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Comparison of nerve conduction and injury degree in patients with lumbar disc herniation after microendoscopic discectomy and fenestration discectomy

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ABSTRACT

Objective: To study the difference of nerve conduction and injury degree in patients with lumbar disc herniation after microendoscopic discectomy and fenestration discectomy. **Methods:** Patients with single-segment lumbar disc herniation who were treated in Dazhou Central Hospital between May 2014 and February 2017 were selected as the research subjects, the history data were reviewed and the operation methods were referred to divide them into FD group and MED group who received fenestration discectomy and microendoscopic discectomy respectively. The conduction velocity of common peroneal nerve and tibial nerve were detected before operation and 4 weeks after operation; serum levels of nerve and muscle injury-related molecules as well as inflammation and stress-related molecules were detected before operation and 3 days after operation. **Results:** MNCV levels of common peroneal nerve and tibial nerve 4 weeks after operation as well as serum CRP, TNF-α, MDA and AOPP contents 3 d after operation of both groups of patients were significantly higher than those before operation, and the MNCV levels of common peroneal nerve and tibial nerve of MED group 4 weeks after operation were significantly higher than those of FD group while serum CRP, TNF-α, MDA and AOPP contents of MED group 3 d after operation were not significantly different from those of FD group; serum NSE, S100B, Tau, pNF-H, CPK, Myo and LDH contents of FD patients 3 d after operation were significantly higher than those before operation while serum NSE, S100B, Tau, pNF-H, CPK, Myo and LDH contents of MED group were not significantly different from those before operation. **Conclusion:** Microendoscopic discectomy for lumbar disc herniation can relieve the nerve and muscle injury, and is equivalent to fenestration discectomy in activating the systemic stress and inflammatory response.

1. Introduction

Lumbar disc herniation is the most common cause of lumbar pain in clinic, and surgical treatment is used to treat patients with ineffective treatment. Discectomy is the preferred method for surgical treatment of lumbar disc herniation, and excision of prominent nucleus pulposus can relieve the compression on nerve roots and alleviate the symptoms of limb pain[1,2]. Fenestration discectomy (FD) is the most widely used way of discectomy, which is easy to operate, has low requirement for equipment and is easy to promote. Microendoscopic discectomy (MED) is a minimally invasive surgery developed in recent years, which can clearly display the surgical field and accurately separate the nucleus pulposus, and can also avoid the operation damage to adjacent nerve root[3,4]. In the following study, the differences of nerve conduction and damage degree in patients with lumbar disc herniation were specifically analyzed after microendoscopic discectomy and fenestration discectomy so as to confirm the value of microendoscopic discectomy and fenestration discectomy for surgical treatment of patients with lumbar disc herniation.

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2. Case information and research methods

2.1 General case information

A total of 152 patients with single-segment lumbar disc herniation who were treated in Dazhou Central Hospital between May 2014 and February 2017 were selected as the research subjects, and all patients were diagnosed with lumbar disc herniation in L4/5 or L5/S1 by lumbar MRI, conformed to the indications for surgical treatment, and received microendoscopic discectomy or fenestration discectomy. The patients combined with infectious diseases, diabetic peripheral neuropathy and mental illness were excluded. The medical history of the patients was reviewed, and then they were divided into FD group and MED group according to the different operation methods. There were 85 cases in FD group, including 56 male cases and 29 female cases that were 49-64 years old; there were 67 cases in MED group, including 37 male cases and 30 female cases that were 46-65 years old. There was no statistically significant difference in general information between the two groups (P>0.05).

2.2 Operation method

MED group: put in the position with the affected side upward after general anesthesia, the C-arm was used to locate the the vertebral lesion, then a incision about 1.5 cm long was made, a locating pin was inserted in the intervertebral space of corresponding vertebral lesion, C-arm machine was used to confirm the location of the locating pin, the expansion tube was inserted along the the locating pin, endoscopic operating system was placed, then the vertebral plate and soft tissue were removed, the bone window was incised, the dural sac was exposed to separate nucleus pulposus and remove it with bone rongeur, and the incision was flushed and sutured. FD group: put in prone position after general anesthesia, C-arm was used to locate the vertebral lesion, then a incision about 1.5 cm long was made, the subcutaneous tissue and fascia were separated to expose vertebral bodies, fenestration discectomy was done, the ligamentum flavum was removed, nerve root and dura mater were protected, then the fiber ring was incised to remove the nucleus pulposus, and then the incision was flushed and sutured.

2.3 Nerve conduction function test

Before surgery and 4 weeks after surgery, the EMG was used to test the lower limb nerve conduction function of the two groups, and the motor nerve conduction velocity (MNCV) of common peroneal nerve and tibial nerve were determined respectively.

2.4 Serum index test

Before surgery and 3 d after surgery, 3 mL of cubital venous blood was collected from two groups of patients, let stand and then centrifuged to separate serum, enzyme-linked immunosorbent assay kit was used to detect serum NSE, S100B, Tau, pNF-H, Myo, CRP and TNF-α levels, and radioimmunoprecipitation kit was used to detect the contents of CPK, LDH, MDA and AOPP.

