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Clinical Study on Treatment of Type II/III Lumbar Brucellar Spondylitis by Unilateral Biportal Endoscopy

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Abstract

Objective: Explore the feasibility and clinical efficacy of using unilateral biportal endoscopy for the treatment of Type II/III lumbar brucellar spondylitis. **Methods:** A retrospective study of the clinical data of 20 patients with Type II/III lumbar brucellar spondylitis admitted to the First Affiliated Hospital of Hebei North University from January 2020 to May 2022, including 15 males and 5 females, aged 41 - 60 years old, average age (48.11 ± 7.28) years old. After admission, the patient can isolate brucella through metagenomic Next-Generation Sequencing (mNGS), meeting the tertiary diagnostic criteria. Preoperative conventional drug treatment, unilateral biportal endoscopic minimally invasive surgery was performed when nutrition was improved, perioperative control of various indexes was stable, and erythrocyte sedimentation was declining. It was completed under an endoscope. The lesion was cleared, spinal nerve compression was relieved, interbody fusion was performed, and the spine was fixed by a percutaneous pedicle screw. Erythrocyte Sedimentation Rate (ESR), C-Reactive Protein (CRP), Visual Analogue Scale (VAS), Japanese Orthopedic Association (JOA) score and Oswestry Disability Index (ODI) were analyzed at 1 month, 3 months, 6 months and the last follow-up. At the final follow-up of all patients, the clinical efficacy criteria and the Bridwell grading criteria were used to evaluate the recovery and intervertebral bone graft fusion, respectively. **Results:** All patients' lower back and leg pain was relieved the next day after surgery. At a follow-up of one month after surgery, both systemic and local symptoms significantly improved. At the last follow-up, clinical symptoms disappeared and there was no tenderness or percussion pain in the local area. With the passage of time, 1 month, 3 months, 6 months after the operation, and the last follow-up are all evaluation indicators compared with those before the operation. No matter VAS, JOA, ODI score, or ESR,

CRP is significantly improved compared with preoperative ($P < 0.05$). All 20 cases in this group reached the BS clinical cure standard, and the excellent rate of intervertebral bone graft fusion was 95%. **Conclusion:** On the basis of standardized drug treatment, as long as the indications are well grasped, unilateral biportal endoscopy is safe and feasible for the treatment of lumbar brucellar spondylitis and has good clinical efficacy.

Keywords

Brucellar Spondylitis, Minimally Invasive Surgery, Unilateral Biportal Endoscopy, Clinical Efficacy

1. Introduction

Brucellar Spondylitis (BS) is an infectious vertebral discitis or spondylitis caused by zoonotic infectious brucellosis invading the spine. It is a kind of specific infectious spondylitis in which intervertebral disc destruction, vertebral body destruction, abscess formation and inflammatory granulation tissue compress spinal cord, cauda equina or nerve roots, leading to bone and joint destruction and spinal dysfunction [1]. The lumbar spine is the most common, followed by the thoracic and cervical spine [2]. Standardized drug therapy is the most important and reliable method for the treatment and prevention of BS recurrence, and the prognosis is usually good [3]. However, surgical intervention may be required for patients with progressive kyphotic aggravation, neurological dysfunction, spinal instability, abscess formation, intractable low back pain, and failure to respond to conservative treatment [4] [5].

In recent years, Unilateral Biportal Endoscopy (UBE) has been widely used in the treatment of spinal diseases. This kind of minimally invasive surgery can effectively protect stable structures around the spine, such as ligament muscles, and maintain the stability of the spine, with advantages such as small incisions, less trauma, and faster postoperative recovery [6]. With the wide clinical application of this technique, its surgical indications have gradually expanded. Some scholars have applied this technique to treat infectious spinal lesions, such as epidural abscess, suppurative spondylitis and spinal tuberculosis [7] [8] [9], and can effectively reduce postoperative complications. However, it has not been reported that this operation has been used in the treatment of short-segment lumbar brucellar spondylitis. Therefore, this study retrospectively analyzed lumbar BS patients treated with the unilateral biportal endoscopy technique, with the aim of evaluating the feasibility and clinical efficacy of the unilateral biportal endoscopy technique in the treatment of lumbar brucellar spondylitis.

