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Spinal epidural abscess successfully treated with biportal endoscopic spinal surgery

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Abstract

Surgical decompression and antibiotic therapy are the treatments of choice for patients with spinal epidural abscess (SEA). Surgical treatment included decompression, evacuation of abscess, and debridement. Recently, minimal invasive surgery has been introduced more widely, and biportal endoscopic spinal surgery have shown satisfactory clinical outcomes compared with traditional open surgery. The purpose of this study was to evaluate the efficacy of biportal endoscopic spinal surgery for the treatment of SEA .

From January 2016 to June 2017, 13 patients who underwent biportal endoscopic spinal surgery under the diagnosis of SEA were retrospectively enrolled in this study. The surgical indications of the enrolled patients included SEA with or without early stage spondylodiscitis who had neurological symptoms. Periopertaive data and clinical outcomes were assessed by regular serologic testing, imaging studies, physical examination, visual analog scale, Oswestry Disability Index and modified Macnab criteria.

Offending pathogens were identified in seven (54%) of 13 biopsy specimens. Appropriate intravenous antibiotics for the identified pathogens isolated from infected tissue biopsy cultures were administrated to patients for at least 30 days. All patients reported satisfactory relief of pain and neurological symptoms after surgery. No surgery-related complications and recurrences were found after 2 years follow up.

Biportal endoscopic spinal surgery may be an effective alternative to traditional open surgical decompression for the treatment of SEA.

Abbreviations: CRP = C-reactive protein, CT = computed tomography, ESR = erythrocyte sedimentation rate, MRI = magnetic resonance imaging, MRSA = methicillin-resistant *Staphylococcus aureus*, MSSA = methicillin-sensitive *Staphylococcus aureus*, ODI = Oswestry Disability Index, SEA = Spinal Epidural Abscess, VAS = visual analog scale.

Keywords: biportal endoscopic spinal surgery, minimally invasive surgery, spinal epidural abscess

1. Introduction

Spinal epidural abscess (SEA) is an uncommon clinical condition, but severe infection is associated with significant morbidity and mortality, requiring prompt recognition and urgent treatment.[1,2] Unrecognized SEA may progress not only to potentially irreversible paralysis, but also to life-threatening sepsis.[3,4] Therefore, early diagnosis and treatment are important for good functional recovery.

Iatrogenic causes of SEA include all types of invasive procedures, such as surgery, lumbar puncture, epidural anesthesia, epidural analgesia and nerve blocks, and are estimated to be responsible for 15% of cases.[1,2] In general, these infections are acquired either during the invasive procedure itself, or through ascending microorganisms from the skin flora.[5] The use of epidural analgesia and nerve blocks using steroid is significantly increasing, so the incidence of iatrogenic spinal infection is also growing.[6]

Immediate surgical decompression, followed by a long duration of antibiotic therapy, remains the treatment of choice for SEA.[1,2,7] The primary aim of surgery is decompression and debridement with biopsy for culture.[8] Surgical treatment is indicated whenever a root, spinal cord or dura mater compression is seen on magnetic resonance imaging (MRI). It is generally accepted that the presence of an epidural abscess is an indication for emergency treatment before the onset of neural compression.[9] The other indications for surgical decompression are increasing neurological deficits, persistent severe pain, and increasing body temperature and white blood cell counts.[10]

Traditional open surgery remains the standard, but invasive surgeries are often problematic; therefore, a less invasive treatment is required.[11] Several minimally invasive methods have been used to treat spinal infections; more severe lesions are currently treated by minimally invasive techniques. Minimal damage to the soft tissue structures results in rapid recovery and early return to a functional level. Percutaneous drainage of the SEA has been reported to be helpful.[12–14]

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Minimally invasive spinal surgery is an attractive alternative method for the diagnosis and treatment of a variety of spinal disorders, and it has benefited from significant advances in recent years. Biportal endoscopic spinal surgery provides several advantages with fewer limitations, and sufficient and safe decompression can be performed using the magnified clear view and free handling of instruments. Several studies have shown favorable results of biportal endoscopic spinal surgery in disc herniation and lumbar spinal stenosis.[15–17]

To our knowledge, the treatment of SEA with biportal endoscopic spinal surgery has not yet been described. We evaluated patients with SEA confirmed on MRI that was successfully treated with biportal endoscopic spinal surgery and antibiotic therapy.

