Infection and Drug Resistance

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ORIGINAL RESEARCH

Retrospective Analysis of the Efficacy and Safety of Endoscopic Spinal Tuberculosis and Brucellosis Lesion Removal and Posterior Pedicle Lesion Removal, Bone Grafting, Internal Fixation and Surgery Combined with Medical Chemotherapy in the Treatment of Spinal Tuberculosis and Brucellosis

Aiben Kayierhan[1,2,*], Abuduwupuer Haibier[1,2,*], Aikebaierjiang Aisaiti[1,2,*], Alimujiang Aximu[1,2], Liang Ma[1,2], Yuntao Liu[1,2], Tuerhongjiang Abudurexiti[1,2]

[1]Minimally Invasive Spine Surgery, Sixth Affiliated Hospital of Xinjiang Medical University, Urumqi, Xinjiang Uygur Autonomous Region, People's Republic of China; [2]Xinjiang Medical University, Urumqi, Xinjiang Uygur Autonomous Region, People's Republic of China

*These authors contributed equally to this work

Correspondence: Tuerhongjiang Abudurexiti, Email 2676661815@qq.com

Objective: To evaluate the clinical effectiveness of endoscopic removal of spinal infections and posterior pedicle surgery, including bone grafting, fixation, and chemotherapy, and to outline preventive strategies for complications, offering guidance for clinical practice.

Methods: 128 spinal infectious disease patients (2018–2022) were categorized into Group A (endoscopic removal, n=44) and Group B (posterior pedicle removal+bone grafting+fixation, n=84). Pre-surgery, all received quadruple antibiotic therapy. Metrics tracked: operation time, blood loss, drainage, recovery, stay, transfusion, complications, and pre/post-surgery VAS, ODI, ESR, CRP, PCT, D-dimer, NLR, Hb, albumin.

Results: (1) Preoperative data: There were no statistically significant differences in age, gender, body mass index, involved segments, past medical history (cardiovascular and cerebrovascular diseases, respiratory diseases, endocrine system diseases, metabolic diseases and tuberculosis), smoking history, preoperative erythrocyte sedimentation rate, C-reactive protein, procalcitonin, D-dimer, lymphocyte and neutrophil-lymphocyte ratio, hemoglobin, total protein, waist VAS score and waist ODI score ($P>0.05$). (2) The main postoperative indexes were significantly lower than those of group B at the last follow-up at 3 months and the last follow-up in group A, and the difference was significant ($P<0.05$), the hemoglobin and total protein in group A were significantly higher than those in group B at the last postoperative follow-up ($P<0.05$), and the recurrence rate in group B was significantly higher than that in group A, and the difference was significant ($P=0.048$). (3) Postoperative secondary indicators: the amount of blood transfusion in group A was significantly lower than that in group B, and the difference between the two groups was statistically significant ($P<0.05$), while the operation time, intraoperative blood loss and postoperative hospital stay in group A were significantly smaller than those in group B, and the difference between the two groups was statistically significant ($P<0.05$).

Conclusion: Endoscopic lesion removal for spinal infections achieves similar safety to posterior pedicle surgery, with shorter operation time, less blood loss, lower recurrence, and reduced drainage. It enhances ESR, spine function, and pain relief, meriting promotion.

Keywords: spinal infectious diseases, lesion removal, spinal tuberculosis, brucellosis, drug chemotherapy

Received: 7 April 2024
Accepted: 14 August 2024
Published: 22 August 2024

Introduction

Spinal infections (SI) are diseases of the spine caused by infection by specific pathogenic microorganisms. The incidence of this type of disease is low, accounting for 3%~5% of the incidence of systemic osteomyelitis.[1] Categorized by pathogens, infections are specific (Mycobacterium tuberculosis, Brucella, syphilis, fungi) or non-specific (Staphylococcus aureus, Escherichia coli, Staphylococcus saprophyticus, Streptococcus, Klebsiella pneumoniae, etc). Based on site, they involve vertebral body, intervertebral space, or epidural infections.[2] In recent years, studies have shown that extrapulmonary tuberculosis involving the osteoarticular system accounts for about 10% of the total number of tuberculosis cases, and spinal tuberculosis patients account for 50% of osteoarticular tuberculosis.[3,4] The age group with the highest incidence has transitioned from 20~30 years old to >30~60 years old, and the most common segment has changed from lumbar spine to thoracolumbar spine.[5] Brucellosis spondylitis, a zoonotic disease from Brucella, accounts for 0.4% of spinal infections. Originating from sick animals, it's prevalent in China's northeast and northwest pastoral regions, affecting multiple spine segments, lumbar most often. Symptoms include vertebral and discitis, with bone and joint involvement. Notably, urban cases have surged recently, featuring multiple, scattered outbreaks.[6] Non-specific infectious diseases of the spine can occur in all ages, especially in men aged 50~60, and the risk factors for infectious spinal diseases include diabetes, liver cirrhosis, neoplastic diseases, end-stage renal disease, intravenous drug addiction, and other immunosuppressive states;[7,8] The lumbosacral region is most vulnerable to invasion, followed by thoracic, then cervical spine. In non-specific infections, gram-positive cocci predominate, with Staphylococcus aureus at 32.9% and gram-negative bacilli next, including Escherichia coli at 17.1%, per domestic epidemiology studies.[9]

SI's low specificity leads to delayed treatment, often resulting in poor outcomes. Treatment choice depends on infection site (neuraxial, intervertebral, paravertebral), disease progression, and patient's general condition, including age and comorbidities.[10,11] Conservative treatment is usually reasonable in patients with no or mild neurologic symptoms in the early stages, minimal bone destruction at the lesion, no abscess or sinus tract formation, and no spinal instability or deformity.[12] However, conservative treatment alone often fails. Therefore, if conservative treatment is ineffective, patients with indications for surgery should consider surgery in a timely manner.[13] The end result of both conservative and surgical treatment is bone fusion. Both treatment regimens require concomitant antimicrobial therapy. The optimal duration of antibiotic therapy remains controversial but should not be less than 6 weeks.[14]