2. Data and Methods

2.1. Inclusion Criteria

1) According to the MRI findings, Type II (intervertebral discitis type), Type III

(psoas abscess type) or Type II with Type III, the systemic symptoms are improved on the basis of drug treatment, but the local symptoms are not significantly relieved; 2) The infection involved 1 segment; 3) The clinical data is complete, and the postoperative follow-up is not less than 1 year.

2.2. Exclusion Criteria

1) According to MRI findings, Type IV (bone destruction type), Type V (spinal nerve compression type); 2) Infection involves more than 2 segments; 3) Infected with other bacteria; 4) The follow-up data are incomplete or lost to follow-up.

2.3. General Information

Clinical data of 20 patients with lumbar brucellar spondylitis who met the inclusion criteria in the First Affiliated Hospital of Hebei North University from January 2020 to May 2022 were retrospectively analyzed. 20 patients were treated with UBE surgery, including 15 males and 5 females, aged 41 - 60 years. The mean age was (48.11 ± 7.28) years old. Before admission, the epidemiological history, clinical manifestations, imaging, and laboratory serological specific examinations (both rosebengal plate agglutination test and standard tube agglutination test were positive) met the clinical diagnostic criteria [10]. After admission, Brucella was isolated in 20 patients through metagenomic Next-Generation Sequencing (mNGS), it meets the precision diagnostic criteria, namely the three-level diagnostic criteria (standardized diagnosis is divided into three steps). All operations were performed by the same chief physician team. All patients were followed up smoothly, and there was no loss of follow-up or death.

This clinical study was authorized and approved by the Ethics Committee of the First Affiliated Hospital of Hebei North University (batch number: 2020-08), and the patients and their families were informed of the clinical treatment plan, and the informed consent of the treatment plan was signed.

2.4. Treatment Methods

2.4.1. Preoperative Preparation and Medication Plan

After admission, patients were given more bed rest and health education about brucellar spondylitis was implemented to improve medication compliance. X-ray, CT and MRI examinations of the diseased segments of the spine were completed to determine the extent of the damaged intervertebral disc. Patients were provided with enhanced systemic nutritional support according to individual needs before surgery to correct malnutrition indicators such as low body weight, hypoproteinemia and anemia, so as to effectively control their own internal diseases. Preoperative anti-brucellosis treatment with drugs was performed, and combined, appropriate, regular and whole-course administration was adopted.

Doxycycline + rifampicin + sulfamemethylisooxazolstreptomycin was the first choice for confirmed cases routinely [3], and patients' liver and kidney functions as well as drug side effects were regularly monitored during drug treatment. Surgical treatment can only be performed after drug treatment until nutrition is improved

(hemoglobin ≥ 100 g/L, albumin ≥ 45 g/L), all indicators are stable in the perioperative period, and erythrocyte sedimentation rate indicators show a downward trend and are not higher than 40 mm/h [11].

2.4.2. Surgical Methods of UBE

According to the preoperative imaging evaluation, the responsible vertebra was determined, and C-arm fluoroscopy positioning was performed. 1 cm was taken from the midline of the paraspinal process of the responsible vertebra, and 0.5 - 1.0 cm incisions were made at 1.5 cm above and below each as the observation channel and operation channel entrance. The skin and subcutaneous tissue were cut with a sharp knife to separate the multifidus space. The proximal end was used as the observation channel and the distal end as the operation channel. The adipose tissue outside the laminae and local muscle fiber tissue were cleaned with large radiofrequency to form a space for operation. The lower articular process and part of the lower margin of the upper lamina were removed to the origin of exposed ligamenta flava by bone knife, bone biter and grinding drill alternately. Remove part of the upper margin of the lower lamina to the insertion of exposed ligamenta flavum. Use a pendulum saw under the endoscopy to remove the tip of the upper articular process of the lower vertebral body, and bite off the remaining bone and the inner side of the upper articular process with a rongeur until the lateral ligamentum flavum and the inner edge of the pedicle are exposed, between the walking root and the exit root create space. The direction of the endoscopy was adjusted, and the lens of the endoscope crossed the middle gap of the ligamenta flavum to achieve "over-the-top". The bone of the medial lamina of the opposite upper vertebra was ground again, and the space between the lamina and ligamenta flavum was established until the inner edge of the contralateral pedicle and the superior articular process of the lower vertebral body were exposed. After the completion of bone decompression, gun forceps and nucleus pulposus forceps were used to completely remove the yellow ligament covering the dura mater and nerve roots, fully exposing inflammatory lesions, dura mater and nerve roots. Light red non-caseous inflammatory granulation tissue is seen pressing the dura mater and nerve roots under endoscopy. A hook probe is used to expose the inflammatory granulation tissue. Use the radio frequency electrocoagulation cutter head to carefully stop the bleeding of the dilated blood vessels, alternately use the nucleus pulposus forceps and rongeurs to grasp and remove the inflammatory granulation tissue, remove the abscess and granuloma in the spinal canal, and completely scrape the bone destruction behind the vertebral body area and infected intervertebral disc tissue until normal vertebral body oozing blood can be seen. Rifampicin mixed with autogenous bone was implanted in the anterior part of the intervertebral space and compacted. Under the supervision of the endoscopy, a cage filled with autogenous bone mixed with rifampicin was placed. The diseased tissue was sent for pathological examination. After repeated rinsing of gentamicin brine, streptomycin powder is placed. Pedicle nails coated with streptomycin were percutaneous inserted into the diseased vertebra. The fixing rod

