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CASE REPORT

Transforaminal endoscopic decompression for thoracic spinal stenosis under local anesthesia

Zhi-Qiang Jia[1,2] · Xi-Jing He[2] · Li-Tao Zhao[1] · San-Qiang Li[3]

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Abstract

Background Thoracic spinal stenosis is a common vertebral degenerative disease, and treatment remains challenging. In recent years, transforaminal endoscopic decompression has been widely used for treating lumbar degenerative diseases. However, the efficacy of this procedure for thoracic spinal stenosis has yet to be established. Herein, we report a case of thoracic spinal stenosis treated with transforaminal endoscopic decompression under local anesthesia.

Case report An 88-year-old man presented with a 1-month history of progressive paralysis and dysesthesia in the bilateral lower extremities. A diagnosis of thoracic spinal stenosis was made, based on physical examination. A two-step percutaneous transforaminal endoscopic thoracic decompression was performed for spinal canal decompression. Over a follow-up of 1 year, a favorable outcome was noted.

Conclusion Transforaminal endoscopic decompression is a safe and an effective surgical approach for the treatment of thoracic spinal stenosis. For patients with thoracic spinal stenosis, accurate diagnosis and elaborate surgical planning should be highlighted, and the surgical outcome can be favorable.

Keywords Thoracic spinal stenosis · Transforaminal endoscopic decompression · Local anesthesia · Case report

Introduction

Thoracic spinal stenosis is a narrowing of the spinal canal in the upper or middle back. It is a vertebral degenerative disease that mostly afflicts the elderly. It is usually caused by hypertrophy of the vertebral plate or intervertebral joint, ossification of the ligamentum flavum or posterior longitudinal ligament, osteophytes, or herniation of an intervertebral disc [1, 2]. Spinal stenosis can lead to compression of the spinal cord or nerve roots, manifesting as variable neurological deficiencies, and degrading the patient's quality of life. The clinical symptoms include local pain, lower extremity numbness with or without weakness, difficulty walking, and sphincter dysfunctions [2, 3]. Treating thoracic spinal stenosis is challenging. Surgical spinal decompression is the prevailing choice [4–7], involving dissection of the paraspinal muscles and spinous process, lamina osteotomy, and removing the hyperplastic ligament. These procedures are associated with high risks and severe complications.

In recent years, minimally invasive surgeries such as transforaminal endoscopic decompression have come to the forefront of spinal management. Transforaminal endoscopic decompression surgery can be performed under local anesthesia with relatively low risk. Other advantages include less expense, less blood loss, low rate of complications, and fast recovery [8–10]. However, the efficacy of transforaminal endoscopic decompression specifically to treat thoracic spinal stenosis has yet to be established. Herein, we report a

✉ Li-Tao Zhao
litaozhao2017@163.com

✉ San-Qiang Li
sanqiangli2017@163.com

Zhi-Qiang Jia
jzqdoctor@163.com

[1] Department of Spinal Surgery, The Second Affiliated Hospital of Henan University of Science and Technology, Luoyang 471000, People's Republic of China

[2] Department of Orthopedics, The Second Affiliated Hospital of Xi'an Jiaotong University, Xian 710004, People's Republic of China

[3] The Molecular Medicine Key Laboratory of Liver Injury and Repair, Medical College, Henan University of Science and Technology, Luoyang 471003, People's Republic of China

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case of thoracic spinal stenosis, treated with transforaminal endoscopic decompression under local anesthesia.

Case report

History

An 88-year-old man was admitted to our department with a 1-month history of progressive paralysis and dysesthesia in the bilateral lower extremities. The physical examination revealed tenderness and percussion pain at the C4–6 spinous areas and loss of sensation below the T4 dermatome, without upper-extremity radiating pain. The Spurling test and the Eaton test were slightly positive, whilst the Hoffmann sign was negative. Muscle strength was grade I in his left lower extremity and grade II in the right lower extremity, with high muscular tensions. The abdominal reflex and cremasteric reflex were normal, while the rectoanal reflex was weakened. Additionally, patellar clonus and ankle clonus were noted. The Kernig, Babinski, and Hoffmann signs were positive. According to the Japanese Orthopaedic Association (JOA) scoring system, this patient's neurological function score was 6 points.