Surgical strategies for spine infections aim to excise infected tissue, provide anti-infective therapy, aid recovery, and restore stability. Conventionally, open surgery involves a large incision to expose and remove infected vertebral and disc tissues for comprehensive treatment.[15] Although traditional posterior pedicle lesion removal, bone grafting, and internal fixation are suitable for a variety of cases of thoracolumbar spine infectious diseases of different types and severities, and can be flexibly designed according to individual conditions and lesion characteristics, the large trauma and severe postoperative pain lead to a long recovery period.[16,17] Endoscopic lesion removal + pharmacochemotherapy is a minimally invasive approach. It uses small incisions for endoscopic access to the thoracic/lumbar spine, enabling direct visualization and treatment. It's less invasive, traumatic, and has a faster recovery than posterior pedicle methods, reducing postoperative pain and complications.[18–20]

In this study, a retrospective analysis was conducted to compare 128 patients treated with spinal infectious diseases treated with endoscopic lesion removal and posterior pedicle lesion removal, bone grafting, and internal fixation combined with drug chemotherapy to explore the differences in the efficacy and safety of these two treatments in patients with spinal infectious diseases.

Subjects and Methods

Design

Retrospective Comparative Trial.

Time and Place

This study was completed from January 2018 to December 2022 in the Department of Spine Surgery, the Sixth Affiliated Hospital of Xinjiang Medical University.

Subjects

The clinical data of 128 patients with spinal infectious diseases who were admitted to the Department of Spine Surgery of the Sixth Affiliated Hospital of Xinjiang Medical University from January 2018 to December 2022 for endoscopic lesion removal and posterior pedicle lesion removal, bone grafting and internal fixation were selected, and were divided into posterior pedicle lesion removal, bone grafting and internal fixation group (n=84) and endoscopic lesion removal group (n=44) according to different surgical methods. The study has been reviewed by the Ethics Committee of the Sixth Affiliated Hospital of Xinjiang Medical University.See Figure 1 for details.

Inclusion Criteria

(1) Tuberculosis history, clinical manifestations, laboratory and imaging examinations are considered to be spinal infectious diseases; (2) Intractable low back pain, which is not relieved after anti-infective drug treatment; Severe or progressive neurologic impairment of the spinal cord; Imaging shows significant epidural abscess; (3) Patients treated with endoscopic lesion removal and posterior pedicle lesion removal, bone grafting and internal fixation; (4) Single-segment lesions were found on imaging; (5) Severe bone destruction and spinal instability; (6) Patients with a follow-up time of at least 6 months, and those with complete follow-up data.

Exclusion Criteria

(1) Combined with active pulmonary tuberculosis (such as pulmonary tuberculosis, intestinal tuberculosis, etc).; (2) Combined with spinal infectious diseases other than spinal tuberculosis, such as spinal disc herniation, tumors, infections, fractures, etc.; (3) Lesions involving 3 or more segments; (4) the patient is unable to tolerate the surgery; (5) Patients with severe spinal deformity;

Diagnostic Criteria for Infectious Diseases of the Spine

Patients with previous or existing infectious diseases in other parts, with clinical manifestations such as low-grade fever, night sweats, weight loss, pain and percussion pain at the site of spinal lesions; Preoperative imaging examination showed the destruction of intervertebral discs, the presence of dead bones, abscesses, spinal cord compression, etc.; Laboratory tests such as CRP, ESR, and tuberculin test showed abnormalities; Postoperative pathology reveals tuberculous granulation tissue or caseous necrotic material.

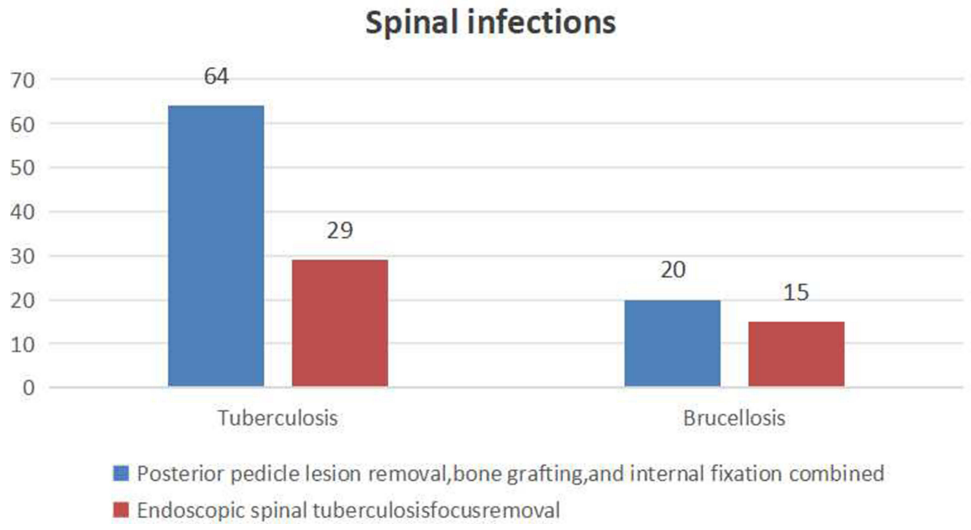

Figure 1 Disease Distribution.

Surgical Method

Preoperative Preparation

Both groups of patients were asked for detailed medical history and physical examination, and X-rays related to the diseased spine (including anterolateral thoracic or lumbar spine position, dynamic position, etc)., CT, MRI and other auxiliary examinations were completed within 3 days after admission to evaluate the patient's general condition and limb function. For hypertensive patients, blood pressure should be kept below 160/100mmHg. For diabetic patients, fasting blood glucose should be controlled within 8mmol/L, blood sugar should be maintained within 10mol/L 2 hours after meals, and urine glucose should be controlled at +~++. Medications that may affect the study (eg, anticoagulant medications) need to be suspended. The patient is instructed to immobilize to reduce the damage caused by spinal instability and ensure good nutrition before surgery. Chemotherapy regimen for patients: After the patient was initially diagnosed with spinal infectious diseases before surgery, oral isoniazid 0.3 g/d, rifampicin 0.45 g/d, ethambutol 0.75 g/d, and pyrazinamide 0.75 g/d for at least 2–4 weeks. When the patient's appetite improves, there is no low-grade fever, night sweats and other manifestations, the low protein condition is improved, the chest X-ray and sputum culture for Mycobacterium tuberculosis are negative, and the laboratory test CRP≤20mm/h, ESR≤50mm/h, or both have a significant decrease after treatment, elective surgery is considered. Before the operation, explain the patient's condition and all risks, and sign the consent form.