is arranged and the screws are fixed with pressure. A drainage tube was placed and sutured layer by layer.

2.4.3. Postoperative Management

Intravenous antibiotics were given 24 h after surgery to prevent infection. Oral Imrecoxib reduces postoperative pain; The drainage tube should be removed when the drainage volume in the operation area is less than 30 mL/24h; 1 - 2 days after surgery can wear waist circumference out of bed activities; Continued regular oral doxycycline, rifampicin and sulfamethylethoxazole combined treatment for at least 4 months, three consecutive reexaminations of ESR, CRP, SAT results in the normal range can be stopped. The liver and kidney function should be monitored regularly during the treatment. Before the patient was discharged from the hospital, the lumbar anteroposterior and lateral radiographs and lumbar CT were reviewed to evaluate the bone grafting situation, the position of the fusion cage and the screw-rod system; Lumbar MRI was re-examined to evaluate decompression and lesion clearance; Waist protection lasts for 3 months.

2.5. Observation Index

ESR, CRP, Visual Analogue Scale (VAS), Japanese Orthopedic Association (JOA) score and Oswestry Disability Index (ODI) were analyzed before operation, before discharge, after 1 month, 3 months, 6 months, and at the last follow-up; Lumbar anteroposterior and lateral radiographs were re-examined at 1 month, 3 months, 6 months after operation and at the last follow-up, and the intervertebral bone fusion was evaluated using the Bridwell grading standard [7]. For those who were not clear on X-ray, CT was further evaluated.

2.6. Statistical Methods

SPSS 26.0 software was used for statistical analysis. Measurement data were expressed as ($\bar{\chi}$ ± s); VAS, JOA score and ODI were compared at each time point before and after surgery by single factor repeated measurement data analysis of variance; t test was used to evaluate the changes of ESR and CRP at each time point before and after surgery. $P < 0.05$ was statistically significant.

3. Results

All patients were relieved of lumbago and lower extremity radiation pain the next day after surgery, and their systemic symptoms and lumbago and back pain were significantly improved at 1 month postoperative follow-up. At the last follow-up, clinical symptoms disappeared and local tenderness and percussion pain were not present. The VAS score was (5.87 ± 1.28) points before surgery, (2.46 ± 0.42), (1.28 ± 0.21), (0.81 ± 0.39), (0.51 ± 0.15) points at the last follow-up 1, 3, 6 months after surgery, and the difference was statistically significant ($P < 0.01$); The ODI was 59.87% ± 11.38% before surgery, 35.11% ± 8.57%, 27.47% ± 7.01%, 10.28% ± 3.35%, 6.05% ± 1.22% at 1 month, 3 months, 6 months and the last follow-up, respectively, with statistical significance ($P < 0.001$); The JOA score

was (12.87 ± 2.23) points before surgery, and (22.21 ± 1.85), (25.24 ± 0.89), (26.37 ± 1.11), (28.78 ± 1.09) points at 1 month, 3 months, 6 months and the last follow-up, respectively, with statistical significance ($P < 0.001$). Intervertebral bone fusion at the last follow-up: excellent in 16 (80%) cases, good in 4 (20%) cases, fair in 0 cases, and poor in 0 cases, with an excellent and good rate of 95%.

