



Laparoscopic-Assisted Resection for Retroperitoneal Dumbbell-Shaped Lumbar Spinal Schwannomas: Operative Technique and Surgical Results

Wei Shi¹, Xing Su¹, Wen-guang Li², Xi-de Xu¹, Jian-fei Huang³, Jian Chen¹

■ BACKGROUND: Retroperitoneal dumbbell lumbar spinal schwannomas (RDLSSs) classified as the Eden type 4 are composed of small intervertebral foramen components and large paravertebral components extending into the retroperitoneal cavity. The surgical management of RDLSSs remains a great challenge for all neurosurgeons because of the features of tumor.

■ OBJECTIVE: To present our experience in the laparoscopic resection of RDLSSs and to evaluate endoscopy surgery by an anterior approach for the treatment of RDLSSs.

■ METHODS: We performed a retrospective review of 3 patients with RDLSSs who underwent laparoscopic surgery by an anterior approach between June 2013 and July 2014. Patient demographics, operative reports, and pre- and postoperative images were reviewed.

■ RESULTS: All tumors were removed completely with retroperitoneal laparoscopy by the anterior approach. There were no major morbidities related to the surgical procedure in this series, and all patients recovered from surgery. The preoperative symptoms either improved or resolved in 2 patients, whereas they remained unchanged in 1 patient. Postoperative follow-up ranged from 12 to 24 months, and none of the patients showed signs of tumor recurrence or spinal deformity.

■ CONCLUSIONS: The operative plan should be tailored to the features of the RDLSS. Retroperitoneal laparoscopy surgery by the anterior approach can produce safe and effective resection of RDLSSs with minimal postoperative

complications. This procedure may be preferred for RDLSSs mainly located in the retroperitoneum without spinal canal extension.

INTRODUCTION

Dumbbell spinal schwannomas (DSSs), which can be classified into 4 types according to Eden taxonomy, are a special part of spinal tumors that connect 2 or more separated regions, such as the intradural, epidural, and paravertebral regions.¹ To date, however, DSSs are still considered one of the difficult lesions to be resected because of the complex features of the intraspinal and extraspinal extension.² Dumbbell lumbar spinal schwannomas (DLSSs) have been defined as a group of DSSs that arise in the lumbar spine. Retroperitoneal DLSSs (RDLSSs), special types of DLSSs classified as the Eden type 4, are composed of small intervertebral foramen components and large paravertebral components extending into the retroperitoneal cavity. Therefore, because of the presence of significant retroperitoneal extension, it is particularly difficult to apply the conventional posterior approach for tumor resection.

Recently, some investigators have reported encouraging results of spinal tumor resection, including spinal dumbbell tumors, by endoscopy³⁻⁵; however, the significance of laparoscopic operative strategy to Eden type 4 RDLSSs has not been evaluated systematically. From June 2013 to July 2014, we performed retroperitoneal laparoscopic surgery with the anterior approach in 3 patients with RDLSS and share our experience here.

METHODS

Between June 2013 and July 2014, 3 middle-aged patients with RDLSSs were treated in our department by laparoscopy. Medical

Key words

- Laparoscopy
- Lumbar spinal tumor
- Minimally invasive surgery
- Schwannoma

Abbreviations and Acronyms

- DLSS:** Dumbbell lumbar spinal schwannomas
DSS: Dumbbell spinal schwannomas
MRI: Magnetic resonance imaging
RDLSS: Retroperitoneal dumbbell lumbar spinal schwannomas

From the Departments of ¹Neurosurgery, ²Urology, and ³Pathology, Hospital Affiliated to Nantong University, Nantong, Jiangsu Province, China

To whom correspondence should be addressed: Jian Chen, M.D.
[E-mail: ntjychenjian@126.com]

Wei Shi and Xing Su are co-first authors.

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records and clinical follow-up evaluations were reviewed retrospectively. Three patients presented with local pain and sensory or motor disturbance of the extremities. Detailed clinical presentation of all 3 cases is summarized in **Table 1**. Preoperative magnetic resonance imaging (MRI) revealed that all the cases presented with RDLSs were classified as the Eden type 4 according to the Eden taxonomy (**Figure 1A–C**).

