A 56-year-old woman underwent laparoscopic right nephrectomy due to pyonephrosis associated with right ureteral stones. Moreover, the patient developed a brain stem hemorrhage and became bedridden before this time. During nephrectomy, a renal tumor, with a size of $24 \times 24 \times 20$ mm, was observed in the left renal hilum; the tumor did not show contrast enhancement on computed tomography. After 3 years, the tumor gradually grew to a size of $45 \times 35 \times 34$ mm, and therefore, laparoscopic non-clamping tumor enucleation was performed. Pathological examination confirmed a diagnosis of renal schwannoma.

Introduction

Laparoscopic partial nephrectomy is widely used as the first line of treatment for T1a renal tumors; however, this procedure involves many technical limitations. Moreover, the presence of a tumor in the renal hilum, especially in a patient with a single kidney, requires careful operation by a highly skilled surgeon. In such cases, non-clamping partial nephrectomy may be used to conserve renal function; however, this surgery is even more challenging.

Schwannomas are known to occur frequently in the head, neck, hands, and feet. Renal schwannomas are rare; they are generally diagnosed on pathological examination since their preoperative diagnosis is difficult.

Here, we report a case of renal hilum schwannoma in a patient with a single kidney that was treated by laparoscopic non-clamping tumor enucleation, and present a review of the relevant literature.

Case presentation

A 56-year-old woman underwent laparoscopic right nephrectomy due to pyonephrosis associated with right ureterolithiasis; furthermore, she developed a brain stem hemorrhage and became bedridden before this time. During nephrectomy, a renal tumor measuring $24 \times 24 \times 20$ mm, was observed in the left renal hilum; on computed tomography (CT), the tumor lacked contrast enhancement (Fig. 1). However, due to the presence of uncontrolled pyonephrosis, right nephrectomy was emergently performed. Postoperative laboratory examination results were almost within normal limit, except for slight renal dysfunction. The tumor grew slowly during follow-up, reaching a size of $45 \times 35 \times 34$ mm after 3 years. The tumor size continued to increase, and we anticipated that its continued growth could cause severe renal dysfunction. The serum creatinine level gradually increased and was $>1.0$ mg/dL at the preoperative stage. The patient refused hemodialysis and chose surgical resection.

Partial nephrectomy was chosen to preserve renal function since the patient had only a single kidney (subsequent to right nephrectomy for pyonephrosis). It was performed without clamping the renal vessels due to further preserve renal function. Renal hilum exfoliation revealed a part of the tumor; further dissection of the renal parenchyma allowed the identification of the entire tumor, which separated completely from the renal parenchyma. The tumor was excised gradually by blunt dissection from the renal parenchyma, followed by closure of the urinary tract and renorraphy. Since the tumor was present in the renal hilum, the renal parenchyma was incised through the renal hilum using a sealing device (Plasma Kinetic system: GYRUS). This exposed the tumor front (Fig. 2). The intraoperative
bleeding volume was 510 mL, and the operation time was 210 min. No postoperative complications were noted. No evidence of local recurrence or distant metastasis was noted on imaging studies performed 5 months postoperatively, and CT findings confirmed adequate function of the renal parenchyma. Continued follow-up imaging studies have been planned. Biochemical tests revealed no changes in the degree of renal dysfunction as compared to the preoperative status. The preoperative serum creatinine level was approximately 1.0 mg/dL; postoperatively, it was approximately 1.2 mg/dL.

Macroscopically, the excised tumor was solid and yellow; further examination revealed a cystic appearance within. Histopathological examination revealed interlacing fascicles of spindle cells (Antoni A) (Fig. 3). S-100 immunostaining showed a positive reaction in the tumor cells.

**Discussion**

Although schwannomas are typically found in the head, neck, and limbs, they may also develop in other parts of the body.
Retroperitoneal schwannomas are rare, accounting for 1–3% of all cases of schwannomas; moreover, retroperitoneal schwannomas account for only 1% of cases of retroperitoneal tumors. Only a few cases of retroperitoneal schwannomas have been reported, and reports of renal retroperitoneal schwannomas are even rarer. A PubMed search revealed 24 reports (comprising a total of 30 patients) of renal schwannoma in English publications (Table 1).

Renal schwannomas are difficult to diagnose preoperatively on the basis of clinical symptoms and radiographic findings; thus, they are often diagnosed based on the results of pathological examinations. In recent years, as diagnostic imaging techniques have improved, schwannomas are commonly diagnosed as an incidental finding.

Regardless of whether a schwannaoma is benign or malignant, this tumor typically does not cause symptoms and grows slowly. Therefore, the diagnosis of schwannomas may become difficult due to the presence of metastasis and direct invasion at the time of the diagnosis.

Under light microscopy, the typical tumor pattern of a schwannoma includes Antoni A and Antoni B areas. Immunostaining may be useful for the differential diagnosis of malignant tumors, as positive staining is specific to neoplasms arising from the neural crest and melanomas.

Preoperatively, it is impossible to distinguish between benign and malignant schwannomas given the similarity in their appearance; furthermore, it is believed that surgical resection is the only effective treatment for renal schwannomas. Almost all the patients described in the reviewed literature underwent nephrectomy or radical nephrectomy; only 4 reported cases (including the present case) underwent tumorectomy, and this treatment was employed primarily due to the specific tumor size and location.