Surgical Methods

(1) Posterior pedicle lesion removal, bone grafting, and internal fixation: After the patient is anesthetized, the patient is placed in the prone position, the horseshoe pad is placed on the patient's abdomen, sterilized, and the sheet is laid, and the surgical area is covered with film, and the surgical intravenous drip of cefuroxime sodium is 2g. The posterior median incision was taken, the tissue was separated layer by layer, the bleeding was stopped, the lesion was exposed and completely removed, and the residual intervertebral disc, nucleus pulposus and endplate cartilage were scraped to fully decompress. Screws are implanted, connecting rods are installed, and bone grafts are made between the vertebrae. Irrigation gun + 3L bag to irrigate the wound cavity, antituberculosis drugs (streptomycin 1g + isoniazid 300mg) and 2 drainage tubes were placed at the lesion, and the incision was sutured layer by layer.

(2) Endoscopic lesion removal: all patients in group A were treated with interbody bone grafting with simple posterior lesion removal. Taking L3 and 4 tuberculosis patients as an example, the airway was intubated under general anesthesia, the prone position was taken, and the body surface projection of the lesion space was determined under X-ray machine fluoroscopy of the C-arm X-ray machine. The right intervertebral foramen of L3 and 4 was performed with the horizontal line of the L3 and 4 intervertebral discs and 9 cm next to the posterior midline of the spine as the needle insertion point, and the puncture positioning needle was 20° to the sagittal plane of the trunk and 35° to the upper articular process of L4, and the soft tissue channel was gradually dilated along the puncture needle, and the working cannula was placed into the spinal canal close to the anterior edge of the upper articular process. Approach lumbar tuberculosis lesion removal, spinal canal decompression, nerve root adhesion release, intervertebral disc radiofrequency ablation, intervertebral space catheterization. Microscopic cleaning of turbid purulent discharge, caseous necrotic scar tissue, removal of dead bones, thorough cleaning of lesions, and complete release of nerves and the anterior edge of the dural sac. After the lesion is removed, suitable autologous bone (generally used to remove an appropriately sized iliac bone behind the anterior superior iliac spine) or allogeneic bone is embedded between the vertebral bodies, mixed with rifampicin, and implanted into a bone graft bed. After X-ray confirmation of the effect and satisfactory fixation of bone grafting, the surgical field was routinely irrigated, and the surgical field was continuously flushed with isoniazid dilution during the operation, and the lesion tissue was taken for bacterial culture, drug susceptibility test and pathological examination. A No. 12 double-lumen tube was placed in the center of the lesion, and a subcutaneous tunnel was established after the fluoroscopy position was good, and the fixed tube was sutured and bandaged.

Postoperative management

(1) Intravenous infusion of antibiotics 24 hours after surgery to prevent infection; NSAIDs are given to reduce postoperative pain; (2) The drainage tube should be removed when the drainage volume in the surgical area<30 mL/

24 h; (3) 1–2 days after surgery, you can wear a lumbar brace to move on the ground; (4) Continue regular oral quadruple [isoniazid 0.3 g/d + rifampicin 0.45 g/d + pyrazinamide 30 mg/(kg·d) + ethambutol 15 mg/(kg·d)] anti-tuberculosis drug chemotherapy for 9–12 months, and regularly monitor liver and kidney function during the medication; (5) X-ray and CT were re-examined before discharge to evaluate the bone grafting and nail position; (6) Follow-up MRI before discharge to evaluate decompression and lesion clearance; (7) Lumbar brace protection lasts for 3 months; (8) Regularly recheck liver and kidney function after discharge.

Postoperative Index Evaluation

(1) VAS score for low back pain: VAS score was performed on the day of admission, the 5th day after surgery, and the last follow-up (within 1 year) of all patients, and the results were compared. The patient's analgesic regimen during hospitalization is oral aminophen dihydrocodeine tablets. The low back pain VAS score was used to assess the degree of pain in focal back pain (0 = no pain, 10 = worst pain).

(2) Low back pain ODI score: composed of 10 questions, including pain intensity, self-care, lifting, walking, sitting, standing, interfering with sleep, sex life, social life, travel and other 10 aspects of the situation, each question 6 options, the maximum score of each question is 5 points, the first option is selected for 0 points, and the last option is selected in turn for 5 points, if there are 10 questions are answered and answered. The scoring method is 100% ×of the actual score/50 (maximum possible score), and if a question is not answered, the scoring method is: actual score/45 (maximum possible score) × 100%, if higher indicates more severe dysfunction.

(3) Intraoperative blood loss: the weight of the postoperative gauze weighing + the blood volume in the suction device - The amount of irrigation solution. Intraoperative blood loss: 30mL can make the small yarn completely wet, the large yarn can be completely soaked to 180mL, and the internal volume of the suction device minus the amount of normal saline used for irrigation.

(4) Blood transfusion requirements: If the postoperative hemoglobin level <70g/L, or ≥ 70 g/L but accompanied by dizziness, paleness, weakness and other uncomfortable symptoms, blood transfusion will be given; Hemoglobin levels were reassessed 6 h after transfusion and transfusion was reconsidered again using the same criteria.

General Information

(1) The clinical data of 128 patients with spinal infectious diseases who were admitted to our hospital from January 2018 to December 2022 for endoscopic lesion removal and posterior pedicle lesion removal, bone grafting and internal fixation were collected for a retrospective study. The patients were divided into two groups according to the different types of surgery. The two groups were 1) posterior pedicle removal, bone grafting, and internal fixation group (n=84) and 2) minimally invasive surgery group (n=44). (2) The effects of posterior pedicle lesion removal, bone grafting, internal fixation and endoscopic lesion removal were statistically analyzed, and the general data of the two groups included: gender, age, body mass index, affected segments, smoking history and past medical history.