Magnetic resonance imaging (MRI) showed herniation of the C4/5 intervertebral disc and ossification of the ligamentum flavum at the T2/3 and T10/11 levels (Figs. 1, 2). A diagnosis of thoracic spinal stenosis and cervical disc herniation was made. Surgical decompression was scheduled for the thoracic spinal stenosis. The cervical disc herniation was conservatively treated.

Surgical treatment

A two-step minimally invasive operation was performed for spinal decompression. In the first step, percutaneous transforaminal endoscopic thoracic decompression was performed at the T10/11 level under local anesthesia. The patient was in the left-lateral decubitus position on a radiolucent table with waist and axilla cushioned. X-ray C-arm fluoroscopy was used for localization and planning the puncture route. The entry point and trajectory of the needle were determined as per the operative MRI to target the thoracic spinal cord compression. After the subcutaneous tissue and trajectory tract were infiltrated with 15 mL of 0.5% lidocaine, a needle was inserted by posterolateral approach (6 cm lateral to the posterior midline). In the anteroposterior and lateral C-arm view, the needle tip reached the middle-upper part of T10 vertebral plate. The needle was replaced with a guidewire. Under the guidance of the guidewire, step-cannulas were replaced. A partial laminectomy of T10 was performed using a trephine, after which a working cannula was placed under