2. Materials and methods

2.1. Study design and participants

Thirteen patients with SEA who underwent biportal endoscopic spinal surgery between January 2016 and June 2017 at out institute were enrolled. This study was approved by Institutional Review Board of our institution. The patients' medical records, including outpatient and emergency department notes, admission notes, inpatient progress and nursing notes, operation notes, radiology reports, pathology reports, and microbiology laboratory results, were reviewed. SEA were diagnosed on the basis of clinical examinations, including elevated erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) values, and radiographic and MRI findings.

2.2. Surgical procedures

Biportal endoscopic spinal surgery was performed under general anesthesia with the patient in the prone position. Two separate 1-cm skin incisions were made 1 cm above and below the disc space obliquely and 1 cm laterally from the midline (KU portal). The first cranial portal was made as a viewing and continuous irrigation portal, and the second caudal portal was made in a more distal direction to be used as a working portal. A 0° arthroscope was inserted through the viewing portal, and a saline irrigation pump was connected and set to a pressure of 30 mmHg during the procedure; a continuous flow of saline irrigation was essential to prevent excessive elevation of epidural pressure. Via the working portal, conventional surgical instruments, such as a Kerrison rongeur, burr, pituitary forcep, and curette, were freely used at various angles. The ligamentum flavum was carefully dissected from the dura and completely excised. After the biopsy and debridement procedures, at least 10,000 ml of saline was used for irrigation of the epidural space and disc space, and debrided tissue was sent for culturing (Fig. 1).