The preoperative ESR was (41.62 ± 16.78) mm/h, which decreased to (29.43 ± 9.58) mm/h before discharge. There was no statistically significant difference compared to preoperative ESR ($t = 1.41$, $P = 0.17$). At 1 month, 3 months, 6 months, and the last follow-up, it decreased to (24.81 ± 3.58) ($t = 3.71$, $P = 0.001$), (20.35 ± 2.62) ($t = 6.1250$, $P < 0.001$), (15.91 ± 1.66) ($t = 6.16$, $P < 0.001$), (5.09 + 4.85) ($t = 9.22$, $P < 0.001$) mm/h, respectively, with a statistically significant difference compared to before surgery. The preoperative CRP was (45.56 ± 12.26) mg/L, and before discharge was (28.68 ± 12.53) mg/L, with no statistically significant difference compared to preoperative ($t = -0.41$, $P = 0.69$); At 1 month, 3 months, 6 months, and the last follow-up, the levels decreased to (23.54 ± 4.54) mg/L ($t = 2.85$, $P = 0.04$), (15.23 ± 1.01) mg/L ($t = 3.95$, $P = 0.001$), (7.69 ± 1.27) mg/L ($t = 4.21$, $P = 0.001$), and (4.13 ± 1.11) mg/L ($t = 4.95$, $P < 0.001$), respectively, with statistically significant differences compared to before surgery. All the 20 cases in this group reached the BS clinical cure standard at the last follow-up [12].

4. Discussion

4.1. Clinical Diagnosis and Typing of BS

At present, there is no unified diagnostic standard for BS, and the diagnosis should be combined with epidemiological history, clinical manifestations, laboratory examination, imaging examination, and pathological examination for comprehensive diagnosis. According to our clinical experience, the diagnostic criteria are divided into hierarchical diagnosis (tertiary diagnosis): 1) primary diagnosis (preliminary diagnosis or suspected diagnosis): a history of bruceopathy, clinical manifestations of systemic intoxication of bruceopathy and local symptoms of infectious spondylitis, with BS imaging characteristic features; 2) Secondary diagnosis (clinical diagnosis): after the initial diagnosis, laboratory tests showed RBPT positive and/or pathological tests showed BS histological characteristics; 3) Tertiary diagnosis is the confirmed diagnosis: those who meet the criteria of primary diagnosis or secondary diagnosis, and one or more test items of SAT, CFT and Coomb's are positive, or Brucella is isolated from bacterial culture and mNGS. In recent years, the MRI imaging manifestations of BS have generally received attention from scholars both domestically and internationally. It has transitioned from auxiliary examinations after clinical diagnosis to first being discovered and preliminarily diagnosed by MRI imaging, followed by laboratory specific examination for brucellosis to obtain a confirmed diagnosis. Clinically, BS meeting the criteria of tertiary diagnosis, namely confirmed diagnosis, were divided into I - V types: Type I (vertebral inflammatory type), Type II (intervertebral disc inflammatory type), Type III (abscess type), type IV (bone de-

struction type), Type V (spinal cord nerve compression type), and Type VI (Two or more types coexist mixed type).

4.2. Feasibility of Unilateral Biportal Endoscopy for Treatment of Type II/III Lumbar Brucellar Spondylitis

With the development of spinal surgery and drug research and development, the effectiveness of surgical treatment for BS has been recognized by scholars at home and abroad. The main method of surgery is posterior or anterior posterior combination, one-stage debridement, intervertebral bone grafting, and spinal fixation [13] [14]. The purpose of surgery is to completely clear the infected lesion, relieve or eliminate pain, relieve spinal cord or cauda equina and nerve root compression, improve nerve function, rebuild spinal stability and restore normal spinal sequence [15]. Redferns [16] and Yin *et al.* [17] achieved good clinical results in the treatment of non-tuberculous spinal infection and BS by anterior debridement, interbody fusion and internal fixation, respectively. The anterior approach surgery achieves sufficient lesion clearance and intervertebral fusion while not affecting the stability of the posterior column of the spine. However, the anterior approach surgery takes a long time, insufficient spinal nerve decompression, and complications such as vascular injury, bone grafting failure, and postoperative intestinal obstruction may occur [13]. Traditional posterior open surgery makes up for the shortcomings of anterior surgery. Although it has achieved good clinical efficacy as a classic operation, its destruction of the muscle ligament structure behind the spine can lead to postoperative complications such as chronic lumbago and muscle atrophy [18]. In recent years, with the widespread clinical application of unilateral biportal endoscopy, its surgical indications have expanded from simple spinal degenerative diseases to spinal infectious diseases and even epidural tumor resection [19], and the therapeutic effect is comparable to that of traditional open surgery. Chu *et al.* [20] successfully treated epidural abscess patients with biportal endoscopy in 2019. Hsu *et al.* [21] used unilateral biportal endoscopy discectomy and debridement to treat salmonella spondylitis with epidural abscess, and the postoperative effect was good. In 2021, Kim *et al.* [9] successfully treated patients with spinal tuberculosis through biportal endoscopy debridement and percutaneous screw fixation. Postoperative follow-up of the 20 patients with lumbar spine BS included in this study reached the standard of clinical cure [12]. According to the above series of literature reports and our study results, biportal endoscopy is feasible for the treatment of lumbar spine BS.

