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Transforaminal Endoscope for the Treatment of Thoracic Disc Herniation

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Abstract: ***Objective:*** Transforaminal endoscope was used in the treatment of thoracic disc herniation and the therapeutic effect was discussed. ***Methods:*** Sixteen patients with thoracic disc herniation admitted to our hospital from October 2018 to May 2019 were divided into control group and observation group according to the random number table method, with 8 patients in each group. The control group was treated with posterior laminectomy approach, and the observation group was treated with transforaminal endoscope. The surgery-related conditions (intraoperative blood loss, surgery time, and postoperative drainage volume), VAS score, JOA score and postoperative complications were compared and analyzed. ***Results:*** There was no statistically significant difference between the two groups in the total effective rate and preoperative VAS score ($P > 0.05$). Compared with the control group, the observation group had shorter surgery time and incision length, less postoperative drainage volume, and higher VAS score 3 days after surgery, JOA score on day 7 after surgery, and JOA score 3 months after surgery, showing statistically significant differences ($P < 0.05$). There was no significant difference in the complications between the two groups (X^2=1.067, P=0.833). ***Conclusions:*** Transforaminal endoscope had a good clinical effect with small incision and injury in the treatment of patients with thoracic disc herniation.

Keywords: Transforaminal endoscope; Thoracic disc herniation; Clinical effect

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Intervertebral discs are mainly composed of nucleus pulposus, annulus fibrosus, and cartilaginous plates. Thoracic disc herniation is mainly the related signs and symptoms caused by the intervertebral disc tissue compression on the conic thoracic spinal cord, and spinal deformity or disc degeneration is the main factor of thoracic disc disease. The clinical manifestations of the patients are mainly sensory disorders, muscle weakness and pain[1]. In clinic, transpedicular approach, lateral extrapleural approach or costotransverse approach are often used for the treatment of patients with thoracic disc herniation, but the patients may suffer from large wound surface, long recovery period and more postoperative complications. In recent years, the application of transforaminal endoscope has been gradually popularized in clinical practice. Therefore, in this study, patients with thoracic disc herniation were treated with transforaminal endoscope, and its efficacy was further discussed. The specific summary is as follows.

1 Materials and methods

1.1 General data

Sixteen patients with thoracic disc herniation admitted to our hospital from October 2018 to May 2019 were divided into control group and observation group according to the random number table method, with 8 patients in each group. The observation group included 6 males and 2 females, aged 26-57 years, with the average age of (41.57±3.21) years; the course of disease was 0.5-2 years, with the average time of (1.27±0.24) years. The control group included 5 males

and 3 females, aged 27-55 years, with the average of (41.42±3.15) years; the course of disease was 0.5-2 years, with the average time of (1.25±0.21) years. There was no statistically significant difference in the general data between the two groups (P>0.05), which was comparable. This study has been approved by the medical ethics committee of our hospital.

1.2 Inclusion criteria

Inclusion criteria: (1) After MRI and CTM examination, patients were consistent with thoracic disc disease, with the changes of sensory level and lower limb muscle strength, and the diagnosis was clear; (2) All patients understood the study and agreed to sign the informed consent; (3) Calcified thoracic disc herniation was excluded; (4) Patients with failed conservative treatment. Exclusion criteria: (1) Patients who experienced other major surgeries in the past 3 months prior to the study; (2) Patients with contraindications.

1.3 Methods

Control group: the control group was treated with posterior laminectomy approach. Patients were given general anesthesia and monitored for the vital signs. The herniated disc was removed by entering the inferior transverse and articular processes on one or both sides of the affected side. An opening was made in the posterior orthotopic center of the lesion to expose the articular processes, spinous processes and vertebral plate around the lesion. An oscillating saw was used to cut the outer vertebral plate from the upper and lower portions of the vertebra in intervertebral disc space along the medial side of the articular process of both sides to reach the inner plate, but the inner plate was not incised temporarily to prevent injury to the spinal cord caused by the oscillating saw. Then, a thin osteotome was used to break the inner plate from bottom to top along the vertebral plate until the spinous process vertebral plate can be swung. The interspinous, supraspinous and yellow ligaments were cut off, and then the spinous process was raised to lift the periosteum stripper. The spinous process vertebral plate of the upper and lower vertebrae of the lesion was completely removed for later use, and the connection between the interspinous, supraspinous and yellow ligaments and the vertebral plate of the two spinous processes was ensured (using the uncovering method). The thoracic spinal cord was fully exposed after uncovering. The deep intervertebral disc and part of the bone are hollowed out from both sides to make a culvert (using culvert method). Then the thoracic spinal cord was gently pulled to gradually remove the protruding thoracic disc until the removal of compression of thoracic spinal cord.