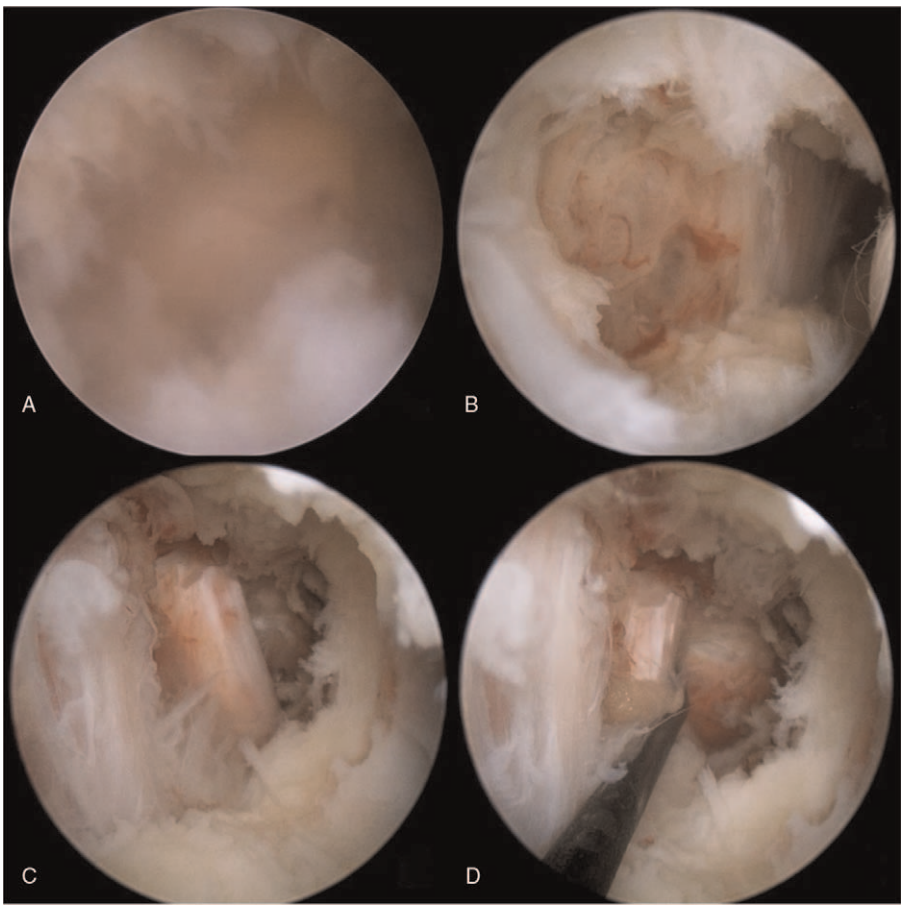

Figure 1. Intraoperative endoscopic view of a L4/5 spinal epidural abscess with spondylodiscitis (Patient 2). (A) The endoscopic view was not clear due to pus drainage. (B) Granulation tissue above the dura mater was identified. (C) After massive debridement and irrigation, the endoscopic view became clear. (D) The infected disc space and epidural abscess were completely removed.

2.3. Outcome measures

Clinical outcomes were evaluated by physical examination, visual analog scale (VAS), Oswestry Disability Index (ODI), modified Macnab criteria, regular serological tests, and imaging studies during admission, at 1 month after surgery, and every 3 months during follow up. All patients were followed up for at least 24 months after surgery.

3. Results

3.1. Demographic data

All patients' medical records were analyzed. Table 1 summarize the patients' data, including diagnosis and involved level, offending pathogens, and clinical outcome after surgery. Seven patients were male and six patients were female with an age of 54.7 years (range, 29–69 years). One patient was a chronic alcoholic, while the others had no predisposing diseases such as diabetes mellitus. Five patients had a history of acupuncture before development of symptoms. Eleven patients with single-level infection, 2 with 2-level infection, 1 with paraspinal abscess, and 5 with spondylodiscitis were enrolled (Figs. 2–4). The mean period from onset of symptoms to surgery was 16 days (range, 12–24 days). Intravenously administered antibiotic agents were continued for a mean of 30 days (range, 21–42 days), and the administration of peroral antibiotic agents was continued for a mean of 24 days (range, 14–30 days) until relief of back pain and decreased CRP levels. The most prominent clinical sign of SEA was back pain and lower leg radiculopathy, which was detected in all patients. Eight patients had lower leg motor weakness. Postoperative MRI showed well decompressed status and disappeared SEA (Fig. 5).

Offending pathogens were isolated in seven (54%) of 13 infected tissue biopsy cultures. Five patients were infected with *Staphylococcus aureus*, 3 with the methicillin-resistant strain (MRSA) and 2 with the methicillin-sensitive strain (MSSA). Two patients were infected with *Pseudomonas aeruginosa*. Systemic antibiotics were administered according to sensitivity studies for identified pathogens. For patients with no pathogens isolated, broad-spectrum antibiotics were administrated.

3.2. Clinical data

All patients responded to biportal endoscopic spinal surgery and were successfully treated with at least a 30-day course of intravenous antibiotics therapy. All patients reported satisfactory relief of back pain and neurological symptoms after surgery. The changes in sereological values before and after surgery in these

Table 1

Demographic data and clinical outcomes of patients.

