence time after PELD is still controversial. Some scholars believe that it should be 6 months, and some scholars believe that it should be 1 month following surgery.[8] This retrospective study enrolled LDH patients who underwent PELD in our hospital from January 2015 to December 2017, and aimed to investigate the postoperative recurrence rate, risk factors and outcomes of re-treatment for recurrent LDH after PELD.

Subjects And Methods

Subjects

Totally 685 LDH patients who underwent PELD in our hospital from January 2015 to December 2017 were enrolled in this study, including 397 males and 288 females, with mean age of 57.7±19.8 years (range 24–88 years). Among them, 351 cases had a history of smoking. Mean body mass index (BMI) was 22.6±5.5 kg/m^2 (range, 17.3–36.8 kg/m^2). The levels for herniated disc were L3/4 in 38 case, L4/5 in 374 cases, and L5/S1 in 273 cases. The types of disc herniation (MRI findings) included protrusion in 298 cases, extrusion in 279 cases, and sequestration in 108 cases. The position of herniated disc (MRI findings, including central to right sided and central to right sided protrusion/herniation) included the left-sided disc herniation in 385 cases and right-sided disc herniation in 300 cases. Mean follow-up time was 21.5 ± 4.7 months (range, 13–30 months).

The inclusion criteria were:(1)LDH was definitely diagnosed in patients in accordance with the patient’s medical history, physical signs, and imaging examination; (2) patients who obtained poor outcomes after systematic conservative treatment for more than 3 months; (3) patients who had no history of previous lumbar surgery; (4) patients who were followed up for more than 12 months; (5) patients who had no obvious contraindications to surgery; and (6) patients and their family members had good compliance, gave written informed consent to participate in study, and completed follow-up.

The exclusion criteriawere: (1) patients who had history of previous lumbar surgery; (2) patients or family members had poor compliance, did not agree to receive treatment and did not complete follow-up;

(3) patients who had psychiatric diseases; (4) patients who had postoperative infection; and (5) patients who became pregnant after surgery.

Diagnostic criteria for recurrent LDH[8-10]

1. Ipsilateral or contralateral radiculopathy symptoms occurred again after a symptom-free period of one week.
2. Postoperative MRI reexamination indicated that the protruding nucleus pulposus tissue had been removed.

(3) MRI revealed reherniation at the same level (ipsilateral or contralateral), which caused nerve compression.

Surgical methods

The operation was performed by senior doctors in the same group. Interlaminar approach was adopted in patients with LDH at the L5–S1 level with high iliac crest. PELD via transforaminal and interlaminar approaches were performed under local anesthesia and epidural anesthesia, respectively. All patients were placed in prone position. After conventional catheterization, the surgery was conducted under endoscope. Attention should be paid to protect the dura mater and nerve roots in order to avoid damage to the endplate. The ligaments and small joints were preserved as much as possible, and the sequestered nucleus pulposus and nucleus pulposus that caused symptoms were removed thoroughly. Simultaneously, thermal annuloplasty was carried out until the dura mater and nerve roots were decompressed completely. The wound was closed with a stitch after a complete hemostasis under the microscope. A drainage tube was placed in case of excessive bleeding. The drainage tube could be removed 1–2 days after operation depending on the amount of drainage.

Postoperative management

Management after the first surgery

All patients received routine anti-infection and symptomatic treatments after surgery. Patients were allowed to get out of bed to perform moderate activity for 15–30 minutes under the protection of the waistline at 24 hours after surgery. After the symptoms relieved, patients were instructed to perform straight leg raising and lower back exercises. Improper waist postures, such as sitting or standing for a long time, bending down, and weight bearing, were avoided. A full rest was taken for three months, and physical labor was avoided within half a year. All patients in this study were followed up by outpatient appointment, telephone, and WeChat for 13–30 months.

Retreatment for recurrent LDH

For patients with recurrent LDH, retreatment options was selected according to the patients' symptoms and MRI examination results. Patients with mild herniation and less pain (VAS score ≤ 3) were treated

with conservative treatment or interventional therapy (radiofrequency ablation, ozone and collagenase chemonucleolysis). Patients with moderate and severe herniation and moderate and severe pain (VAS score ≥ 4) and without obvious lumbar instability underwent PELD again. Patients with moderate and severe herniation, a VAS score of ≥ 4 and lumbar instability were treated with spinal canal decompression by open posterior approach, discectomy, and screw rod system internal fixation with cage fusion.

Evaluating indicators

(1) Recurrence rate; (2) visual analogue score (VAS) and Japanese Orthopaedic Association (JOA) score before the first surgery, after the recurrence and at the final follow-up; (3) postoperative activity levels that were scored with postoperative activity level scale (**Table 1**)[11]; (4) factors for recurrent LDH: age, sex, the levels for herniated disc, the types of disc herniation, the position of herniated disc and postoperative activity levels.