2.5 Statistical methods

SPSS 20.0 software was used to input data, the differences between groups were analyzed by t test and P<0.05 indicated statistical significance in differences in test results.

3. Results

3.1 MNCV of common peroneal nerve and tibial nerve

Before surgery and 4 weeks after surgery, analysis of the MNCV levels of common peroneal nerve and tibial nerve between two groups of patients was as follows: MNCV levels of common peroneal nerve and tibial nerve were not significantly different between the two groups of patients before surgery; MNCV levels of common peroneal nerve and tibial nerve of both groups of patients 4 weeks after operation were significantly higher than those before operation, and the MNCV levels of common peroneal nerve and tibial nerve of MED group 4 weeks after operation were significantly higher than those of FD group.

Table 1.

Changes in perioperative MNCV of common peroneal nerve and tibial nerve (m/s).

Groups	n	Time	Common peroneal nerve MNCV		Tibial nerve MNCV	
			Left	Right	Left	Right
MED group	85	Before surgery	40.3±5.8	38.9±5.3	41.7±5.8	41.1±6.2
		3 d after surgery	47.2±6.2△▲	46.8±6.4△▲	48.9±7.7△▲	48.2±7.1△▲
FD group	67	Before surgery	40.7±5.9	39.2±4.7	41.3±5.2	40.8±5.8
		3 d after surgery	43.8±5.3△	42.8±4.8△	44.6±5.4△	44.1±6.3△

△: comparison of serum indexes between before and after surgery, P<0.05; ▲: comparison of indexes between MED group and FD after surgery, P<0.05.

Table 2.

Changes in perioperative serum nerve injury-related molecules.

Groups	*n*	Time	NSE	S100B	Tau	pNF-H
MED group	85	Before surgery	29.5±4.2	1.08±0.13	16.7±2.2	42.9±5.9
		3 d after surgery	30.2±4.5▲	1.14±0.16▲	17.4±1.9▲	44.1±5.7▲
FD group	67	Before surgery	29.7±4.6	1.12±0.14	17.2±2.1	43.5±5.4
		3 d after surgery	39.4±5.5△	1.89±0.25△	25.2±3.4△	72.6±9.4△

△: comparison of serum indexes between before and after surgery, $P<0.05$; ▲: comparison of indexes between MED group and FD after surgery, $P<0.05$.

Table 3.

Changes in perioperative serum muscle injury-related molecules.

Groups	*n*	Time	CPK	Myo	LDH
MED group	85	Before surgery	177.5±29.3	47.4±6.1	113.2±14.6
		3 d after surgery	180.1±22.4▲	49.1±5.9▲	117.0±13.8▲
FD group	67	Before surgery	179.2±25.2	48.7±5.5	116.4±16.2
		3 d after surgery	256.2±32.9△	64.1±8.2△	168.4±20.3△

△: comparison of serum indexes between before and after surgery, $P<0.05$; ▲: comparison of indexes between MED group and FD after surgery, $P<0.05$.

Table 4.

Changes in perioperative serum inflammation and stress-related molecules.

Groups	*n*	Time	CRP	TNF-α	MDA	AOPP
MED group	85	Before surgery	6.29±0.78	38.5±5.9	6.92±0.93	78.2±9.5
		3 d after surgery	8.13±0.94△	50.2±7.3△	8.95±1.06△	90.7±11.5△
FD group	67	Before surgery	6.33±0.72	39.1±5.5	6.98±0.97	77.5±8.9
		3 d after surgery	8.21±1.05△	50.8±6.9△	9.02±1.04△	91.2±10.8△

△: comparison of serum indexes between before and after surgery, $P<0.05$; ▲: comparison of indexes between MED group and FD after surgery, $P<0.05$.

3.2 Serum nerve and muscle injury–related molecule contents

Before surgery and 3 d after surgery, analysis of serum nerve injury-related molecules NSE (ng/mL), S100B (pg/mL), Tau (ng/mL) and pNF-H (pg/mL) as well as muscle injury-related molecules CPK, Myo (μg/L) and LDH between two groups of patients was as follows: serum NSE, S100B, Tau, pNF-H, CPK, Myo and LDH contents were not significantly different between the two groups of patients before surgery; serum NSE, S100B, Tau, pNF-H, CPK, Myo and LDH contents of FD patients 3 d after operation were significantly higher than those before operation while serum NSE, S100B, Tau, pNF-H, CPK, Myo and LDH contents of MED group were not significantly different from those before operation.