Observation Indicators

(1) Main outcome indicators: erythrocyte sedimentation rate, C-reactive protein, procalcitonin, D-dimer, lymphocyte and neutrophil-lymphocyte ratio, preoperative hemoglobin and preoperative protein, and VAS score and ODI score of lumbar spine and low back pain were followed up before, 1 day after surgery, 3 months after surgery and at the last postoperative follow-up.

(2) Secondary outcome measures: operation time, intraoperative blood loss, postoperative drainage volume, postoperative time to land, postoperative complications (dural tears, lower extremity intermuscular vein thrombosis, lower extremity deep vein thrombosis, incision infection, cerebrospinal fluid leakage, internal fixation loosening, skin margin necrosis, sinus tract formation and total complication rate), blood transfusion rate and blood transfusion volume, etc.

Statistical Methods

SPSS 26.0 statistical software was used for data analysis. Quantitative data are described as mean ± standard deviation (X±S) and qualitative data are expressed as the number of cases. Quantitative data were compared using an independent-samples

t-test. For cases that do not meet the conditions of the *t*-test, the rank-sum test is used. The chi-square test was used for comparison of qualitative data. The P<0.05, which was considered to be statistically significant.

Results

Analysis of the Number of Participants

A total of 128 patients with spinal infectious diseases who underwent endoscopic lesion removal and posterior pedicle lesion removal, bone grafting and internal fixation were divided into two groups according to the surgical method, 84 cases in the posterior pedicle removal, bone grafting and internal fixation group, and 44 cases in the endoscopic lesion removal group.

Test Flow Chart

The flow chart of the two groups is shown in Figure 2.

Preoperative General Information of the Two Groups of Patients

There were no statistically significant differences in age, gender, body mass index, involved segments, past medical history (cardiovascular and cerebrovascular diseases, respiratory diseases, endocrine system diseases, metabolic diseases and tuberculosis), smoking history, preoperative erythrocyte sedimentation rate, C-reactive protein, procalcitonin, D-dimer, lymphocyte and neutrophil-lymphocyte ratio, hemoglobin, total protein, waist VAS score and waist ODI score (P<0.05). See Table 1 for details.

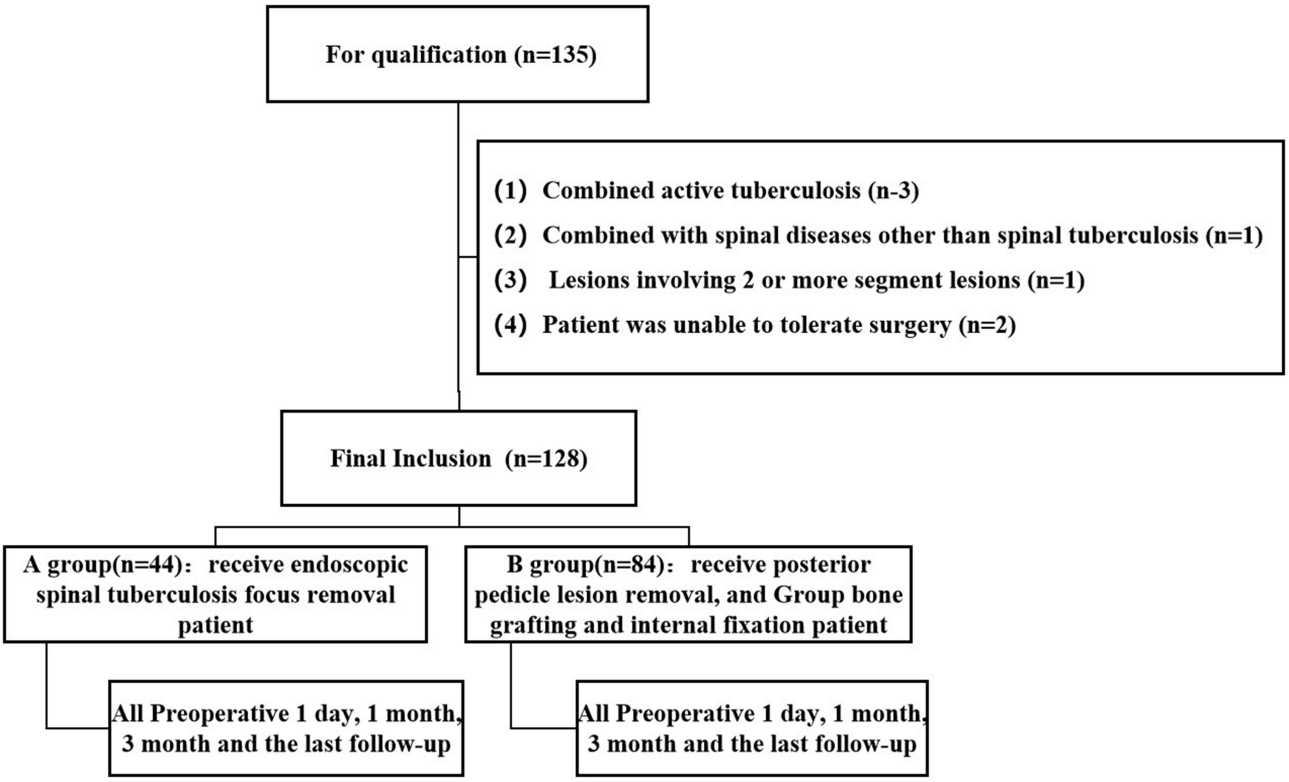

Figure 2 Flow chart of trial grouping.

Comparison of preoperative and postoperative VAS scores and DOI scores between the two groups

There was no significant difference between the two groups in the waist VAS score and ODI score at 1 month after surgery (P>0.05), but the waist VAS score and ODI score in the minimally invasive surgery group were significantly lower than those in the posterior pedicle removal, bone grafting and internal fixation groups at the 3rd month and the last follow-up after surgery. The difference was significant (P<0.05), as shown in Table 2, suggesting that the minimally invasive surgery group may have a better long-term prognosis.