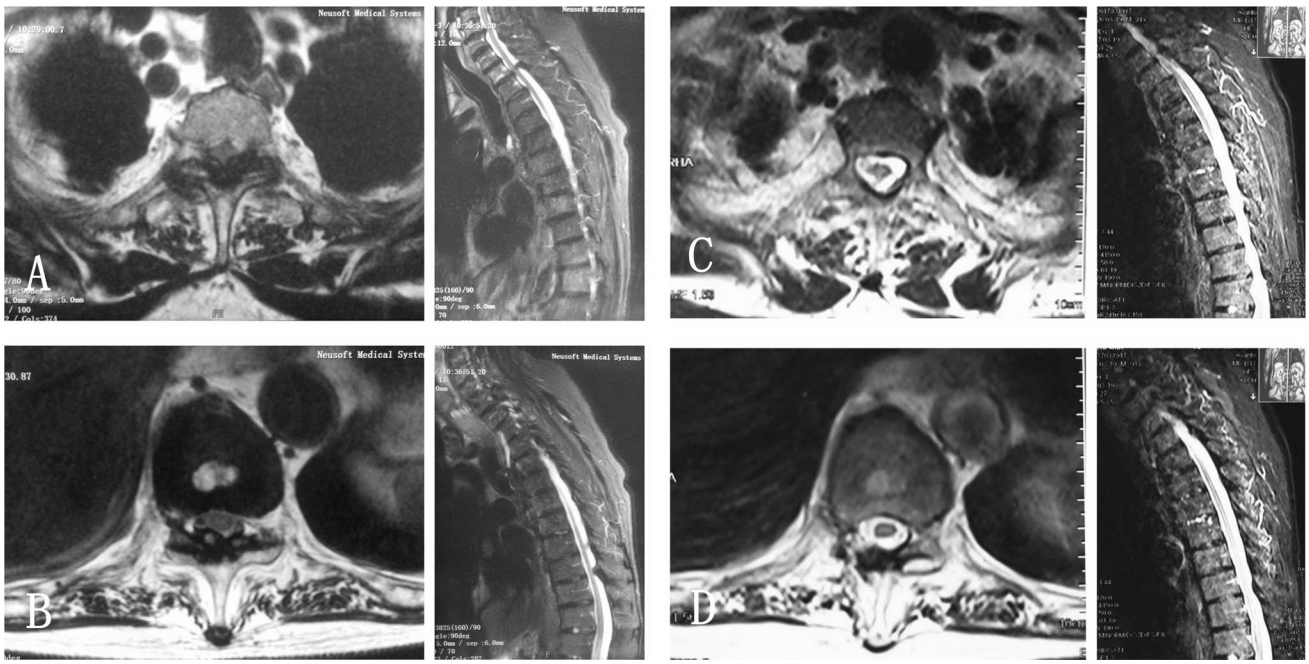

Fig. 1 Preoperative and postoperative thoracic MRI. **a** Sagittal T2-weighted imaging showed spinal canal stenosis at the T2/3 and axial T2-weighted imaging revealed hypertrophy of the ligamentum flavum at the T2/3 level, leading to compression of the dural sac. **b** Sagittal T2-weighted imaging showed spinal canal stenosis at the T10/11 and axial T2-weighted imaging revealed hypertrophy of the ligamentum flavum at the T10/11 level, leading to compression of the dural sac. **c** A year after surgery, thoracic MRI revealed satisfactory decompression at the T2/3. **d** A year after surgery, thoracic MRI revealed satisfactory decompression at the T10/11 levels

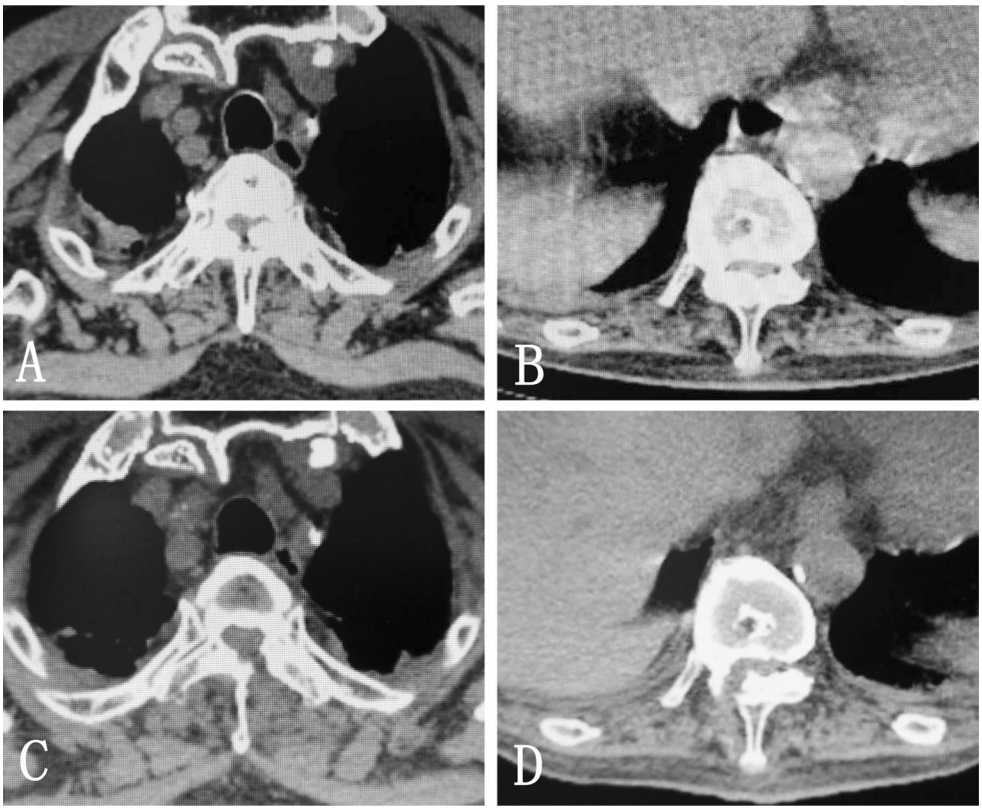

Fig. 2 Preoperative and postoperative computed tomography (CT). Preoperative CT showed hypertrophy and ossification of the ligamentum flavum at the **a** T2/3 and **b** T10/11 levels, leading to compression of the dural sac and spinal canal stenosis. Postoperative CT revealed satisfactory decompression at the T2/3 (**c**) and T10/11 (**d**) levels

C-arm fluoroscopic control (Fig. 3). Then, the inner part of the T10 vertebral plate was removed endoscopically using an orthopedic micro-power system.

The calcified ligament flavum was exposed and thinned using an abrasion drill, and we used laminal forceps to remove the incrassated ligament flavum. The adhesion surrounding the nerve was released, and bipolar radiofrequency was used for prompt endoscopic hemostasis. After nerve decompression, adhesion release, and hemostasis, we observed that the nerve was significantly released (Fig. 4). Intraoperatively, autonomous pulse of the nerve was noted endoscopically, and the patient reported that symptoms in the right leg were significantly improved. The intraoperative blood loss was about 20 ml. Post-operatively muscle strengths in the lower extremities were slightly improved.