Case no.	Age	Sex	Diagnosis	Culture	Complication	Macnab criteria
1	29	M	L2/3/4 epidural abscess with paraspinal abscess	MSSA	None	Excellent
2	57	M	L4/5 epidural abscess	MRSA	None	Good
3	44	F	L5/S1 epidural abscess with spondylodiscitis	No growth	None	Excellent
4	65	F	L3/4 epidural abscess	Pseudomonas	None	Excellent
5	24	F	L4/5 epidural abscess	No growth	None	Excellent
6	60	M	L5/S1 epidural abscess with spondylodiscitis	MRSA	None	Good
7	54	M	L4/5 epidural abscess	Pseudomonas	None	Excellent
8	62	M	L5/S1 epidural abscess	No growth	None	Good
9	57	F	L4/5 epidural abscess with spondylodiscitis	No growth	None	Good
10	72	F	L3/4 epidural abscess	No growth	None	Excellent
11	55	F	L2/3 epidural abscess	MSSA	None	Excellent
12	69	M	L4/5 epidural abscess with spondylodiscitis	MRSA	None	Good
13	63	M	L3/4/5 epidural abscess with spondylodiscitis	No growth	None	Excellent

L = lumbar spine, MRSA = methicillin-resistant *Staphylococcus aureus*, MSSA = methicillin-sensitive *Staphylococcus aureus*, S = sacral spine.

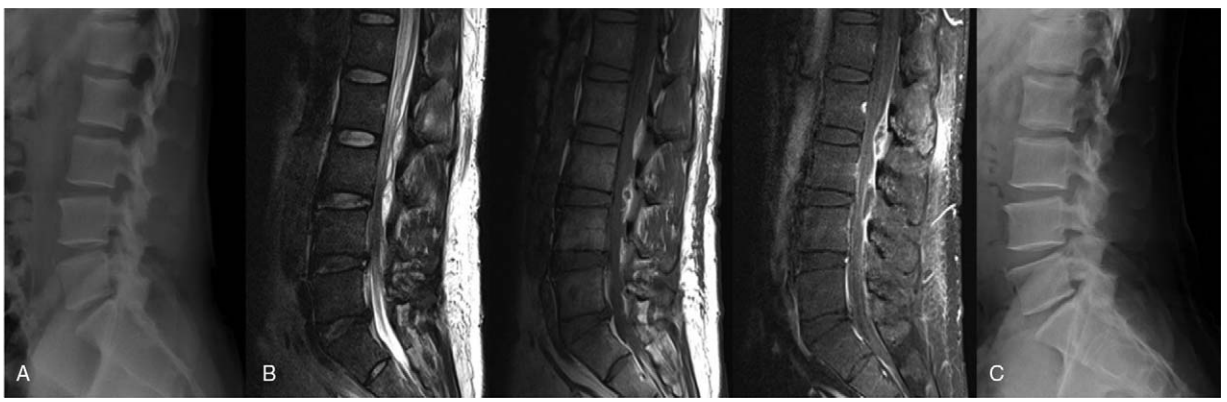

Figure 2. L2/3/4 spinal epidural abscess (Patient 1) treated by biportal endoscopic decompression and irrigation. (A) Preoperative radiograph. (B) Sagittal T1- and T2-weighted and contrast-enhanced magnetic resonance imaging showed L2/3/4 spinal epidural abscess and neural compression. (C) Postoperative radiograph. D) After surgery, MRI at 1 month confirmed the disappearance of the epidural abscess.

