Effect of combination of lateral recess decompression by Tessys technique and PTED in patients suffering from contralateral symptoms of lumbar disc herniation

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Abstract
The aim was to explore the effect of lateral recess decompression by percutaneous transforaminal endoscopic spine system (Tessys) technique combined with percutaneous transforaminal endoscopic discectomy (PTED) on pain medium, nerve function and stress response in patients suffering from contralateral symptoms of lumbar disc herniation. A total of 96 patients with contralateral symptoms of lumbar disc herniation treated in our hospital from February 2015 to April 2017 were randomly divided into control group and study group, with 48 cases in each group. The control group underwent PTED, and the study group underwent lateral recess decompression by Tessys technique combined with PTED. The visual analogue scale (VAS) score and Japanese Orthopaedic Association (JOA) score before surgery and 3 months after surgery were compared between the two groups. The levels of serum pain medium (prostaglandin E2 (PGE2), histamine (HA), 5-hydroxytryptamine (5-HT)) and oxidative stress indexes (malondialdehyde (MDA), myeloperoxidase (MPO), superoxide dismutase (SOD), total antioxidant capacity (TAC)) before surgery and 7 days after surgery were compared. The clinical efficacy of the two groups was compared at 1 month after treatment. One month after treatment, the excellent and good rate in the study group was significantly higher than that in the control group (85.4% vs 56.3%; P < 0.05). There was no significant difference between VAS and JOA score in the two groups preoperatively (P > 0.05). At 3 months after surgery, the VAS score in the study group was significantly lower than that in the control group (P < 0.05), and the JOA score in the study group was significantly higher than that in the control group (P < 0.05). There was no significant difference in serum PGE2, HA and 5-HT levels between the two groups preoperatively (P > 0.05). At 7 days after surgery, the serum PGE2, HA and 5-HT levels in the study group were significantly lower than those in the control group (P < 0.05). Preoperatively, the levels of serum MDA, MPO, SOD and TAC were not significantly different between the two groups (P > 0.05). On the seventh day after surgery, the levels of serum MDA and MPO in the study group were significantly lower than those in the control group (P < 0.05), and the levels of SOD and TAC were significantly higher than those in the control group (P < 0.05). In conclusion, the combined therapy of lateral recess decompression by Tessys technique and PTED in patients suffering from contralateral symptoms of lumbar disc herniation has a definite clinical effect, which can significantly alleviate the symptoms of low back pain and motor nerve function and reduce the contents of serum pain medium and the levels of oxidative stress. It is worthy of clinical promotion.

Keywords
contralateral symptom, lateral recess decompression, lumbar disc herniation, pain medium, transforaminal endoscope

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Lumbar disc herniation is a common clinical disease with multiple morbidity rates. The main manifestations are cauda equina syndrome, intermittent claudication, abnormal sensation of lower extremities and pain in the waist and leg, and it can even cause muscle cramps. In recent years, influenced by many factors, the incidence of lumbar disc herniation has increased year by year, and tends to be younger gradually, affecting the quality of life of Chinese people. Therefore, it is very important to take effective measures to treat lumbar disc herniation in order to improve the quality of life of patients. Intervertebral fenestration discectomy is a traditional surgical method for the treatment of lumbar disc herniation. Most patients can achieve the purpose of relieving symptoms and the curative effect is reliable. However, the operation is traumatic and easy to destroy the bone, the amount of bleeding during operation is more, which affects postoperative recovery. In recent years, with the rapid development of minimally invasive spine surgery techniques, percutaneous transforaminal endoscopic discectomy (PTED) surgery has been gradually applied in the treatment of lumbar disc herniation, for it has advantages of less surgical trauma, less intraoperative blood loss, faster postoperative recovery and less likely to affect spinal stability. Surgical indications of PTED include simple disc herniation, local infection debridement, lateral recess download and free intervertebral disc prolapse. However, because of the short application time of PTED in our country, most patients have doubts about it. In patients with lumbar disc herniation, due to the protrusion of one side of the lumbar intervertebral disc, the nerve root is compressed, resulting in contralateral limb numbness and pain. In some patients, the prominent intervertebral disc is on one side, and the clinical symptoms are on the other side, namely the contralateral symptoms of lumbar disc herniation. The pathogenesis of contralateral symptoms caused by disc herniation can be simply summarized by the following four points: (1) Immune factors. Naylor et al. thought that the nucleus pulposus is bloodless, so the antigen is closed. When it protrudes into the spinal canal, it can trigger antigen exposure and activate the immune response. Free antigen spreads around and irritates the contralateral nerve root. (2) Inflammatory factors. Broken intervertebral discs release inflammatory factors such as interleukin (IL)-1, IL-6 and tumour necrosis factor (TNF) and increase the intensity of local inflammation. (3) Oppression. Direct oppression causes nerve root structural damage, such as displacement of demyelination and langeone nodules. (4) Disorder of blood supply. Mild oppression or inflammation-mediated increase in vascular permeability leads to an impediment of nerve root blood flow, resulting in abnormal or irreversible damage to the nerve root. At present, there is no unified therapeutic method for the treatment of contralateral symptoms of lumbar disc herniation. Percutaneous transforaminal endoscopic spine system (Tessys) technique is developed by Dr Thomas and makes it possible to operate inside the spinal canal using foraminoplasty and widen the foramen between vertebrae. This article mainly discussed the effect of lateral recess decompression by Tessys technique combined with PTED on pain medium, nerve function and stress response in patients with lumbar disc herniation, in order to provide reference for the clinical treatment of contralateral symptoms of lumbar disc herniation.

