

Therapeutic effect of percutaneous endoscopic lumbar discectomy on lumbar disc herniation and its effect on oxidative stress in patients with lumbar disc herniation

FENG CHANG*, TING ZHANG*, GANG GAO, CHEN YU, PING LIU, GENLE ZUO and XINHU HUANG

Department of Orthopedics (Minimally Invasive Spine Surgery), The Affiliated People's Hospital
of Shanxi Medical University, Taiyuan, Shanxi 030012, P.R. China

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Abstract. This study investigated the therapeutic effect of percutaneous endoscopic lumbar discectomy on lumbar disc herniation, and explored its effect on oxidative stress in patients with lumbar disc herniation. One hundred and ten patients with lumbar disc herniation were selected in The Affiliated People's Hospital of Shanxi Medical University from May 2015 to May 2016. Patients were divided into control group (n=50) and observation group (n=60) according to different surgical methods. Patients in control group were subjected to traditional open discectomy, while patients in observation group were treated with percutaneous endoscopic lumbar discectomy. Surgical-related indicators, ODI and VAS scores before and 3 months after surgery, serum inflammatory factors and oxidative stress indicators were compared between 2 groups. There was no significant difference in operation time between the groups. Blood loss, incision size and time of bed rest in observation group were better than those in control group ($P<0.05$). Compared with preoperative levels, ODI and VAS scores of the two groups were significantly reduced at 3 months after surgery, but the scores of observation group were significantly higher than those of control group ($P<0.05$). There were no significant differences in the levels of serum inflammatory factors TNF- α and CRP and oxidative stress indicators MDA, MPO, SOD and TAC between the two groups before surgery ($P>0.05$). Levels of serum inflammatory factors TNF- α and CRP and oxidative stress indicators MDA and MPO were significantly lower and levels of oxidative

stress indicators SOD and TAC were significantly higher in observation group than in control group ($P<0.05$). Therefore, treatment of lumbar disc herniation with percutaneous endoscopic lumbar discectomy has the advantages of small trauma, less blood loss and fast recovery, and can effectively improve the dysfunction, reduce pain and serum levels of inflammatory factors, and improve the levels of oxidative stress indicators, thereby improving the surgical results. Thus, this method should be considered for wide-use.

Introduction

As a common disease in orthopedics, lumbar disc herniation is a common cause of low back pain (1). Incidence of lumbar disc herniation is gradually increasing, seriously affecting people's physical and mental health. Traditional open discectomy is an effective method for the treatment of lumbar disc herniation. However, this treatment usually brings relatively large trauma to patients and may also damage the patient's spinal stability and induce complications. Thus, the application of this treatment is limited (2,3). How to reduce surgical trauma, maintain the integrity and stability of spine and reduce the incidence of postoperative complications is a difficult point for the treatment of lumbar disc herniation. With the rapid development of modern spine surgery technology, percutaneous endoscopic lumbar discectomy was introduced and has attracted attention (4,5). This technology has the advantages of small trauma, less blood loss, low incidence of complications and rapid recovery (6). However, percutaneous endoscopic lumbar discectomy is still a relatively new technique, and the short-term and long-term clinical efficacy still need to be further investigated. Our study aimed to investigate the therapeutic effect of percutaneous endoscopic lumbar discectomy on lumbar disc herniation, and to explore its effect on oxidative stress in patients with lumbar disc herniation, so as to provide valuable references for the clinical treatment of lumbar disc herniation.

Patients and methods

General information. A total of 110 patients with lumbar disc herniation who were treated in the Affiliated People's Hospital

Correspondence to: Dr Feng Chang, Department of Orthopedics (Minimally Invasive Spine Surgery), The Affiliated People's Hospital of Shanxi Medical University, 29 Shuangtadong Street, Yingze, Taiyuan, Shanxi 030012, P.R. China
E-mail: feng_changsx@163.com; cfmedmail@163.com