Table 1 Basic Preoperative Data of the Two Groups

Items	A group (n=44)	B group (n=84)	X^2/t	P
Age ($\bar{x} \pm s$)	74.25±6.06	70.48±17.32	−1.394	0.166
Sex(n)			1.549	0.213
Male	19/29.2%	46/70.8%		
Female	25/39.7%	38/60.3%		
BMI ($\bar{x} \pm s$, kg/m^2)	24.54±4.02	23.39±3.44	−1.696	0.092
Tuberculosis site(n)			1.735	0.629
Thoracic vertebra	0/0%	2/100%		
Thoracolumbar	1/20%	4/80%		
Lumbar vertebra	37/36.3%	65/63.7%		
Lumbosacrum	6/31.6%	13/68.4%		
History of smoking	5/41.7%	7/58.3%	0.312	0.576
Cardiovascular and cerebrovascular(n)	23/36.5%	40/63.5%	0.250	0.617
Respiratory system(n)	14/29.2%	34/70.8%	0.924	0.337
Endocrine system(n)	19/33.3%	38/66.7%	0.049	0.824
Metabolic diseases(n)	8/26.7%	22/73.3%	1.032	0.310
History of tuberculosis(n)	9/36.0%	16/64.0%	0.036	0.849
Erythrocyte sedimentation Rate	49.11±22.17	47.38±20.90	−0.436	0.663
C-reactive protein	38.61±44.66	31.52±34.48	−0.996	0.321
Procalcitonin	0.28±0.09	0.39±1.07	0.677	0.500
D-Dimer (mg/L)	1.66±0.82	1.35±1.87	−1.033	0.303
Neutrophil to Lymphocyte ratio	46.44±20.67	48.86±20.76	0.628	0.531
Hemoglobin (g/L)	121.72±14.86	126.38±16.70	1.553	0.123
Total protein (g/L)	43.66±17.34	46.72±13.24	1.113	0.268
Preoperative lumbar VAS score (score)	7.77±1.32	7.34±1.38	−1.683	0.095
Preoperative lumbar ODI score (%)	65.70±9.08	67.96±9.03	1.342	0.182

Notes: The continuous value was given as the mean and the standard deviation.
Abbreviations: BMI, Body mass index=weight/height2; VAS, visual analogue scale; ODI, Oswestry disability index.

Table 2 Postoperative Lumbar VAS and ODI Scores of the Two Groups

Items	Follow-Up Time	A group (n=44)	B group (n=84)	t	P
Low back VAS score ($\bar{x} \pm s$, score)	**1 month**	3.34±1.61	3.47±1.33	0.507	0.613
	3 month	2.25±0.81	2.60±1.00	2.033	**0.044***
Low back ODI score ($\bar{x} \pm s$, %)	**last follow-up**	1.68±0.88	2.05±0.93	2.210	**0.029***
	1 month	37.81±11.86	35.60±11.44	−1.025	0.307
	3 month	26.77±9.36	31.13±10.87	2.256	**0.026***
	last follow-up	22.15±5.49	24.88±8.04	2.010	**0.047***

Notes: The continuous value was given as the mean and the standard deviation. *Bold text represents a statistically significant difference between the two groups.
Abbreviations: VAS, visual analogue scale; ODI, Oswestry disability index.

Comparison of test indexes between the two groups on the first day after surgery and the last postoperative follow-up

There was no significant difference between the two groups on the first day after surgery (P>0.05), and there was no significant difference in erythrocyte sedimentation rate, C-reactive protein, procalcitonin, D-dimer, lymphocyte and neutrophil-lymphocyte ratio between the two groups at the last postoperative follow-up (P>0.05), but the hemoglobin and total protein in the endoscopic spinal tuberculosis removal group were significantly higher than those in the posterior pedicle lesion clearance at the last postoperative follow-up, bone grafting and internal fixation groups, the difference was significant (P<0.05), see Table 3, and the above data results showed that the minimally invasive surgery group recovered hemoglobin and total protein quickly after surgery.

Analysis of postoperative complications between the two groups

There were no significant differences in dural tear, lower extremity intermuscular vein thrombosis, lower extremity deep vein thrombosis, incision infection, cerebrospinal fluid leakage, internal fixation loosening, skin margin necrosis and sinus tract formation between the two groups (P>0.05), but the recurrence rate of posterior pedicle lesion removal, bone grafting and internal fixation group (11 cases) was significantly higher than that in the minimally invasive surgery group (1 case), and the difference was significant (P=0.046), as shown in Table 4. The recurrence rate of the minimally invasive surgery group was significantly lower than that of the posterior pedicle removal, bone grafting and internal fixation group, and the difference was statistically significant (P=0.046). The above data suggest that endoscopic spinal

Table 3 The Test Indexes of the Two Groups at 1 Day and the Last Postoperative Follow-Up

Items	Follow-Up Time	A group (n=44)	B group (n=84)	t	P
1 day after surgery Inspection index	**Erythrocyte sedimentation Rate**	48.27±21.05	43.94±23.42	−1.028	0.306
	C-reactive protein	85.00±40.89	87.78±78.83	0.219	0.827
	Procalcitonin	0.24±0.06	0.23±0.07	−1.025	0.308
	D-Dimer	3.62±2.07	3.99±2.75	0.790	0.431
	Neutrophil to Lymphocyte ratio	53.53±26.29	55.93±30.62	0.443	0.659
	Hemoglobin	105.97±16.25	107.04±17.71	0.334	0.739
	Total protein	56.51±8.13	56.85±5.84	0.273	0.785
The last time after surgery Inspection index	**Erythrocyte sedimentation Rate**	26.72±14.36	30.22±20.32	1.016	0.312
	C-reactive protein	71.01±53.07	56.81±57.41	−1.364	0.175
	Procalcitonin	0.26±0.07	0.24±0.07	−1.407	0.162
	D-Dimer	4.56±2.48	4.63±2.85	0.137	0.891
	Neutrophil to Lymphocyte ratio	49.99±22.99	47.45±22.96	−0.595	0.553
	Hemoglobin	110.14±19.58	98.20±15.16	3.525	**0.001***
	Total protein	62.16±6.87	58.97±7.81	2.378	**0.019***

Notes: The continuous value was given as the mean and the standard deviation. *Bold text represents a statistically significant difference between the two groups.