**Materials and methods**

**General information**

A total of 96 patients with contralateral symptoms of lumbar disc herniation treated in our hospital from February 2015 to April 2017 were selected, including 50 males and 46 females, aged 43–60 years, mean (50.7 ± 2.2) years, duration of 3 months to 2.5 years, average (1.2 ± 0.4) years. All the patients had unilateral lesion, including 49 cases on the left side and 47 cases on the right side. Inclusion criteria: The patients met the diagnostic criteria for lumbar disc herniation developed by the Chinese Medical Association Orthopaedic Society; the patients with lumbar disc herniation were diagnosed with prolapse or protrusion of the corresponding segment of the lumbar intervertebral disc by computed tomography (CT) or magnetic resonance imaging (MRI) (see Figure 1); conservative treatment for more than 1 month without remission of symptoms; the imaging data were complete, and the symptom segments and prominent segments were corresponding, and patients with single-segment disc herniation, but the left and right sides were opposite; significant symptoms involving nerve roots of the lower extremities, including reduced muscle strength, partial relief after lying down, increased symptoms after walking, and
there was inductance, pain and numbness in the innervation area. Exclusion criteria: Patients associated with severe mental illness, metabolic disorders, visceral diseases and physical weakness; other degenerative diseases of non-single intervertebral disc herniation complicated with ossification of ligamentum flavum, ossification of posterior longitudinal ligament, lumbar spondylolisthesis and spinal canal stenosis; non-degeneration diseases such as tuberculosis, infection and tumours.

All patients were divided into control group and study group according to the random number table method. There were 48 cases in each group. All patients voluntarily participated in the study and signed informed consent. There was no significant difference in clinical data between the two groups (median age, lesion location, gender, etc.; \(P > 0.05\)), and they were comparable.

Methods

The control group underwent PTED. The study group underwent lateral recess decompression by Tessys technique combined with PTED. In detail, the patients were taken lateral position after anaesthesia and constantly monitored. Then, the Tessys technique was performed. In the middle of the centre, an incision of 12–14 cm was taken. In the direction of the 20–40 degree of intervertebral disc, under the guidance of X-ray machine, the needle directly reaches the external superior border of the superior articular process and anaesthetized the periosteum and joint capsule. Removing the superior articular lateral bursting bone with a blunt skull drill, the blunt head guide wire breaks through the bone cortex and reaches the intervertebral disc. In the case of unpalpable nerve root, the spun guide wire is inserted into the hard tissue in situ. Ensuring that the guide wire is unable to move, a guide wire is placed inside the parallel displacement device, and the bone is grind with the blunt bone drill again. According to the preoperative assessment of the degree of lateral recess stenosis (repeated 1–4 times), expanded the lateral recess to insert working lens and sleeve to remove the prominent nucleus pulposus. Under the endoscope, the root of the nerve was fluctuated and the pressure was completely reduced. Radiofrequency ablation was used to burn the joint capsule and fibrous ring to achieve the effect of constriction and haemostasis of the nucleus pulposus.

Observation indexes

1. One month after treatment, the clinical efficacy of the two groups of patients was compared. Judgement and assessment criteria: Excellent: symptoms disappear, no nervous system abnormalities were found, and normal life and work can be performed; Good: occasionally, there were leg pain and lumbago symptoms, but it did not affect basic life and work; Poor: symptoms of leg pain and back pain were frequent or aggravated, and straight leg raising tests were positive, affecting life and work.

2. The visual analogue scale (VSA) score and Japanese Orthopaedic Association (JOA) score were compared between the two groups before surgery and 3 months after surgery. Pain condition was assessed by VSA: 0 point meant painlessness and 10 points meant unbearably severe pain. JOA was used to assess the improvement of dysfunction: a full score of 29 points and a minimum score of 0. The lower the score, the more obvious the dysfunction.