*Contributed equally

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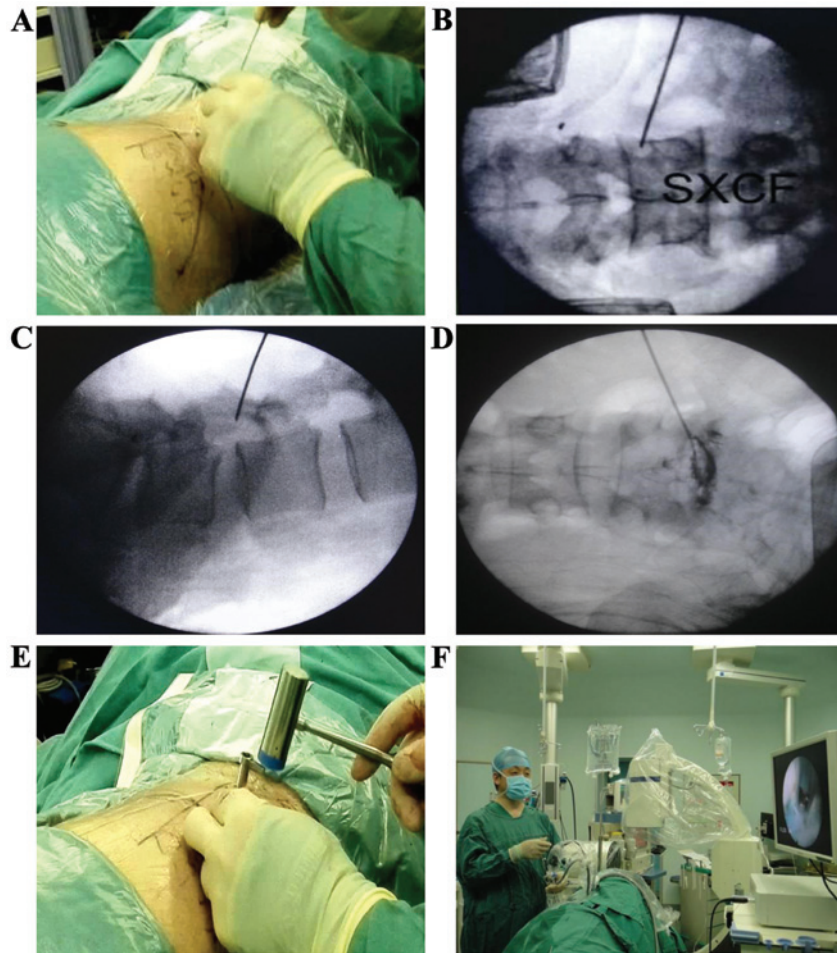


Figure 1. Percutaneous endoscopic lumbar discectomy procedures: (A) percutaneous lumbar discectomy under the guidance of C-arm; (B) position of puncture point under positive perspective; (C) position of puncture point under lateral perspective; (D) discography under positive perspective; (E) placement of working column; (F) removal of intervertebral disc tissue in working channel.

of Shanxi Medical University from May 2015 to May 2016 were selected as subjects. Inclusion criteria: 1) patients met the diagnostic criteria of lumbar disc herniation (7); 2) with single segmental lumbar disc herniation determined by imaging examination, which is consistent with clinical symptoms; 3) no improvement in symptoms after conservative treatment for 3 months; 4) without surgery contraindications. Exclusion criteria: 1) with intervertebral disc inflammation changes; 2) with recurrent lumbar disc herniation; 3) with instable lumbar; 4) patients combined with heart, lung, liver and kidney and other vital organs disease. According to different surgery strategies, patients were divided into control group (n=50) and observation group (n=60). In control group, there were 30 males and 20 females, and the ages ranged from 20 to 65 years with an average age of 3.67 ± 4.28 years, and the course of disease ranged from 1 to 9 years with an average course of 5.24 ± 1.74 years. In observation group, there were 40 males and 20 females, and the ages ranged from 19 to 64 years with an average age of 52.54 ± 4.12 years, and the course of disease ranged from 2 to 8 years with an average course of 5.01 ± 2.32 years. There was no significant difference in sex, age and course of disease between the two groups ($P > 0.05$). This study was approved by the Ethics Committee of The Affiliated People's Hospital of Shanxi Medical University, and all patients signed written informed consent.

Traditional open discectomy was performed for patients in control group. An incision was made on the intervertebral space of the lesion center (6 cm). Supraspinous ligament and erector spinae muscle were cut in turn to expose lumbar spine. A window was made by bone rongeur, and flavum ligamentum flavum was removed to expose dural sac. Dural sac was separated to expose prominent discs. Nucleus pulposus of intervertebral disc was then removed and drainage tube was placed after surgery.

Percutaneous endoscopic lumbar discectomy was performed for patients in observation group. Lateral position was taken. After local anesthesia, percutaneous puncture was performed under the guidance of c-arm, and a guide needle was placed. The ideal needle point is to locate the lower tip of the needle to the line connected to the center pedicle of vertebra under positive perspective and to the line connected to the edge of adjacent lumbar spines under lateral perspective (Fig. 1A-C). Deformed nucleus pulposus was subjected to methylene blue staining, and lumbar diskography was also performed (Fig. 1D). Bone reamer was used to grind prominent facet joint and to expand intervertebral foramen (Fig. 1E). Saline (3,000 ml) was used in full endoscopic discectomy to remove the nucleus pulposus in spinal canal, outside fibrous ring, the stained nucleus pulposus was also removed (Fig. 1F). Conditions of fibrous ring, dural sac and nerve root were

Table I. Comparison of surgery related indicators between two groups (mean \pm SD).