Table 4 Comparison of Postoperative Complications Between the Two Groups

Group	Dural Laceration	Muscular Calf Vein Thrombosis	DVT	Incision Infections	CSF Leak	Internal Fixation loose	Skin Necrosis	Sinus Formation	Postoperative Recurrent rate	Total Complications
A group (n=44)	0	6	1	2	2	3	4	0	1	17
B group (n=84)	3	20	6	3	5	5	3	2	11	40
X^2	1.609	1.846	1.325	0.073	0.111	0.037	1.702	1.064	3.981	0.943
P	0.205	0.174	0.250	0.787	0.740	0.848	0.192	0.302	0.046	0.331

Notes: *Bold text represents a statistically significant difference between the two groups.
Abbreviations: DVT, deep venous thrombosis; CSF leak, Cerebrospinal fluid leak.

tuberculosis removal has better postoperative efficacy, but in terms of safety, both groups have achieved significant clinical efficacy.

Comparison of blood transfusion rate and blood transfusion volume between the two groups

28 patients in the perioperative period of posterior pedicle lesion removal, bone grafting and internal fixation group, the blood transfusion rate was 33.3%, and the blood transfusion volume was 1.86±1.90U. The blood transfusion rate of 12 patients in the endoscopic spinal tuberculosis removal group was 27.27%, and the blood transfusion volume was 1.12 ±2.05U, and the blood transfusion volume in the endoscopic spinal tuberculosis removal group was significantly lower than that in the posterior pedicle removal, bone grafting and internal fixation group, and the difference between the two groups was statistically significant (P<0.05), as shown in Table 5, and the difference in blood transfusion rate between the two groups was not statistically significant (X^2=2.007, P>0.05) in Table 5.

Comparison of operation time, intraoperative blood loss, postoperative drainage volume and postoperative grounding time between the two groups

There was no significant difference in postoperative drainage volume between the two groups (P>0.05), the operation time was 243.19±46.02 in group B, 226.13±39.57 in group A, and the operation time in group A was significantly lower than that in group B, and the difference between the two groups was statistically significant (P<0.05), and the intraoperative blood loss in group B was 274.28±145.67, and group A was 210.22±96.26, the intraoperative blood loss in group A was significantly lower than that in group B, and the difference between the two groups was statistically significant (P<0.05), the postoperative time of group B was 4.36±1.67, group A was 3.77±1.41, and the postoperative time of group B was significantly greater than that of group A, and the difference between the two groups was statistically significant (P<0.05). as shown in Table 6.

Typical case

See Figures 3 and 4 for more details.

Table 5 Comparison of Transfusion Rates and Transfusion Volume Between Two Groups

group	Blood Transfusion Rate (%)	Blood Transfusion Quantity (x±s, U)
A group (n=44)	12/27.27%	1.12±2.05
B group (n=84)	28/33.3%	1.86±1.90
X^2/t	2.309	2.042
P	0.315	**0.043***

Table 6 Comparison of Secondary Indicators Between the Two Patient Groups

Items	A group (n=44)	B group (n=84)	t	p
Operative time ($\bar{x} \pm s$, min)	226.13±39.57	243.19±46.02	2.086	**0.039***
Intraoperative bleeding ($\bar{x} \pm s$, mL)	210.22±96.26	274.28±145.67	2.629	**0.010***
Volume of drainage ($\bar{x} \pm s$, mL)	173.75±53.72	189.04±73.67	1.217	0.226
Post-operative downtime/ ($\bar{x} \pm s$, d)	14.04±5.92	16.72±6.41	2.303	**0.023***
Time to the ground after surgery/d	3.77±1.41	4.36±1.67	2.019	**0.046***

Notes: The continuous value was given as the mean and the standard deviation. *Bold text represents a statistically significant difference between the two groups.

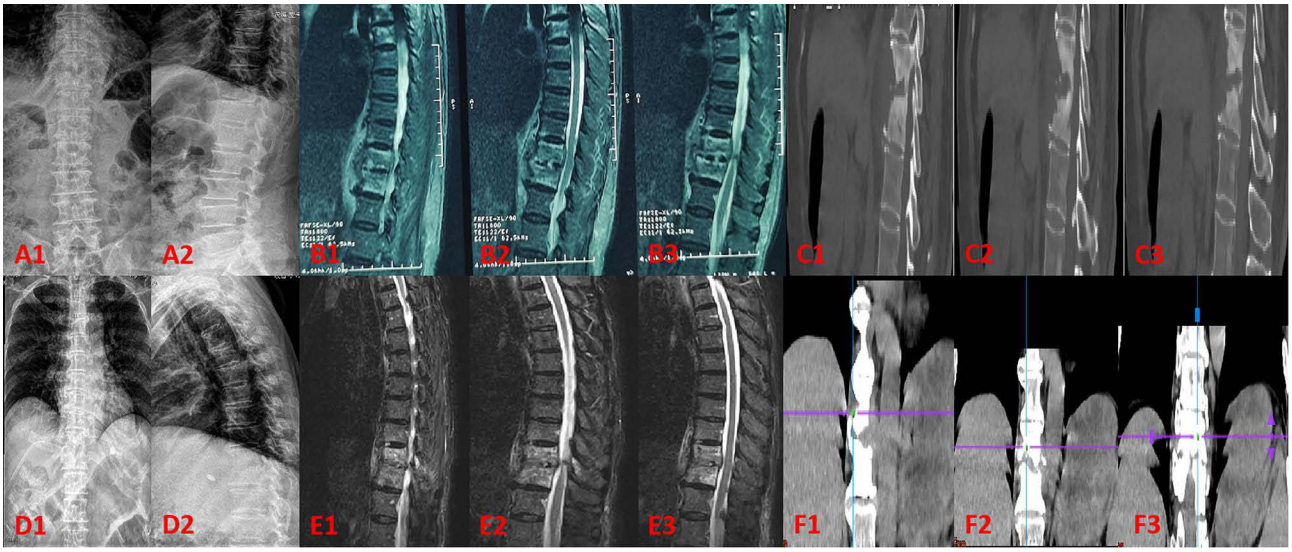

Figure 3 Group A is a typical case.
Notes: The patient is a 69-year-old female with back pain and left lower limb pain for 6 months. **A**1-2, **B**1-3 and **C**1-3 are the preoperative X-ray, MRI and CT images of the patients. **D**1-2, **E**1-3, **F**1-3: X-ray, MRI, CT images 1 week after surgery.