Observation group: the observation group was treated with transforaminal endoscope. Patients were placed in the prone position to suspend the abdomen. The midline of the spinous process was marked, and body surface markers and approach were drawn for accurate positioning. Parallel to the target intervertebral space of about 5-7cm away from the midline, 5-10 ml of 0.5% lidocaine was used for anesthesia injection of the skin fascia and intervertebral foramen area. Then the puncture was performed, with the location of the puncture in the protruding intervertebral disc. The guide wire was placed, and the catheter was placed from small to large, which should be against the bone surface, and the middle catheter was removed then. The articular process bones that need to be ground in the path were ground so as to expand the intervertebral foramen and the operating path. Due to the limited thoracic disc height, it is necessary to use trephine to remove part of the posterior margin of the vertebral body. Finally, the transforaminal endoscope was inserted through the working channel to complete the establishment of the channel. The endoscope was inserted and the anatomical structure of the spinal canal was identified. The dural sac, posterior longitudinal ligament, protruding nucleus pulposus and intervertebral disc annulus were identified accordingly. If bleeding, radio frequency can be used for hemostasis, avoiding the contact of the dura sac with radiofrequency. By rotating into the intervertebral space, the deep intervertebral disc tissues on the both sides were removed, and then the curved nucleus pulposus clamp was used to process the part that protruded and compressed the thoracic spinal cord from both sides until the nucleus pulposus was removed, the pulsation of the dural sac was observed to be good, and the ascending thoracic spinal cord fell back. A drainage tube was placed on both sides of the path and the incision was sutured with only one stitch. After surgery, patients were given neurotrophic drugs and dehydrating drugs for 3 days, and were requested to rest in bed. The drainage tube could be removed at the 2nd day after surgery and the patients were encouraged to get out of bed.

1.4 Evaluation indicators

(1) The clinical efficacy of the two groups of patients was observed and compared[2-3], which was divided into

markedly effective: symptoms completely disappeared and signs improved, effective: symptoms basically disappeared and signs relieved, ineffective: symptoms and signs had no significant improvement than those before surgery, or even worse, total effective rate = markedly effective rate + effective rate.

(2) The surgery time of the two groups was observed and recorded, and the pain sensation of the two groups was evaluated according to the VAS pain scale[4], which was divided into 0-10 points, with 0 considered as painless, 1-3 as mild pain, 4-6 as moderate pain, and 7-10 as severe pain; JOA scores at 7 days and 3 months after surgery: the Japanese Orthopaedic Association (JOA) Score for Low Back Pain was used to evaluate the waist function of patients: Improvement rate =[(post-treatment score - pre-treatment score)/(full score - pre-treatment score)]×100%. The full score is 29 points. Higher scores indicate more obvious waist dysfunction.

(3) Complications: the patients were observed for spinal cord injury, dural injury, and sensory abnormalities in the innervated area of the outlet nerve root.

1.5 Statistical methods

SPSS 23.0 software was used for data processing. Measurement data were expressed as $\bar{x} \pm s$ and analyzed by t test. Enumeration data were expressed as n (%) and adopted with the X^2 test. If the theory of sample size was 40, or $1<T\leq5$, the exact probability calculation method should be adopted, namely the Fisher's exact test. Ranked data were adopted with rank sum test. $P < 0.05$ was considered as statistically significant difference.

2 Results

2.1 Clinical efficacy

The results of the rank sum test showed that there was no statistically significant difference between the two groups in the therapeutic effect ($P > 0.05$). The total effective rate of the two groups was consistent and not comparable, as shown in Table 1.

Table 1. Comparison of clinical efficacy between two groups n (%)

Group	Markedly effective	Effective	Ineffective	Total effective rate
Control group (n=8)	2 (25.00)	5 (62.50)	1 (12.50)	7 (87.50)
Observation group (n=8)	4 (50.00)	3 (37.50)	1 (12.50)	7 (87.50)
Z		0.810		-
P		0.418		-

2.2 Comparison of surgical indicators, VAS score and JOA score

There was no statistically significant difference in preoperative VAS score between the two groups ($P > 0.05$). Compared with the control group, the observation group had shorter surgery time and incision length, less postoperative drainage volume, higher VAS score at 3 days after surgery, JOA score on day 7 after surgery, and JOA score at 3 months after surgery, indicating statistically significant differences ($P < 0.05$, Table 2).