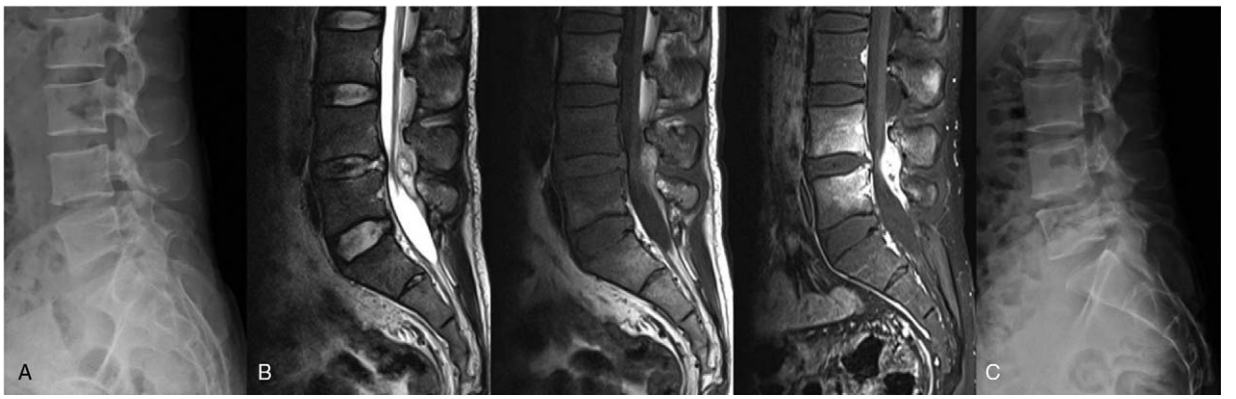

Figure 3. L4/5 spinal epidural abscess (Patient 2) treated by biportal endoscopic decompression and irrigation. (A) Preoperative radiograph. (B) Sagittal T1- and T2-weighted and contrast-enhanced magnetic resonance imaging showed L4/5 spinal epidural abscess with spondylodiscitis and neural compression. (C) Postoperative radiograph.

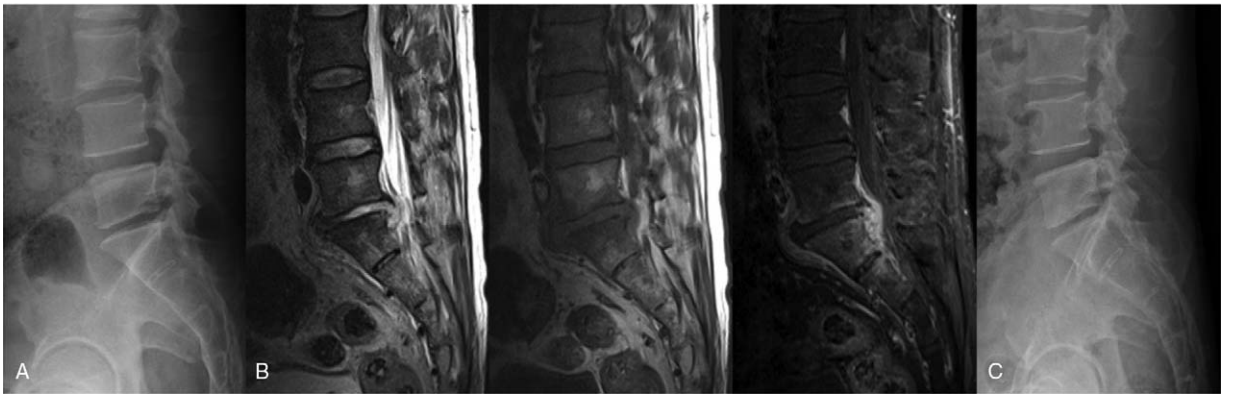

Figure 4. L5/S1 spinal epidural abscess with spondylodiscitis (Patient 3) treated by biportal endoscopic decompression and irrigation. (A) Preoperative radiograph. (B) Sagittal T1- and T2-weighted and contrast-enhanced magnetic resonance imaging showed L5/S1 spinal epidural abscess with spondylodiscitis and neural compression. (C) Postoperative radiograph.