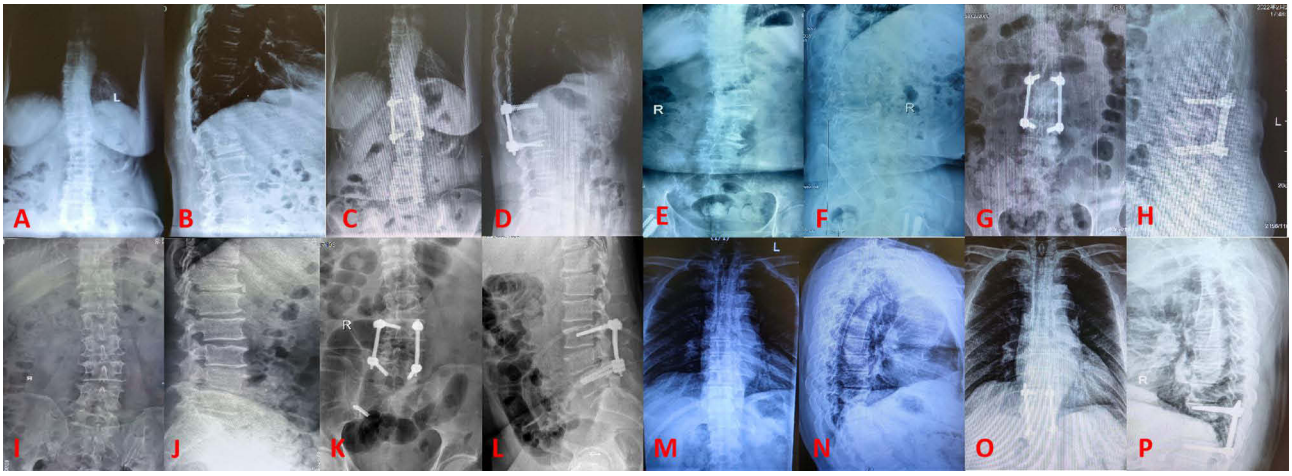

Figure 4 Group B is a typical case.
Notes: Patient 1: A 71-year-old female was admitted to the hospital with the complaint of "back pain and right lower limbs pian for 1 month". Diagnosis is: L4-S1 spinal tuberculosis. (**A** and **B**): Preoperative anterolateral X-rays of patients: (**C** and **D)** Postoperative anterolateral X-rays of patients. Patient 2: A 61-year-old male was admitted to the hospital with the complaint of "Low back pain associated with right lower limbs pain for 3 months". Diagnosis was: L3-L5 spondylolysis brucellosis. (**E** and **F**) Preoperative anterolateral X-rays of the patient: (**G** and **H)** Postoperative anterolateral X-rays of the patient. Patient 3: A male, male, was admitted to the hospital with the complaint of "back pain and lower limbs pain for 4 month". Diagnosis is: T6-T9 spinal tuberculosis. (**I** and **J**) Preoperative anterolateral X-rays of patients: (**K** and **L**) Postoperative anterolateral X-rays of patients.Patient 4: A 56-year-old male patient was admitted to the hospital with the main complaint of "back pain for 1 year, aggravated for 2 month". Diagnosis is: brucellosis of the spine. (**M** and **N**): Preoperative anterolateral X-ray: (**O** and **P**) Postoperative anterolateral X-ray.

Discussion

Summary of the Evidence

The purpose of surgical treatment of spinal infection is to improve pain symptoms by completely removing infected necrotic tissue, and at the same time identifying the type of pathogenic microorganisms to carry out targeted treatment; Surgical treatment with obvious compression symptoms can provide adequate spinal cord or nerve root decompression: prevent or correct spinal deformity and restore spinal stability; Move early postoperatively to avoid complications caused by long-term bed rest.[21,22] At present, the commonly used one-stage surgical methods are: (1) anterior lesion removal, intervertebral bone graft fusion and anterior internal fixation. (2) Posterior pedicle lesion removal, bone grafting, and

internal fixation. (3) Anterior lesion removal and posterior bone graft internal fixation. (4) Endoscopic lesion removal. However, anterior surgery is invasive, complications, and long-term kyphotic deformity, and it has been observed that a large number of patients with conservative treatment can spontaneously fuse the spine without surgery, leading many scholars to question whether this surgery is worthwhile.[23] The concept of a minimally invasive approach to the treatment of spinal infections is to shift from surgery-based and drug-supplemented to drug-based and surgery-supplemented. Increase the concentration of drugs in the lesion, treat it as soon as possible, and stop the pathological progression of the lesion.[24] Therefore, we believe that although the lesion is not completely removed through catheter drainage and local chemotherapy, abscess drainage can be realized, the symptoms of poisoning can be reduced, the patient's general condition can be improved, and the drug concentration in the lesion can be increased at the same time, which is conducive to killing pathogenic bacteria, especially for drug-resistant spinal tuberculosis with low concentration resistance and high concentration sensitivity, which is more effective, thus solving the biological problem of Mycobacterium tuberculosis infection. In addition, specimens can be obtained as soon as possible, which is conducive to timely drug susceptibility testing and adjustment of chemotherapy regimens.[25,26] At the same time, it assists percutaneous pedicle screw internal fixation, so that the spine can be stabilized immediately, encourage patients to get out of bed early, reduce the complications of long-term bed rest, and enhance patients' confidence.