Table 2. Comparison of surgical indicators, VAS score and JOA score ($\bar{x} \pm s$)

Group	Surgery time (min)	Incision length (cm)	Postoperative drainage volume (mL)	Preoperative VAS score (point)	VAS score at 3 day after surgery (point)	JOA score on day 7 after surgery (point)	JOA score at 3 months after surgery (point)
Control group (n=8)	78.05±11.92	2.85±1.02	115.12±5.85	7.21±2.53	4.52±1.42	10.93±1.30	18.56±2.06
Observation group (n=8)	71.52±8.23	0.52±0.13	20.02±2.23	7.19±2.24	2.43±0.85	16.63±1.85	23.12±2.31
t	1.275	6.409	42.964	0.017	3.572	7.130	4.167
P	0.223	0.000	0.000	0.987	0.003	0.000	0.001

2.3 Complications

There were 2 cases of muscle weakness in lower extremity in the control group after surgery, with the total incidence of 12.50% (1/8), and 1 case in the observation group, who was recovered after three months of treatment. There was no statistically significant difference in the complications between the two groups (X^2=1.067, P=0.833). Note: P is accurately tested by Fisher test.

3 Discussion

Thoracic disc herniation is mainly manifested as muscle tension increase and lower limb weakness, which damages the upper motor neurons; and it is impossible to avoid the possibility of protruding nerve root compression and intercostal neuralgia. The level of the thoracolumbar segment from the head to the tail is followed by the nerve structures such as the spinal cord, cone, and cauda equina nerve. With the protrusion and compression of different parts, the upper and lower motor neurons may also suffer from mixed injuries, or single upper and lower motor neuron injury, so clinical misdiagnosis or misdiagnosis often occur[5]. Clinically, surgical treatment is used for symptomatic thoracic disc herniation.

The results of this study showed that, compared with the control group, the observation group had shorter surgery time and incision length, less postoperative drainage volume, higher VAS score at 3 days after surgery, JOA score on the day 7 after surgery and JOA score at 3 months after surgery, indicating that the treatment of transforaminal endoscope in patients with thoracic disc herniation can relieve postoperative pain degree and promote the recovery of waist function.

This is because posterior vertebral plate resection approach the joints must be joint resection with inferior pedicle, incision length, need assisted pedicle internal fixation, hemorrhage, trauma, although can reduce the risk of spinal cord compression and pull, but for the central type or near the central type is outstanding, because the chest pulp to pull and sensitive to potential risks are still great[6].

The reason is that the posterior laminectomy approach requires the removal of the articular process joint and the lower vertebral pedicle. The surgical incision is long, and the auxiliary pedicle internal fixation is required. There is much bleeding and trauma. Although the risk of spinal cord compression and traction can be reduced, for central or paracentral protrusion, there is still a great potential risk because thoracic spinal cord is extremely sensitive to traction[6]. Conventional open surgery is very easy to squeeze and stimulate thoracic spinal cord, and the biggest advantage of the endoscope is to operate directly in front of the spinal cord. With the grinding and drilling under the endoscope and the direct treatment of protruding and compressing part under direct vision, the stimulation of the spinal cord is reduced, which can greatly reduce the damage to the surrounding tissues and make up for the disadvantages of traditional surgery. Moreover, there is no need to peel the muscle during the surgery or to remove the anatomical structures such as facet joint and vertebral plate, so the stability of the spine will not be damaged [7-8]. In the treatment of transforaminal endoscope, local anesthesia is adopted, and the patient is awake during the treatment, which is convenient to determine whether the patient has nerve injury according to the response of the patient during the surgery. The spinal cord injury is monitored and avoided through the sensory activities of the lower limbs of the patient during the local anesthesia. By means of puncture and gradual expansion of the catheter, the fragmented nucleus pulposus can be removed under the endoscope, so as to relax and reduce the pressure of the spinal cord. In addition, there is no need to stretch the dura mater and nerve root during the surgery, and the incision is only 8mm, which is relatively small and effective compared with traditional surgery [9-10]. Postoperative direct suture does not require drainage, and patients can be guided to get out of bed on the 1st day after surgery to promote recovery, and can be discharged on the 4th day after surgery. Thus it can be seen that the treatment of transforaminal endoscope causes a small wound to the patients, which is conducive to the recovery of the patients. However, there are some limitations in this study. The number of samples included is small, and the reliability of the research results still needs to be verified by more prospective studies with large samples and multi-centers in the future.

In summary, for patients with thoracic disc herniation, transforaminal endoscope is adopted to treat intervertebral disc directly in front of the spinal cord, which is safe and effective, with not only minimally invasive but also good clinical effect.

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