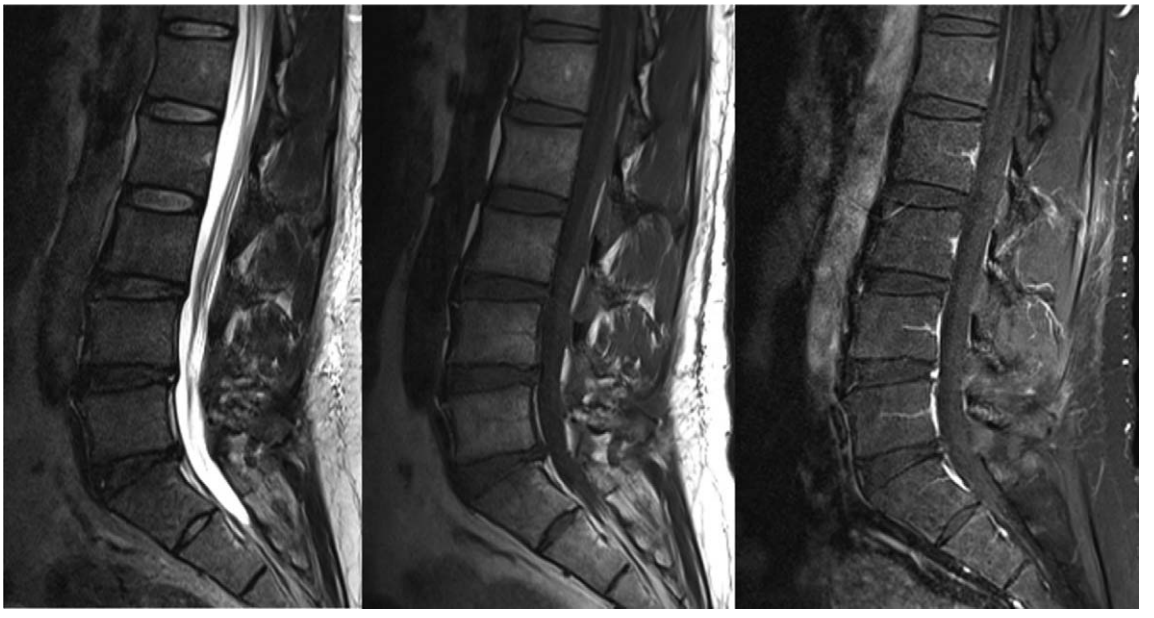

Figure 5. Sagittal T1- and T2-weighted and contrast-enhanced magnetic resonance imaging 3 months after surgery showed well decompressed and disappeared L2/3/4 spinal epidural abscess (Patient 1).

Table 2

Regular serologic test results.

Case no.	Peak fever (°C)	Highest preoperative CRP (mg/L)	Time to normal value (weeks)	Highest preoperative ESR (mm/h)	Time to normal value (weeks)
1	38.9	279.69	2	93	6
2	38.4	80.99	6	70	6
3	37.9	86.67	4	30	6
4	38.3	180.45	3	75	5
5	38.5	110.81	2	80	8
6	39.1	130.09	5	85	7
7	38.0	173.89	5	51	6
8	38.2	155.71	4	69	7
9	37.8	396.68	3	72	6
10	37.4	233.59	5	81	5
11	39.7	244.52	6	94	8
12	39.5	43.35	2	70	4
13	37.9	273.03	5	63	5

CRP = C-reactive protein, ESR = erythrocyte sedimentation rate.

patients are shown in Table 2. The mean preoperative CRP level was 183.81 mg/L (range, 43.35–396.68 mg/L), and the mean preoperative ESR level was 74.9 mm/hour (range, 51–94 mm/hour). Elevated CRP values returned to normal ranges over a mean of 4 weeks, whereas elevated ESR decreased to normal ranges over a mean of 6 weeks. No recurrent infection was found among these patients during at least 24 months of follow-up (mean, 26 months; range, 24–30 months). No major surgery-related complications were noted.

The VAS score was 8.5 preoperatively, then 5.9, 2.4, 2.1, 1.9, 1.6, and 1.5 at immediately after surgery, 1, 3, 6, 12, and 24 months after surgery, respectively. The ODI score was 42 preoperatively, then 30, 15, 13, 11, 10, and 10 at immediately after surgery, 1, 3, 6, 12, and 24 months after surgery, respectively. Eight patients showed excellent outcome and 5 patients showed good outcome using modified Macnab criteria. Clinical outcomes using VAS and ODI scores, and modified Macnab criteria showed satisfactory results.