In the second step, percutaneous transforaminal endoscopic thoracic decompression was performed at the T2/3 level in the right-lateral decubitus position under X-ray control. After the entry point and trajectory of the needle were planned, subcutaneous tissue and the trajectory tract were infiltrated with 15 mL of 0.5% lidocaine, and then a needle was inserted by posterolateral approach (4 cm lateral to the posterior midline). In the anteroposterior and lateral C-arm view, the needle tip reached the middle-lower part of T2 vertebral plate. Under the guidance of the guidewire, step-cannulas were replaced. A part of T2 vertebral plate was removed using a trephine, after which a working cannula was placed under C-arm fluoroscopic control (Fig. 3). The inner part of the T2 vertebral plate was removed endoscopically using an orthopedic micro-power system for enlargement and decompression of the spinal canal. The calcified ligament flavum was exposed and thinned using an abrasion drill, and we used laminal forceps to remove the incrassated ligament flavum. The adhesion surrounding the nerve was released, and bipolar radiofrequency was used for prompt endoscopic hemostasis. After nerve decompression, adhesion release, and hemostasis, we observed that the nerve was significantly released (Fig. 4). Intraoperatively, autonomous pulse of the nerve was observed, and the patient reported significant relief of symptoms in the right leg. The intraoperative blood loss was approximately 30 ml.

Outcome and follow-up

Immediately after the surgery, the patient's pain was relieved significantly, and rehabilitation training was scheduled.