3. The contents of serum pain medium were compared between the two groups before surgery and 7 days after surgery. The indexes of serum pain medium were mainly prostaglandin E2 (PGE2), histamine (HA) and...
5-hydroxytryptamine (5-HT), and they were detected by enzyme-linked immunosorbent assay (ELISA). The kits were purchased from Shanghai Future Industrial Co., Ltd.

4. The indexes of serum oxidative stress before surgery and 7 days after surgery were compared between the two groups. The serum oxidative stress indexes were mainly malondialdehyde (MDA), myeloperoxidase (MPO), superoxide dismutase (SOD) and total antioxidant capacity (TAC). ELISA was used to detect MDA, MPO, SOD and TAC. The kits were purchased from Shanghai Meilian Biotechnology Co., Ltd.

Statistical analysis

SPSS 21.0 software was used for data analysis. Measured data were expressed as mean ± SD. The t-test was used for comparison between groups. The count data were expressed as cases and chi-square test was used. \( P < 0.05 \) was considered statistically significant.

Results

Comparison of clinical effects between the two groups of patients

One month after treatment, the excellent and good rate in the study group was significantly higher than that in the control group (85.4% vs 56.3%); \( P < 0.05 \), as shown in Table 1.

| Group          | Case | Excellent | Good | Poor | Excellent and good rate (%) |
|----------------|------|-----------|------|------|-----------------------------|
| Study group    | 48   | 26        | 15   | 7    | 85.4                        |
| Control group  | 48   | 19        | 8    | 21   | 56.3                        |
| \( \chi^2 \)    |      |           |      |      | 9.416                       |
| \( P \)         |      |           |      |      | 0.017                       |

Comparison of VAS and JOA scores between the two groups of patients

There was no significant difference between VAS and JOA scores in the two groups preoperatively \( (P > 0.05) \). At 3 months after surgery, the VAS score in the study group was significantly lower than that in the control group \( (P < 0.05) \), and the JOA score in the study group was significantly higher than that in the control group \( (P < 0.05) \), as shown in Table 2.

Comparison of the contents of serum pain medium between the two groups of patients

There was no significant difference in serum PGE2, HA and 5-HT levels between the two groups preoperatively \( (P > 0.05) \). At 7 days after surgery, the serum PGE2, HA and 5-HT levels in the study group were significantly lower than those in the control group \( (P < 0.05) \), as shown in Table 2.

Comparison of the levels of oxidative stress between the two groups of patients

Preoperatively, the levels of serum MDA, MPO, SOD and TAC were not significantly different between the two groups \( (P > 0.05) \). On the seventh day after surgery, the levels of serum MDA and MPO in the study group were significantly lower than those in the control group \( (P < 0.05) \), and the levels of SOD and TAC were significantly higher than those in the control group \( (P < 0.05) \), as shown in Table 3.

Discussion

Lumbar intervertebral disc degeneration is the basic factor of lumbar disc herniation. The degeneration of nucleus pulposus is mainly manifested as the decrease of water content, and it can cause pathological changes such as destabilization and loosening of vertebral segment. The degeneration of the annulus fibrosus is mainly manifested by the decrease of the degree of tenacity. In addition, injury, inheritance, fatigue, sudden weight-bearing, congenital anomalies of the lumbosacral region and the anatomical factors of the intervertebral disc are also important inducing factors of lumbar disc herniation.

This study investigated the combination of lateral recess decompression by Tessys technique and PTED in patients with contralateral symptoms of lumbar disc herniation. The results showed that 1 month after treatment, the excellent and good rate was 85.4% in the study group, which was significantly higher than 56.3% of the control group. At 3 months after surgery, the VAS score in the study group was significantly lower than that in the
control group, and the JOA score in the study group was significantly higher than that in the control group. It is suggested that the lateral recess decompression by Tessys technique combined with PTED can significantly alleviate the symptoms of the lateral lumbar numbness, pain and motor nerve function caused by the protruding lumbar intervertebral disc compression, and the clinical effect is accurate.