Statistical analysis

Measurement data were expressed as the mean ± standard deviation. All data were analyzed using SPSS 23.0 software. Count data were compared using chi-square test. Intergroup difference was compared using independent sample *t* test. Logistic regression analysis was used to analyze the factors with statistical significance in univariate analysis. A P value < 0.05 was considered statistically significant, and P < 0.01 was deemed highly significant.

Results

Recurrence rate

Recurrent LDH was observed in 23 patients with a recurrence rate of 3.35%, including 14 males and 9 females, mean age was 61.2±16.2 years (range, 37–88 years). mean BMI was 30.3±7.9 kg/m^2 (range, 17.6–36.8 kg/m^2). Disc herniation occurred at level L3/4 in 1 case, L4/5 in 14 cases, and L5/S1 in 8 cases. 3 cases had protruded disc herniation, 11 cases had extruded disc herniation, and 9 cases had sequestered disc herniation. 12 cases had left-sided disc herniation and 11 cases had right-sided disc herniation. Pain occurred at the original site in 22 cases and at the contralateral side in 2 cases.

VAS and JOA scores

The mean recurrence time was 6.1±3.1 months (range, 0.5 -11 months). The symptoms of 4 cases relieved gradually after 2 weeks of conservative treatment. One case underwent ablation of dorsal branch of spinal nerve. Five cases underwent radiofrequency and ozone nucleus pulposus ablation. Eight cases underwent PELD again. Five cases underwent spinal canal decompression via posterior approach, discectomy, and screw rod system internal fixation with cage fusion. VAS score was significantly

decreased and JOA score was significantly increased in patients with recurrent LDH at the final follow-up compared with before the first operation and after the recurrence (P<0.05, **Table 2)**.

Postoperative activity levels

Postoperative activity level scores was shown in **Table 3**. There were significant differences in postoperative activity levels between the recurrence group and the non-recurrence group ($P < 0.01$).

Factors for recurrent LDH

Univariate analysis revealed that BMI, the types of disc herniation and postoperative activity level were correlated with postoperative recurrence. Sex, age, smoking history, the levels and position of herniated disc were not correlated with recurrent LDH (**Table 4**). Multivariate analysis showed that high BMI, extruded and sequestered disc herniation, and high-intensity postoperative activity levels were risk factors for recurrent LDH (**Table 5**).

Discussion

Since 2003, Professor Thomas Hoogland from Germany designed the PELD on the basis of YESS. PELD has been favored by experts and scholars due to its advantages such as less trauma, less bleeding, and faster recovery.[1,12–13] However, the risk of recurrence after PELD is inevitable. Hoogland et al.[4] showed that the recurrence rate after PELD within 1 year was approximately 3.92%. Li et al.[1] reported that the recurrence rate after PELD was approximately 2.5%. In our study, the recurrence rate was 3.17%, which was consistent with the finding from previous studies. Therefore, clarifying the factors for recurrent LDH is necessary to improve the success rate and reduce the postoperative recurrence rate.

The factors for recurrent LDH mainly included[8]: (1) patient's own condition: age, sex, BMI, and chronic diseases such as diabetes; (2) preoperative factors: the levels for herniated disc, types of disc herniation, degree of disc degeneration, and stability of the lumbar spine; (3) surgical factors: surgical method, amount of nucleus pulposus removal, treatment of of the damaged annulus fibrosus; (4) postoperative factors: postoperative functional exercise and activity levels, and secondary lumbar instability. In this present study, univariate analysis revealed that BMI, the types of disc herniation and postoperative activity levels were correlated with postoperative recurrence, while patients’ sex, age, smoking history, BMI, the levels and position for herniated disc were not correlated with recurrent LDH. However, finding on factors related to recurrent LDH are still controversial. Kim et al.[13] performed a nationwide cohort study and suggested that PELD was not suitable for LDH patients aged over 57 years. Older patients (≥ 57 years) had a higher reoperation rate within 3.4 years after PELD. However, the reoperation rate was not higher for patients younger than 57 years 1.9 years after PELD than after open discectomy. However, Meredith et al.[14] found that age had no significant influence on the recurrence after discectomy.