Surgical Technique

The 3 cases underwent surgery via the retroperitoneal laparoscopic-assisted anterior approach with a 4-port technique similar to adrenalectomy. A C-arm roentgenogram was undertaken to localize precisely the involved lumbar vertebral. The lesion was accessed by means of the portal to the retroperitoneal space after the retroperitoneal space dilation. The Gerota fascia was opened and the kidney and ureter could be easily identified and protected (**Figure 2A**). The protuberant site of psoas muscle caused by the compression of RDLSs between the lumbar vertebrae and psoas muscle was split to expose the tumor (**Figure 2B–C**). Then, the elastic soft tumor was identified and easily dissected free from adjacent structures according to the clear plane (**Figure 2D**). The source nerve of schwannomas was identified with laparoscopy then clipped and divided (**Figure 2E–F**). Then, the intervertebral foramina were explored under laparoscopy to remove the intervertebral foraminal component of RDLSs. The bony elements of vertebrae were eroded and intervertebral foramina enlarged. As the enlarged foramen is approached, special care must be taken to avoid inadvertent injury to the nerve root, vascular pedicle, and spinal dura.

After the anatomic relationship in the foramen was delineated, it was not difficult to separate and pull out the remnant tumor in the foramen with excellent visualization (**Figure 2G**). After we removed the mass entirely, it was easy to identify the spinal dura in the enlarged intervertebral foramina (**Figure 2H**). In one case of this series (case 2), the spinal dura was damaged after the schwannoma resection. Therefore, the dura was repaired by Duragen layer and adjacent psoas muscle with fibrin glue to prevent the cerebrospinal fluid leak postoperatively. In case 2, because of the large size of the lesion, the resection was performed intrascapsular in a piecemeal fashion before we dissected the plane between the tumor and involved structures.

RESULTS

We performed complete laparoscopic excision in all 3 RDLSs. The diagnosis of schwannoma was confirmed by postoperative

histopathological examination. In all the treated cases, the postoperative course was uneventful; no surgery-related complication occurred, such as wound infection or cerebrospinal fluid leak postoperatively. All the patients were mobilized on second day postoperatively. The preoperative low back pain resolved in patient 1, and preoperative symptoms of right lower extremity numbness for patient 2 significantly improved postoperatively (**Table 1**). For patient 3, however, the neurological status of motor strength in left lower extremity remained unchanged after surgery (**Table 1**). Total resections were achieved in all patients based on the postoperative MRI within 72 hours (**Figure 1D–F**). Postoperative follow-up ranged from 12 to 24 months in all 3 patients. None of the patients showed signs of tumor recurrence and spinal instability or deformity at the time of follow-up evaluation.

DISCUSSION

Dumbbell spinal tumors account for approximately 13.7%–17.5% of all primary spinal tumors.^{1,2} Eden¹ has described the classification of dumbbell spinal tumors from type 1 to 4. RDLSs, a special group of Dumbbell spinal schwannomas classified as the Eden type 4, usually have separate regions including foraminal and paravertebral tumor components with retroperitoneal space extension. The presence of complex extension in the retroperitoneal space has made the surgical treatment of RDLSs different from other spinal schwannomas. It is difficult to obtain access to tumor by the conventional posterior approach because of the special features of RDLSs. In addition, conventional open surgery may be associated with iatrogenic trauma to muscle and vertebral bony structures.^{4,6–8}

Minimally invasive surgery is the current common practice for the treatment of spinal tumors.^{9–11} With the recent development of the minimally invasive endoscopic technique, there have been several reports of the experience in endoscopic resection of spinal tumors including DSSs, with promising results.^{3–5,12–14} In this study, we attempted to apply the laparoscopy-assisted anterior approach to tackle the lesion located in the retroperitoneal space and intervertebral foramen. All 3 patients were satisfied with the outcomes. We believe that one of the biggest advantages of this approach is the full use of the retroperitoneal space, which can provide sufficient working space and preserve the vertebral arches bone structures of the middle and posterior vertebral column.

In addition, it is important to identify the tumor and adjacent organs during the resection of RDLSs, which include the kidney/ureter in the retroperitoneal space, ventral spinal cord, and normal nerve root in the intervertebral foramen. These important proximal structures, however, are all difficult to visualize with the

Table 1. Patient Demographics

| Case | Age/Sex | Preoperative Symptoms | Level | Size, cm ³ | Pathology | Resection and Clinical Outcome |
|------|---------|--------------------------------|----------|-----------------------|------------|---------------------------------|
| 1 | 42/F | Low back pain | L3/Left | 3.0 × 2.5 | Schwannoma | Total resection and resolution |
| 2 | 47/M | Right lower extremity numbness | L2/Right | 5.0 × 4.5 | Schwannoma | Total resection and improvement |
| 3 | 45/M | Left lower extremity weakness | L3/Left | 4.0 × 3.5 | Schwannoma | Total resection and no change |

F, female; M, male.

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