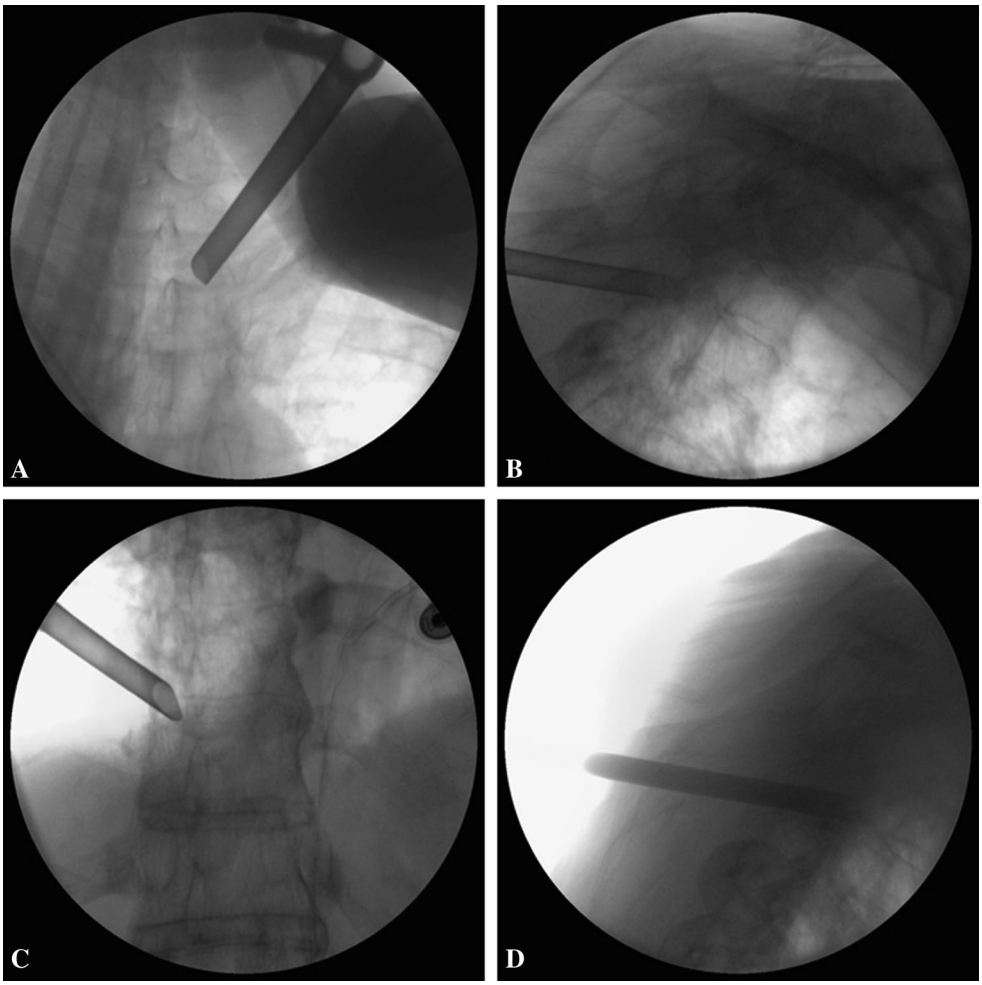

Fig. 3 Intraoperative fluoroscopy. **a** Anteroposterior view showing needle localization at the T2/3 level. **b** Lateral view showing needle localization at the T2/3 level. **c** Anteroposterior view showing needle localization at the T10/11 level. **d** Lateral view showing the needle localization at the T10/11 level

Seven days after the operation, the muscle strength of the left lower extremity improved to grade II, and that of the right lower extremity improved to grade III; the JOA score was 7 points. After 1-year of follow-up, the patient could walk a short distance independently with an aid, and the JOA score improved to 14 points (Fig. 5).

Discussion

Thoracic spinal stenosis refers to narrowing of the spinal canal at the thoracic level. The common etiological factors include congenital developmental narrowing and hypertrophic changes to the vertebrae, disc, facet joint, posterior longitudinal ligament, or ligamentum flavum [11–13]. According to Aizawa et al. [11], ossification of the ligamentum flavum may contribute to ~ 70% of all cases with thoracic spinal stenosis. In the current case, the thoracic spinal stenosis was also caused by ossification of the ligamentum flavum.

Surgical treatment is the first choice for thoracic spinal stenosis caused by a hypertrophic or ossified ligamentum flavum. These procedures usually include laminoplasty, hemilaminectomy, lamina drilling decompression, cap-uncovering en bloc removal of the posterior wall of the spinal canal, and laminectomy [1, 13–15]. Li et al. [16] confirmed that the removal of the posterior wall of the spinal canal is a safe and an effective approach to treat thoracic spinal stenosis caused by ossification of the ligamentum flavum. In addition, Nie et al. [17] proposed lamina osteotomy and replantation with miniplate fixation as a new surgical method. However, all these procedures are associated with higher complication rates compared with spinal operations at the cervical or lumbar levels. Common postoperative complications include spinal cord injury, leakage of cerebrospinal fluid, pulmonary infection,