Groups	Blood loss (ml)	Operation time (min)	Incision size (cm)	Bed rest time (days)
Observation group (n=60)	25.21 \pm 9.35	75.03 \pm 20.21	2.10 \pm 0.08	2.61 \pm 1.07
Control group (n=50)	52.42 \pm 12.74	77.95 \pm 18.56	5.15 \pm 0.31	6.20 \pm 2.44
t-value	7.451	0.126	8.735	9.307
P-value	<0.05	>0.05	<0.05	<0.05

checked. Hemostasis was performed after cleaning tissue debris, and the incision was sutured.

Observation indicators and evaluation criteria. i) Surgery related indicators including intraoperative blood loss, operation time, incision size and postoperative time of bed rest were recorded. ii) According to Oswestry disability index (ODI), the disability before and 3 months after surgery was scored (8) from the following aspects: social life, standing, walking, degree of pain and self-dependent ability. Score = actual score/50 (highest score) \times 100%. Lower score indicated better function. iii) According to the visual analogue scale (VAS), pain of the two groups of patients was evaluated (9): painless, 0 points, mild pain, 1-3 points, moderate pain, 4-6 points, severe pain, 7-10 points. iv) Levels of serum tumor necrosis factor- α (TNF- α) and CRP (C-reactive protein) were measured before

and 3 months after operation. TNF- α level was determined by double antibody sandwich ELISA method, and CRP level was determined by latex-enhanced immunoassay. All operations were performed in strict accordance with the instructions of the kits. v) Levels of serum malondialdehyde (MDA), myeloperoxidase (MPO), superoxide dismutase (SOD) and total antioxidant capacity (TAC) before and 3 months after surgery were compared between groups. Levels of MDA, MPO, SOD and TAC were measured by double antibody sandwich ELISA, and all operations were performed in strict accordance with the instructions of kits.

Statistical analysis. Statistical analysis was performed using SPSS 20.0 (IBM, Armonk, NY, USA). Measurement data were expressed as mean \pm SD, and processed using t-test. Comparisons with groups were performed by t-test. $P < 0.05$ was considered to indicate a statistically significant difference.

Results

Comparison of surgery related indicators between two groups. There was no significant difference in operation time between the groups. Blood loss, incision size and time of bed rest in observation group were better than those in control group ($P < 0.05$) (Table I).

Comparison of ODI scores between two groups. Compared with preoperative levels, ODI scores of the groups were significantly decreased, but the decrease in observation group was higher than that in control group ($P < 0.05$) (Table II).

Comparison of VAS scores between two groups. VAS scores of the groups were significantly decreased after operation,

Table II. Comparison of ODI scores between two groups (mean \pm SD, points).

Groups	n	Preoperative	Postoperative	t-value ^a	P-value ^a
Observation group	60	52.16 \pm 17.07	18.33 \pm 9.72	12.623	<0.05
Control group	50	53.28 \pm 18.45	29.14 \pm 11.31	9.421	<0.05
t-value ^b		0.007	7.523		
P-value ^b		>0.05	<0.05		

t-value^a, P-value^a: comparison between before and after surgery within a group; t-value^b, P-value^b: comparisons between groups before and after surgery.

Table III. Comparison of VAS scores between two groups (mean \pm SD, points).

Groups	n	Preoperative	Postoperative	t-value ^a	P-value ^a
Observation group	60	7.96 \pm 2.44	2.21 \pm 1.57	8.254	<0.05
Control group	50	7.99 \pm 2.57	4.82 \pm 2.31	4.017	<0.05
t-value ^b		0.115	8.925		
P-value ^b		>0.05	<0.05		

t-value^a, P-value^a: comparison between before and after surgery within a group; t-value^b, P-value^b: comparisons between groups before and after surgery.

Table IV. Comparison of serum TNF- α and CRP levels between groups (mean \pm SD).

Groups	n	TNF- α (μ g/l)		CRP (mg/l)	
		Preoperative	Postoperative	Preoperative	Postoperative
Observation group	60	27.11 \pm 3.26	3.21 \pm 0.45	28.34 \pm 4.18	3.54 \pm 0.32
Control group	50	27.26 \pm 3.15	5.78 \pm 0.67	28.45 \pm 4.35	6.68 \pm 0.58
t-value		0.258	8.021	0.306	8.935
P-value		>0.05	<0.05	>0.05	<0.05

Table V. Comparison of changes in serum oxidative stress indicator between two groups (mean \pm SD).