The main cause of pain is the change of the levels of PGE2, HA and 5-HT in the circulating blood. The increased levels of PGE2, HA and 5-HT can reduce the pain threshold and increase the sensitivity of pain. At the same time, the above substances can also constrict the blood vessels and cause ischaemic injury to the nerve root.8–10 The results of this study showed that at 7 days after surgery, the serum PGE2, HA and 5-HT levels in the study group were significantly lower than those in the control group. It is suggested that lateral recess decompression by Tessys technique combined with PTED can reduce the contents of serum pain medium in patients, which was one of the main mechanisms for reducing pain sensation in patients. The body’s ability to resist oxidative stress can be used to reflect the body’s rehabilitation status. If the human body is stimulated by surgery or externally injured, the body’s oxidative stress can be

### Table 2. Comparison of VAS and JOA scores, the contents of serum pain medium and the levels of oxidative stress between the two groups of patients.

| Group        | Case | VAS Before surgery | VAS 3 months after surgery | JOA Before surgery | JOA 3 months after surgery | PGE2 (ng/mL) Before surgery | PGE2 7 days after surgery | HA (ng/mL) Before surgery | HA 7 days after surgery | 5-HT (μmol/L) Before surgery | 5-HT 7 days after surgery | MDA (nmol/L) Before surgery | MDA 7 days after surgery | MPO (mg/L) Before surgery | MPO 7 days after surgery | SOD (nU/mL) Before surgery | SOD 7 days after surgery | TAC (kU/L) Before surgery | TAC 7 days after surgery |
|--------------|------|--------------------|----------------------------|--------------------|---------------------------|----------------------------|----------------------------|---------------------------|------------------------|---------------------------|--------------------------|---------------------------|---------------------------|------------------------|--------------------------|------------------------|---------------------------|------------------------|
| Study group  | 48   | 7.42 ± 1.55        | 2.63 ± 1.32               | 13.87 ± 1.43       | 24.58 ± 2.26             | 5.77 ± 0.54                | 1.72 ± 0.36                | 246.65 ± 21.78        | 0.84 ± 0.07            | 0.19 ± 0.02               | 4.72 ± 0.34               | 1.45 ± 0.27               | 2.96 ± 0.45               | 0.78 ± 0.19              | 53.68 ± 2.75             | 72.01 ± 5.16            | 6.15 ± 1.19               | 9.74 ± 1.25             |
| Control group| 48   | 7.38 ± 1.61        | 4.15 ± 1.41               | 13.75 ± 1.52       | 20.33 ± 2.12             | 5.74 ± 0.48                | 2.58 ± 0.51                | 246.52 ± 19.81        | 0.83 ± 0.06            | 0.48 ± 0.05               | 4.69 ± 0.36               | 2.37 ± 0.21               | 2.94 ± 0.42               | 1.31 ± 0.23              | 53.59 ± 2.71             | 65.97 ± 4.62            | 6.13 ± 1.25               | 8.16 ± 1.37             |
| t            | 0.601| 0.327              | 0.036                      | 0.911              | 0.413                    | 0.028                      | 0.157                    | 5.852                    | 6.204                 | 0.368                    | 7.106                    | 0.183                    | 5.006                    | 0.256                   | 0.026                  | 2.58                   |
| P            | 0.327| 0.523              | 0.026                      | 0.133              | 0.705                    | 0.021                      | 0.183                    | 5.988                    | 6.075                 | 0.256                    | 5.006                    | 0.336                    | 0.037                    | 0.279                   | 0.012                  | 2.37                   |

### Table 3. Comparison of VAS and JOA scores between the two groups of patients (point).

| Group        | Case | VAS Before surgery | VAS 3 months after surgery | JOA Before surgery | JOA 3 months after surgery |
|--------------|------|--------------------|----------------------------|--------------------|---------------------------|
| Study group  | 48   | 7.42 ± 1.55        | 2.63 ± 1.32               | 13.87 ± 1.43       | 24.58 ± 2.26             |
| Control group| 48   | 7.38 ± 1.61        | 4.15 ± 1.41               | 13.75 ± 1.52       | 20.33 ± 2.12             |
| t            | 0.601| 0.327              | 0.036                      | 0.911              | 0.413                    |
| P            | 0.327| 0.523              | 0.026                      | 0.133              | 0.705                    |

VAS: visual analogue scale; JOA: Japanese Orthopaedic Association.  

PGE2: prostaglandin E2; HA: histamine; 5-HT: 5-hydroxytryptamine; MDA: malondialdehyde; MPO: myeloperoxidase; SOD: superoxide dismutase; TAC: total antioxidant capacity.
significantly affected. Therefore, changes in indexes of antioxidant stress such as MDA, MPO, SOD and TAC can be used to reflect the recovery of human disease. The results showed that 7 days after surgery, the levels of serum MDA and MPO in the study group were significantly lower than those in the control group, and the levels of SOD and TAC were significantly higher than those in the control group. It is suggested that lateral recess decompression by Tessys technique combined with PTED can reduce serum oxidative stress.

In summary, lateral recess decompression by Tessys technique combined with PTED has a definite clinical effect, which can significantly alleviate the symptoms of low back pain and motor nerve function and reduce the contents of serum pain medium and the levels of oxidative stress. It is worthy of clinical promotion.

**Declaration of conflicting interests**
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