In 2017, South Korean researcher Eun and his team improved the traditional surgical method, proposed the use of arthroscopy to enhance the field of vision in the observation channel, and introduced minimally invasive discectomy instruments in the operation channel, which was successfully applied to the treatment of lumbar spine diseases.[27] With the increasing preference for minimally invasive surgery, surgery with less trauma, less pain, and fewer postoperative complications – the technique of endoscopic removal of infectious lesions of the spine has received extensive attention from spine physicians and has been applied in the treatment of spinal diseases.[28] In 2023, Xiangbin Wang's team studied the treatment of 9 patients with thoracolumbar spine infectious diseases using UBE technology debridement, decompression, interbody fusion, combined with percutaneous screw internal fixation and drug chemotherapy, and there were no complications such as recurrence, incision infection, dural tear or cerebrospinal fluid leak during the follow-up period.[29] In a retrospective study of 128 patients with spinal infectious diseases, it was concluded that endoscopic removal of spinal infectious disease lesions in the treatment of spinal infections could achieve the same safety as posterior pedicle nail fixation, and the operation time was short, and the intraoperative blood loss, postoperative recurrence rate and postoperative drainage volume were smaller. Endoscopic removal of lesions of spinal infectious diseases can effectively improve erythrocyte sedimentation rate, lumbar spine function, and reduce pain, which is worthy of promotion and application. Fu et al[30]'s study used intervertebral foraminoscopy to remove lesions in 12 patients with lumbar spine infectious diseases, used a large amount of streptomycin saline solution to flush and implant streptomycin calcium sulfate artificial bone into the intervertebral space, and restored spinal stability by percutaneous pedicle screw technique. This approach is as effective as traditional open surgery, but is more minimally invasive. The channel-assisted small incision technique has been widely used in the treatment of lumbar degenerative diseases by completing spinal decompression, intervertebral discectomy, intervertebral bone graft fusion, and internal fixation and placement through limited incisions. The results of the study showed that the internal fixation of lesion removal bone graft can completely remove the lesion, rebuild spinal stability, promote spinal bone graft fusion, shorten the time of bed rest, and is conducive to the recovery of patients. In 2021, Kim et al[1] successfully treated spinal infectious diseases by debridement of lesions and percutaneous screw internal fixation with UBE technology, further confirming the effectiveness of this technique in the diagnosis and treatment of spinal infectious diseases. Xue Haibin et al[31] treated 56 patients with lumbar spine infectious diseases using this technique, and the final follow-up showed that all lesions were cured, bone grafting was bony fusion, lumbar curvature was improved, no internal fixation failed, and the patients basically returned to their pre-illness life and work state. A retrospective study by He Deng-wei et al[32] suggests that effective antimicrobial therapy and posterior minimally invasive internal fixation combined with percutaneous abscess drainage can effectively control infection in patients with purulent spondylitis. At the same time, percutaneous minimally invasive internal fixation combined with anterior lesion removal can also be selected for patients with multi-level vertebral tuberculosis, considering that anterior lesion removal and internal fixation are difficult. In addition, studies have also shown that patients undergoing minimally invasive surgery have less trauma, short operation time, less intraoperative blood loss,

reduced postoperative recurrence rate and drainage volume, and minimally invasive puncture drainage combined with local chemotherapy significantly improves ESR and lumbar spine function, bringing better long-term prognosis. HSU et al[33] used UBE lower discectomy and debridement to treat Salmonella spinal infectious disease with epidural abscess, and the postoperative effect of patients was good. The above results prove that percutaneous endoscopic removal of spinal infectious diseases has a positive preliminary clinical effect in the treatment of thoracolumbar infectious diseases, which is a safe, feasible and effective method, and provides a new direction for the treatment of spinal infectious diseases with minimally invasive surgery.

Limitations of the Article

(1) This study is a retrospective study, so there may be a possibility of data loss or failure to record the data in time, which will bias the results, but the research team to which the author belongs has strictly and carefully recorded the postoperative outcome indicators of each group to maintain the integrity of the experimental data to the greatest extent; (2) the included sample size was relatively small, the statistical power was insufficient, and the reporting was biased; (3) The evaluation indicators were limited, and the treatment cost and postoperative hospital stay were not included. The results of this study require further, multicenter, prospective studies to elucidate the relationship between surgery and clinical outcomes for spinal infectious diseases.

Conclusion

The results of this study show that minimally invasive puncture drainage combined with local chemotherapy can obtain the same safety as traditional posterior surgery, but minimally invasive puncture drainage combined with local chemotherapy in the treatment of spinal infectious diseases has a short operation time, small trauma, intraoperative blood loss and postoperative recurrence rate, and more importantly, the combination of minimally invasive puncture drainage and local chemotherapy can not only effectively control erythrocyte sedimentation rate, improve lumbar spine function, but also relieve pain symptoms as soon as possible. It has high practical value and promotion significance.

Abbreviations

ESR, Erythrocyte sedimentation Rate; CRP, C-reactive protein; PCT, Procalcitonin; ODI, Oswestry disability index; VAS, Visual analogue scale; DVT, deep venous thrombosis; CSF, Cerebrospinal fluid; TB, Tuberculosis; SI, Spinal infections.

Data Sharing Statement

To investigate and analyze the clinical efficacy of endoscopic removal of spinal infectious diseases and posterior pedicle lesion removal, bone grafting, internal fixation combined with drug chemotherapy in the treatment of spinal infectious diseases, and to summarize the strategies for preventing complications and provide reference for clinical treatment. Because part of the data is incomplete, so the dataset analyzed in this study is not publicly available but is available to the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

We confirm that all experiments were performed in accordance with the Declaration of Helsinki. The study was approved by the Ethical Committee of the Sixth Affiliated Hospital of Xinjiang Medical University. Each patient provided written informed consent before participating in the study.

Author Contributions

All authors contributed to data analysis, drafting or revising the article, have agreed on the journal to which the article will be submitted, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

Funding

There is no funding to report.

Disclosure

Aiben Kayierhan, Abuduwupuer Haibier and Aikebaierjiang Aisaiti are co-first authors for this work. The authors report no conflicts of interest in this work.

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