Groups	n	MDA (nmol/l)		MPO (mg/l)		SOD (nU/ml)		TAC (kU/l)	
		Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative
Observation group	60	4.65 \pm 0.27	1.34 \pm 0.32	2.83 \pm 0.34	0.82 \pm 0.14	54.78 \pm 3.42	76.15 \pm 4.77	6.03 \pm 1.26	9.81 \pm 1.75
Control group	50	4.73 \pm 0.29	2.56 \pm 0.45	2.91 \pm 0.37	1.35 \pm 0.22	54.83 \pm 3.65	63.86 \pm 5.74	6.12 \pm 1.33	8.43 \pm 1.61
t-value		0.108	6.735	0.275	6.072	0.204	7.155	0.014	8.826
P-value		>0.05	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05

but the decrease in observation group was higher than that in control group ($P < 0.05$) (Table III).

Comparison of changes in serum inflammatory factors between two groups. There was no significant difference in serum TNF- α and CRP between the groups before surgery ($P > 0.05$). Levels of serum TNF- α and CRP in observation group were significantly lower than those in control group ($P < 0.05$) (Table IV).

Comparison of changes in serum oxidative stress indicator between two groups. There were no significant differences in serum MDA, MPO, SOD and TAC levels between the groups preoperatively ($P > 0.05$). Postoperative levels of serum MDA and MPO were significantly lower and levels of SOD and TAC were significantly higher in observation group than in control group ($P < 0.05$) (Table V).

Discussion

Lumbar disc herniation is a common orthopedic disease. Open discectomy is used as the main treatment of lumbar disc herniation, but the application of open discectomy is limited by the big surgical trauma and the incidence of postoperative complications including adhesions of nerve roots and lumbar instability (10). In order to reduce the damage of normal tissue caused by surgical operations and the incidence of postoperative complications, percutaneous endoscopic lumbar discectomy has been widely applied and is attracting increased attention. In this study, 110 cases of lumbar disc herniation were selected for different surgical treatment to further evaluate the effectiveness and reliability of percutaneous endoscopic lumbar discectomy.

Results of this study showed that blood loss, incision size and time of bed rest were better in observation group than in the control group. Compared with preoperative levels, ODI and VAS scores of the two groups were significantly decreased, but the decreases in observation group was lower than those in control group. This finding is consistent with the results of Mroz *et al* (11), indicating that treatment of lumbar disc herniation with percutaneous endoscopic lumbar discectomy can avoid large surgical trauma, reduce blood loss, promote postoperative recovery, shorten hospitalization and reduce economic burden of patients' families. The possible explanations may be that the working channel in percutaneous endoscopic lumbar discectomy can be used to directly access the prominent disc to remove the nucleus pulposus, so as to directly cut the prominent part. Moreover, the targeting is more accurate, so nerve root will be decompressed directly (12-14). Local anesthesia was used in percutaneous endoscopic lumbar discectomy, which avoided the risk of general anesthesia and reduce the probability of nerve root damage. At the same time, lumbar facet joints and neural scute were not cut, which in turn avoided the damage of adjacent paravertebral ligament and muscle. The effect on spinal canal and nerve structure was not strong, and scar tissue would not form in spinal canal (8,15,16). The surgical incision was small, which brought less pain to patients. Washing with saline performed during surgery could remove inflammatory mediators and prevent the accumulation of by-products. Thus, postoperative pain and the incidence of postoperative infection were reduced (1,17,18).

TNF- α and CRP are common serum inflammatory factors, and serum contents of TNF- α and CRP can reflect patient's recovery condition (19). Results of this study showed that there was no significant difference in serum levels of TNF- α and CRP between the groups before surgery ($P > 0.05$), while serum

levels of TNF- α and CRP were significantly lower in observation group than in control group postoperatively ($P<0.05$). The data suggest that the application of percutaneous endoscopic lumbar discectomy can effectively reduce the serum contents of TNF- α and CRP, which maybe the pathophysiological basis of the advantages of this technique in the treatment of lumbar disc herniation.

Studies have shown that oxidative stress indicators would change after damage (20). Thus, the recovery can be evaluated by the changes in oxidative stress indicators. Results of this study showed that there was no significant difference in serum MDA, MPO, SOD and TAC between two groups before surgery ($P>0.05$), while serum levels of MDA and MPO were significantly lower and serum levels of SOD and TAC were significantly higher in observation group than in control group postoperatively ($P<0.05$). Those data suggest that the application of percutaneous endoscopic lumbar discectomy can effectively improve oxidative stress. This study is still limited by the environment, small sample size and time of clinical observation. Further studies are still needed to investigate the long-term effects of this method.

In summary, treatment of lumbar disc herniation by percutaneous endoscopic lumbar discectomy has the advantages of small trauma, less blood loss and rapid postoperative recovery. This method can effectively improve dysfunction, reduce pain and serum levels of inflammatory factors, and improve oxidative stress, thereby improving the surgical results. Thus, this technique should be popularized in clinical practice.

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