3.3 Serum inflammation and stress–related molecule contents

Before surgery and 3 d after surgery, analysis of serum inflammation-related molecules CRP (mg/L) and TNF-α (μg/L) and stress-related molecules MDA (mmol/L) and AOPP (mmol/L) between two groups of patients was as follows: serum CRP, TNF-α, MDA and AOPP contents were not significantly different between the two groups of patients before surgery; serum CRP, TNF-α, MDA and AOPP contents of both groups of patients 3 d after operation were significantly higher than those before operation, and serum CRP, TNF-α, MDA and AOPP contents of MED group were not significantly different from those of FD group.

4. Discussion

Chronic back-leg pain is a major clinical symptom in patients with lumbar disc herniation, and intervertebral disc degeneration will cause nucleus pulposus herniation to spinal canal, which will oppress nerve root, dural sac, cauda equina and other nerve structures to cause the clinical symptoms of back and leg pain. Patients with ineffective conservative treatment should consider discectomy to relieve the compression on the neural structure. FD is the most widely applied way of clinical discectomy, which is easy to operate and can fully remove the oppression on nerve root, but the operation will cause damage to adjacent nerve, spinal dura mater and other structures to some extent, and thus influence the early postoperative recovery of neurological function[5,6]. MED is a minimally invasive discectomy developed in recent years, which uses diskoscope to get a clear view of operation field and increase the precision of the operation, and can fully remove the nucleus pulposus and also furthest avoid damage to peripheral nerve tissue and structure[7–9].

FD and MED have been increasingly used in the surgical treatment of lumbar disc herniation, they have different advantages, but there is no clear report about the differences in their curative effects for lumbar disc herniation. The nerve compression caused by herniation of nucleus pulposus in patients with lumbar disc herniation can lead to lower limb nerve conduction function injury, and surgery can remove the nucleus pulposus, relieve nerve compression, and thus improve nerve conduction function. In order to define the FD and MED effects for lumbar disc herniation, the perioperative lower limb nerve conduction function was compared, and the results showed that MNCV levels of common peroneal nerve and tibial nerve of both groups of patients 4 weeks after operation were significantly higher than those before operation, and the MNCV levels of common peroneal nerve and tibial nerve of MED group 4 weeks

after operation were significantly higher than those of FD group. This means that both FD and MED can improve the lower limb nerve conduction function in patients with lumbar disc herniation, and MED is better than FD in improving the lower limb nerve conduction function in patients with lumbar disc herniation.

The surgical operation damage to nerve tissue and structure will not only cause the changes of the corresponding nerve conduction function, but also cause the release of multiple molecules from nerve cells into the blood circulation. NSE, S100B, Tau and pNF-H are the important functional molecules in nerve cells. NSE is a catalytic enzyme that is specific to the neurons and it participates in the regulation of cell energy metabolism; S100B is the molecule in glial cells that is closely related to the Ca^{2+} homeostasis and cell membrane structure stability[10]; Tau is the functional phosphoprotein in the cellular and axonal structure of the neuronS, which can maintain the stability of the microtubule structure[11]; pNF-H is a kind of neurofilament protein, which has strong enzyme-resistant capacity and can maintain the stability of cell structure[12]. In the study, analysis of the changes in perioperative serum contents of nerve injury molecules showed that serum NSE, S100B, Tau and pNF-H contents of FD patients significantly increased 3 d after operation while serum NSE, S100B, Tau and pNF-H contents of MED group were not significantly different from those before operation. This indicates that FD operation can cause injury to the nerve tissue and structure, and the MED operation is more delicate and does not cause obvious damage to the nerve tissue and structure. MED can not only increase the precision of operation and reduce the nerve damage, but also avoid the extensive dissection of paravertebral muscles and reduce the injury of muscle tissue. CPK, Myo and LDH are the functional molecules within the muscle cells, and the injury of muscle tissue will cause the above molecules to be released into the blood circulation[13]. In the study, analysis of the changes in perioperative serum levels of muscle injury molecules showed that serum CPK, Myo and LDH contents of FD patients significantly increased 3d after operation while serum CPK, Myo and LDH contents of MED group were not significantly different from those before operation. This indicates that the operation of FD can cause injury to the muscle tissue, and the operation of the MED is more delicate and does not cause significant injury to the muscle tissue. Although MED increases the operation precision and reduces the local tissue damage, it will prolong the operation time to a certain extent, which increases the activation extent of the systemic inflammatory response and stress response[14,15]. In the study, analysis of the changes in perioperative serum levels of inflammation and stress-related molecules in two groups of patients showed that serum CRP, TNF-α, MDA and AOPP contents of both groups of patients significantly increased 3 d after operation, and the inflammation and stress-related molecules were not significantly different between the two groups. This indicates that the surgical trauma of both FD and MED can cause varying degrees of inflammation and stress activation, and the two types of surgeries are equivalent in activating inflammation and stress response.

Microendoscopic discectomy is better than fenestration discectomy in improving the lower limb nerve conduction function in patients with lumbar disc herniation, causes less damage to nerve and muscle tissue than fenestration discectomy, and is equivalent to fenestration discectomy in activating systemic stress and inflammatory response.

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