4.3. Advantages and Clinical Efficacy of Unilateral Biportal Endoscopy for Treatment of Type II/III Lumbar Brucellar Spondylitis

The treatment of Type II/III lumbar spine BS by unilateral biportal endoscopy has the advantages of less trauma, rapid recovery and short hospital stay. Compared with foraminoscope, endoscopic debridement and decompression under biportal endoscopy can ensure more thorough and adequate debridement, and it

is safer and more efficient to treat intervertebral space and operate bone graft fusion. It can not only ensure adequate decompression and effective debridement on the ipilateral side, but also clear contralateral lesions and decompress across the top, with less damage to the posterior muscle ligament and bone structure. So as to reduce postoperative lumbago, muscle atrophy, spinal instability and other complications. In the process of treating endplate cartilage, endoscopic curettage is more clear, clean and perfect, and bone grafting and cage implantation are safer. Continuous saline irrigation during the operation can remove most pathogenic bacteria, pus and inflammatory factors in the lesion and discharge them in time. At the same time, percutaneous screw fixation can effectively maintain or rebuild spinal stability, help control inflammation, and promote bone healing, which truly embodies the minimally invasive concept of endoscopic open surgery. Through the clinical application of this group, the author believes that the unilateral biportal endoscopy can treat BS indications: according to clinical classification, Type II, Type III or Type II with Type III, systemic symptoms improved on the basis of drug treatment, but local symptoms no significant relief. After surgical treatment, the symptoms of low back pain and lower extremity radiating pain in this group of patients were significantly relieved. With the passage of time, the symptoms of infectious spondylitis gradually disappeared. Regardless of VAS, JOA, ODI scores, or ESR, CRP was significantly improved compared with preoperative ($P < 0.05$). The 20 cases in this group all reached the BS clinical cure standard at the last follow-up, and the excellent and good rate of intervertebral bone graft fusion was 95%.

4.4. Limitations of Unilateral Biportal Endoscopy for Treatment of Type II/III Lumbar Brucellar Spondylitis

UBE has many advantages and good efficacy in the treatment of lumbar spine BS, but it also has its limitations. During the surgery, a workspace needs to be created between the multifidus muscle and the spinous process. If the cavity is too large, the formation of dead space after surgery is prone to fluid accumulation and abscess formation. If the intraoperative water pressure is too high, it is easy to cause peripheral edema and the risk of infection spreading; Difficulty in managing dural tear during surgery can easily lead to intraspinal infection. It is not possible to display the boundary of the lesion on a large scale (complete clearance of the lesion is the key to controlling infection), and it is more cautious to choose for Type V brucellar spondylitis.

5. Conclusion and Prospect of This Study

The above clinical studies have confirmed that on the basis of standardized drug therapy, as long as the indications are well held, unilateral double-channel endoscopy is safe and feasible for the treatment of lumbar brucellosis spondylitis, with advantages of less trauma, less bleeding, rapid recovery, low cost and short hospital stay, and has good clinical efficacy. This study is a retrospective study,

with less clinical experience, insufficient sample size, less comprehensive evaluation indicators, and short follow-up time, which needs the support of multi-center, big data and evidence-based medicine in the future. With the continuous improvement of minimally invasive techniques and whole-view endoscopic techniques in spinal surgery, the application of unilateral double-channel endoscopy for the treatment of whole-spine brucellosis spondylitis with the characteristics of precise, minimally invasive and personalized surgery is gradually mature, which has a good development prospect and popularization value.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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