In our hospital, non-clamping partial nephrectomy has been performed since 2013. In the present patient, there were no obvious perioperative or postoperative complications. Thus, non-clamping resection of renal tumors may be considered a safe treatment option, especially for tumors with clear capsules.

| Author          | Year | Age (years) | Sex | Symptoms                                | Side  | Treatment       | Size (cm) | Location | Malignancy |
|-----------------|------|-------------|-----|-----------------------------------------|-------|-----------------|-----------|----------|------------|
| Phillips        | 1955 | 56          | M   | Flank pain                              | L     | Nephrectomy     | 12        | Pelvis   | No         |
| Fein            | 1965 | 51          | F   | Recurrent pyelonephritis, palpable mass | R     | Nephrectomy     | 6         | Pelvis   | No         |
| Romics          | 1978 | 56          | M   | Microhematuria                          | R     | Nephrectomy     | 7         | Hilum    | No         |
| Steers          | 1985 | 50          | F   | Palpable mass                           | R     | Tumorectomy     | 9         | Hilum    | No         |
| Somers          | 1988 | 55          | F   | Incidental findings                     | L     | Nephrectomy     | 5.1       | Pelvis    | Yes        |
| Kitagawa        | 1990 | 51          | M   | Upper abdominal pain and high fever     | L     | Nephrectomy     | 2.8       | Hilum    | No         |
| Ma              | 1990 | 67          | M   | Epigastric pain                         | R     | Nephrectomy     | 8         | Pelvis    | Yes        |
| Naslund         | 1991 | 50          | F   | Anemia, weight loss                     | L     | Nephrectomy     | 14        | Pelvis    | Yes        |
| Romics          | 1992 | 52          | M   | Back and flank pain                     | R     | Nephrectomy     | NR        | Capsule  | Yes        |
| Ikeda           | 1996 | 89          | M   | Abdominal pain                          | R     | Nephrectomy     | NR        | Pelvis    | No         |
| Singer          | 1996 | 70          | F   | Incidental finding                      | L     | Nephrectomy     | 6         | Hilum    | No         |
| Pantuck         | 1996 | 50          | F   | Palpable mass                           | R     | Nephrectomy     | 28        | Capsule  | Yes        |
| Alvarado-Cabrer | 2000 | 18          | F   | Flank pain                              | R     | Nephrectomy     | 6.2       | Pelvis    | No         |
| Alvarado-Cabrer | 2000 | 84          | M   | Incidental finding                      | R     | Nephrectomy     | 4         | Pelvis    | No         |
| Alvarado-Cabrer | 2000 | 40          | F   | Flank pain, abdominal mass              | L     | Nephrectomy     | 12.5      | Pelvis    | No         |
| Alvarado-Cabrer | 2000 | 45          | M   | Flank and abdominal pain                | L     | Nephrectomy     | 16        | Pelvis    | No         |
| Tsurusaki       | 2001 | 69          | F   | Incidental finding                      | L     | Tumorectomy     | NR        | Capsule  | No         |
| Cachay          | 2003 | 74          | F   | Incidental finding                      | R     | Nephrectomy     | 9         | Capsule  | Yes        |
| Singh           | 2005 | 40          | M   | Renal colicky pain, vomiting            | L     | Nephrectomy     | 3         | Hilum    | No         |
| Singh           | 2005 | 35          | M   | Flank pain, gross hematuria             | R     | Nephrectomy     | NR        | Pelvis    | No         |
| Tokunaga        | 2005 | 39          | F   | Incidental finding                      | R     | Nephrectomy     | 8         | Hilum    | No         |
| Hung            | 2007 | 36          | F   | Palpable mass, flank pain               | L     | Nephrectomy     | 7         | Pelvis    | Yes        |
| Gobbo           | 2008 | 59          | F   | Incidental finding                      | L     | Nephrectomy     | 4.8       | Hilum    | No         |
| Gobbo           | 2008 | 27          | F   | Incidental finding                      | R     | Nephrectomy     | 8.5       | Pelvis    | No         |
| Gobbo           | 2008 | 35          | F   | Flank and abdominal pain, nausea        | L     | Nephrectomy     | 7         | Hilum    | No         |
| Sfoungaristos   | 2011 | 55          | F   | Incidental finding                      | L     | Nephrectomy     | 2.8       | Hilum    | No         |
| Yang            | 2012 | 40          | F   | Flank pain                              | L     | Nephrectomy     | 6.8       | Pelvis    | No         |
| Himabindu       | 2012 | 36          | F   | Flank pain                              | R     | Nephrectomy     | 4.6       | Pelvis    | No         |
| Verze           | 2013 | 59          | M   | Incidental finding                      | R     | Nephrectomy     | 15        | Pelvis    | No         |
| Himabindu       | 2013 | 36          | F   | Flank pain, fever                       | R     | Tumorectomy     | 4.6       | Pelvis    | No         |
| Present case    | 2015 | 63          | F   | Incidental findings                     | L     | Tumorectomy     | 2.4       | Hilum    | No         |

NR: Not reported.

The study participant provided informed consent.
Conflicts of interest
None declared.

References
1. Hung SF, Chung SD, Lai MK, et al. Renal schwannoma: case report and literature review. Urology. 2008;72:e3–716.e6.
2. Gubbay AD, Moschilla G, Gray BN, Thompson I. Retroperitoneal schwannoma: a case series and review. ANZ J Surg. 1995;65:197–200.
3. Cachay M, Sousa-Escandón A, Gibernau R, et al. Malignant metastatic parirenal schwannoma. Scand J Urol Nephrol. 2003;37:443–445.
4. Fein RL, Hamm FC. Malignant schwannoma of the renal pelvis: a review of the literature and a case report. J Urol. 1965;94:356–361.
5. Imao T, Seki M, Amano T, Takemae K. Laparoscopic resection of retroperitoneal schwannoma: report of three cases and review of 22 cases in Japanese literature. Hinyokika Kiyo. 2011;57:491–495 [in Japanese].