In the present study, multivariate analysis showed that high BMI, the types of disc herniation, i.e. extrusion, sequestration, and high-intensity postoperative activity levels were risk factors for recurrent

LDH. High BMI is a risk factor for postoperative recurrence, which was consistent with the findings from the study of Yao et al.[15] Yao et al. showed that increased weight load can lead to increased loading of lumbar disc at the operated level, resulting in recurrence after surgery. Kim et al.[9] and Yao et al.[15] showed that the extrusion and sequestration types of disc herniation were risk factors for postoperative recurrence after PELD, this may be due to that the view field of the endoscope is narrow, the working space is small, and the blind areas exist (especially around the working channel), so the extruded and sequestered disc herniations can not be removed completely, and the residual nucleus pulposus fragments can lead to postoperative recurrence of LDH, but the underlying mechanism still needs to be further investigated. Meredith et al.[14] and Shimia et al.[16] reported that high-intensity postoperative activity levels were risk factor for postoperative recurrence, the high intensity of postoperative activity levels can lead to increased loading on lumbar disc at the operated level, which easily cause the residual nucleus pulposus to protrude again, resulting in recurrent LDH. Our study demonstrated that recurrent LDH occurred mainly at early early period (12 months) after the first surgery, the reason may be that there was a long learning curve in the use of endoscopy. As experience increases, the recurrence rate will decrease to a certain extent. For patients with recurrent LDH, appropriate treatment was chosen based on imaging data. At the final follow-up, VAS score was decreased from 7.58 ± 1.12 to 2.37 ± 1.26, while JOA score was increased from 8.17 ± 4.62 to 16.87 ± 6.74 in patients with recurrent LDH. The outcomes of the second surgery were satisfactory.

In summary, there is a possibility of postoperative recurrence in the treatment of LDH with PELD. Our findings suggested that high BMI, the extrusion and sequestration types of disc herniation, and high-intensity postoperative activity levels were correlated with postoperative recurrent LDH. However, the limitation of our study is that this was a retrospective study, which could lead to potential selection selection bias, and cause bias to the results, therefore further studies are needed to confirm the results.

Declarations

Ethical approval

This research was approved by Hubei 672 Orthopaedics Hospital of Integrated Chinese & Western Medicine Ethics Committee(Wuhan, China; permit no.

HB6720189) and was in conformity with the guidelines of the National

Institute of Health.

Consent for publication

Written informed consents were formally obtained from all participants.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

JT,QLL and YL made substantial contributions to the study conception and design, the acquisition of data and the analysis and interpretation of data. CJW,WX, and XGL contributed to drafting the manuscript and critically revising the manuscript for important intellectual content. JT and QLL prepared the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1 Postoperative activity level scale (5)

Question	Group	Score
What is the main activity (exercise) after surgery?	Low intensity (such as walking and doing housework)	0
	Medium intensity (such as jogging and cycling)	1
	High intensity (such as fast running and playing basketball)	2
How long is each activity?	≤ 30 minutes	0
	30 minutes–2 hours	1
	≥ 2 hours	2
How often is the activity?	1–2 times/week	0
	3–4 times/week	1
	5–6 times/week and above	2

Table 2 VAS and JOA scores of patients with recurrent LDH

	Before the first operation	After the recurrence	Final follow-up
VAS	8.18±1.11	7.58±1.12	2.37±1.26*
JOA	7.78±4.46	8.17±4.62	16.87±6.74*

Note:*$P < 0.05$, vs before the first operation and after the recurrence

Table 3 Postoperative activity level scores

Postoperative activity level (score)	Recurrence group	Non-recurrence group	χ^2	P
≤ 2	4	249	14.084	0.001
3–4	5	243		
≥ 5	14	170		

Table 4 Univariate analysis of factors associated with recurrent LDH

Ractors for recurrent LDH		Number of recurrent patients	Number of non-recurrent patients	χ^2	*P*
Sex	Male	14	383	0.083	0.773
	Female	9	279		
Age (year)	≤ 40	4	181	1.539	0.463
	40–64	9	194		
	≥ 65	10	287		
BMI kg/m^2	< 18.5	2	212	14.331	0.001
	18.5–22.9	6	257		
	≥23	15	193		
Smoking history	Yes	9	289	0.185	0.667
	No	14	373		
The levels for herniated disc	L3/4	1	37	0.387	0.824
	L4/5	14	360		
	L5/S1	8	265		
The types of disc herniation	Protrusion	3	295	13.61	0.001
	Extrusion	11	268		
	Sequestration	9	99		
The position of herniated disc	Left	12	373	0.157	0.692
	Right	11	289		
Postoperative activity level (score)	≤ 2	4	249	14.084	0.001
	3–4	5	243		
	≥ 5	14	170		

Table 5 Multivariate analysis of factors associated with recurrent LDH

	B	SE	Wald	df	Sig.	Exp(B)	95% CI for Exp(B)	
							Lower part	Upper part
BMI	1.948	0.489	15.880	1	0.00006	7.012	2.690	18.276
The types of disc herniation	1.252	0.464	7.276	1	0.007	3.496	1.408	8.679
Postoperative activity level	1.192	0.450	7.023	1	0.008	3.295	1.364	7.959