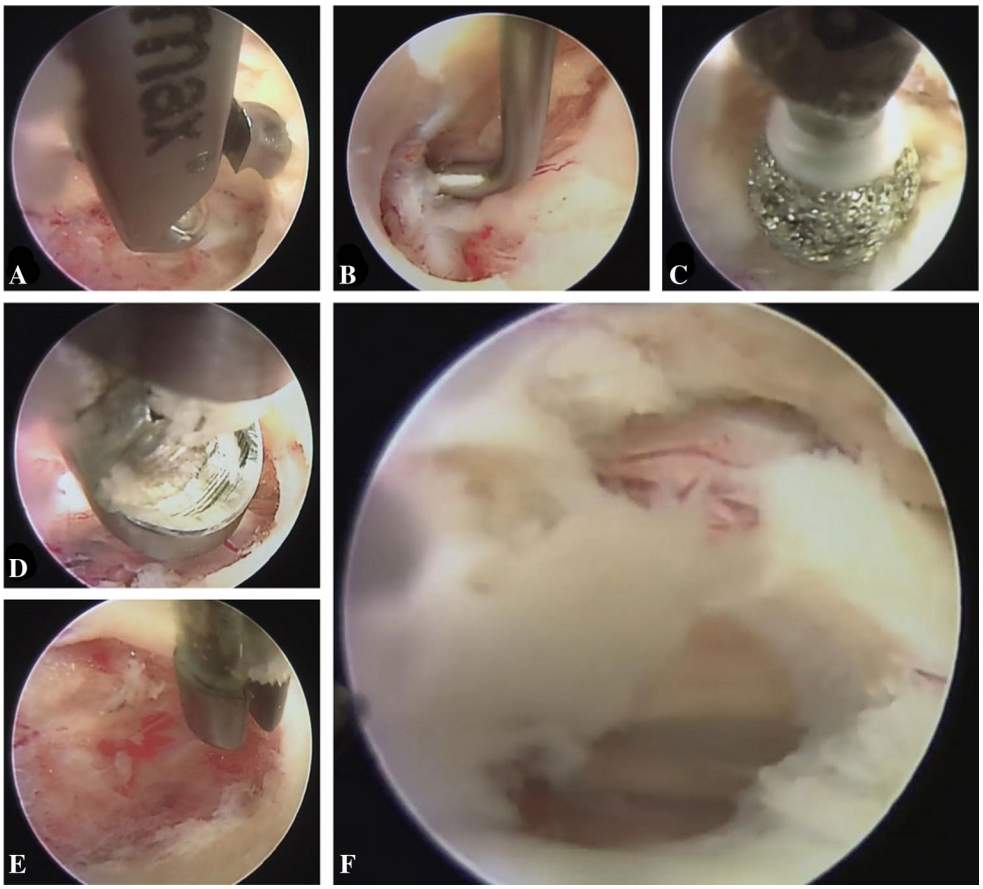

Fig. 4 Intraoperative findings. **a** Endoscopically, we used a rongeur tip to resect the peripheral tissues. **b** We used a neuro-detacher for stripping the nerve. **c** Orthopedic abrasive drilling was used to remove the peripheral osseous tissues. **d** Laminal forceps were used to remove the peripheral calcified tissues. **e** Bipolar radiofrequency was used for hemostasis. **f** Endoscopic imaging showing the nerve root after decompression

epidural hematoma, and infection of the incisional wound [6, 7, 18].

With advances in minimally invasive surgical techniques, percutaneous transforaminal endoscopic decompression has become widely used for the treatment of spinal degenerative disease [12]. Compared to the conventional methods, transforaminal endoscopic surgery has significant merits, including mini-invasion, less intraoperative blood loss, rapid postoperative recovery, short hospitalization, and less total cost. In addition, it can be performed under local anesthesia. However, this technique also has strict indications, requires a high level of skills, and involves high doses of X-ray radiation.

To the best of our knowledge, this is the first report of thoracic spinal stenosis treated with transforaminal endoscopic decompression under local anesthesia. In the current case, we analyzed the clinicoradiological profiles and made a precise diagnosis preoperatively. Then the surgical strategies were planned, during which the surgical target and extent of the intraoperative decompression were determined. A combination of transforaminal endoscopic techniques, an orthopedic micro-power system (endoscopic abrasion drill system), and a U-shaped approach were adopted for sufficient intraoperative decompression, which guaranteed the success of our mini-invasive surgical treatment. We reviewed the relevant clinical profiles regarding the treatment of thoracic spinal stenosis. Herein, we also summarized our experience on the application of transforaminal endoscopic techniques in thoracic spinal stenosis. For patients suspected of thoracic spinal stenosis, a precise diagnosis is imperative. For patients with thoracic spinal stenosis concomitant with cervical spondylosis or lumbar spinal stenosis, clinicians should comprehensively evaluate the clinical symptoms and determine which deficiency is most in need of surgical treatment. To address the main deficiency, an optimal minimally invasive surgical strategy (such as spinal endoscopy) should be planned, based on symptoms and radiological examinations. The operators' level of proficiency should be assessed to guarantee surgical safety and sufficient decompression.

Fig. 5 Photographs showing neurological functions after rehabilitation. **a** 1 month after the surgery, the patient can stand with an aid. **b** 1 year after the surgery, the patient can walk independently

In the current study, we found that transforaminal endoscopic decompression is a safe and an effective approach to treat thoracic spinal stenosis, and the surgical outcome was favorable. However, a longer follow-up and more systematic research is needed to determine the long-term prognosis.

Conclusion

Transforaminal endoscopic decompression is a safe and an effective surgical approach for the treatment of thoracic spinal stenosis. With accurate diagnosis and elaborate planning, the surgical outcome can be favorable.

Compliance with ethical standards

Conflict of interest None of the authors has any potential conflict of interest.

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