4. Discussion

The purpose of this study was to evaluate feasibility of biportal endoscopic spinal surgery for SEA. All patients in this study showed satisfactory clinical outcome with no recurrence or complications and resolution of infection.

The incidence of spinal infection is rising due to an increase in the rate of infections associated with vascular devices and other forms of instrumentation, and to an increasing prevalence of intravenous drug abuse.[18] In particular, the use of epidural analgesia and nerve blocks is significantly increasing, so the incidence of iatrogenic spinal infection is also growing.

The basic principle of management of SEA is drainage of the abscess and eradication of the microorganism. Surgical therapy is the treatment of choice in the majority of cases. Rapid surgical intervention is not only needed to minimize neurological damage, but also to control sepsis. Evaluation of the indication for decompressive surgical intervention should always be considered urgent, since neurological improvement is unfavorable if the duration of paralysis exceeds 24 hours to 36 hours.[3] Generally, resolution of the abscess is achieved after 4 weeks to 6 weeks of treatment.[1] Treatment success needs to be confirmed by follow-up imaging studies 4 weeks to 8 weeks after therapy.[19]

Several minimally invasive methods have been used to treat spinal infections. Cwikiel reported that a patient stabilized after continuous percutaneous drainage of the psoas and epidural abscess for 2 weeks.[12] Walter et al described a 9-month-old infant whose SEA gradually resolved after continuous percutaneous drainage and irrigation for 2 days.[14] Tabo et al performed percutaneous drainage and irrigation using an epidural needle and catheter for 2 patients with SEA.[13] Yu et al described good results in 2 cases of spinal osteomyelitis treated with nucleotome-based percutaneous suction aspiration.[20] Nagata et al obtained good results in 23 patients with early-stage pyogenic spondylitis after continuous drainage and local administration of antibiotic agents, in addition to percutaneous suction aspiration.[21] Staatz et al reported computed tomography (CT)-guided percutaneous catheter drainage as an efficient and safe procedure for early-stage spondylodiscitis.[22] Lyu et al reported successful results after CT-guided needle aspiration of one patient with SEA.[23] Haaker et al treated 16 patients with spondylodiscitis by percutaneous lumbar discectomy and concluded that the treatment is a useful and minimally invasive technique for lumbar discitis, although the offending pathogens could be identified in only 45% of cases.[24] However, the continuous irrigation method restrained the patients to their beds and limited their postoperative ambulation and activities.

Biportal endoscopic spine surgery is an emerging technique in the field of minimally invasive spinal surgery.[15] It combines the advantages of traditional open surgery and uniportal endoscopic surgery.[16] It allows for a good field of vision of the contralateral, sublaminar, and foraminal areas with high magnification, and it uses ordinary arthroscopic and spine instruments without the need for special endoscopic instruments.[25] This allows free movement and handling, as well as angulation of the surgical instruments and the arthroscope, independent of each other, as they are not restricted in a single portal. It also reduces irritation to the nerve roots, and technical flexibility by sufficient bony and soft tissue work is as possible as in traditional open surgery.[15] Finally, continuous saline irrigation can control epidural and bone bleeding, as well as infection.[17]

The indications for minimally invasive biportal endoscopic spinal surgery include herniated intervertebral discs and decompression of spinal stenosis. We suggest this technique as an alternative in patients with SEA with early spondylodiscitis.

This study had several limitations. First, we examined small number of patients. Second, a retrospective medical record analysis was performed. The feasibility and benefits of biportal endoscopic spinal surgery for SEA need to be rigorously evaluated in a larger patient population with prospectively controlled comparison groups.

5. Conclusion

On the basis of the findings of this study, we propose that biportal endoscopic spinal surgery is an effective alternative to traditional open surgery for the treatment of uncomplicated SEA. This treatment is successful in obtaining a bacteriological diagnosis, relieving the patient's symptoms, and assisting in the eradication of SEA.

Author contributions

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