Laparoscopic Resection of Nonadrenal Retroperitoneal Tumors

Keun Soo Ahn, MD; Ho-Seong Han, MD, PhD; Yoo-Seok Yoon, MD, PhD; Hyung-Ho Kim, MD, PhD; Tae-Seung Lee, MD, PhD; Sung-Bum Kang, MD, PhD; Jai Young Cho, MD, PhD

Background: Laparoscopic resection of primary retroperitoneal tumors is a challenging procedure because access is difficult due to the deep, posterior location and adjacent major vessels.

Objective: To assess the safety and feasibility of laparoscopic resection of primary nonadrenal retroperitoneal tumors.

Method: Data on 20 patients with a diagnosis of primary retroperitoneal tumor who underwent laparoscopic resection from August 1, 2003, to June 30, 2009 were analyzed.

Results: Twenty patients (12 men and 8 women; median age, 45.5 years) were included in the review. The tumor sizes ranged from 2.0 to 9.5 cm in diameter (median, 4.7 cm). In 10 patients, tumors were adherent to adjacent major vessels (ie, inferior vena cava, renal vein, superior mesenteric vein, or the splenic vessel). Postoperative examination of the samples revealed that lymphangioma (7 [35.0%]) was the most common tumor type, followed by ganglioneuroma (3 [15.0%]), schwannoma (2 [10.0%]), paraganglioma (2 [10.0%]), and Castleman disease (2 [10.0%]). The median operative time was 117.5 minutes and the median estimated blood loss was 50.0 mL. One operation (0.05%) was converted to laparotomy due to intraoperative bleeding. Postoperative complications occurred in 2 patients (10.0%), both of whom were treated conservatively. The median length of the postoperative hospital stay was 5 days. Neither tumor size nor the presence of adhesions to adjacent vessels affected the perioperative or clinical outcomes.

Conclusion: Laparoscopic resection of retroperitoneal tumors is feasible even when a tumor is large or adheres to adjacent vascular structures if there is no evidence of malignancy based on preoperative radiologic studies.

Arch Surg. 2011;146(2):162-167

See Invited Critique at end of article

Author Affiliations: Department of Surgery, Seoul National University Bundang Hospital, Seoul National University College of Medicine, Seoul, Korea.

Methods

Between August 1, 2003, and June 30, 2009, a total of 155 patients underwent laparoscopic (n=121) or open (n=34) resection of retroperitoneal tumors. Of these, 121 patients who had a tumor of adrenal gland origin were excluded. A primary retroperitoneal tumor was diagnosed in the remaining 34 patients; 20 pa-
tients (58.8%) underwent laparoscopic excision and 14 pa-
tients (41.2%) had open excision. Laparoscopic excision of a
retroperitoneal tumor was indicated when the diagnosis of a
benign tumor was made based on findings from preoperative
radiologic studies. We excluded patients who had tumors larger
than 10 cm or features of malignancy, such as the presence of
irregular margins and definite invasion to adjacent organs based
on preoperative radiologic findings. Even for patients without
symptoms, laparoscopic excision was used because of the pos-
sibility of misdiagnosis17-19 and malignant transformation.19,20

We retrospectively analyzed the clinical outcomes of 20 pa-
tients who underwent laparoscopic excision of a primary non-
adrenal retroperitoneal tumor. The clinical outcomes, includ-
ing operative time, estimated blood loss, postoperative hospital
stay, and complications, were evaluated with respect to tumor
size and adhesions to adjacent major vessels. Finally, the out-
comes of this study population were compared with the out-
comes of 14 patients who underwent open excision.

Tumor locations were classified into 5 groups based on ra-
diologic findings (computed tomography or magnetic reso-
nance imaging) and relationships with the IVC and renal vein
(Figure 1). Postoperative surgical complications were de-
signed and graded, as described by the proposed Clavien clas-
sification system.21

OPERATIVE TECHNIQUE

Under general anesthesia, the patient was placed in the supine
or lateral decubitus position, depending on the approach cho-
sen. Three to 7 trocars were used as required during the op-
eration, and a 30° or flexible laparoscope was used. Dissection
and mobilization were performed using electrocautery and ul-
tasonic shears (Harmonic scalpel; Ethicon, Cincinnati, Ohio;
or SonoSurg; Olympus, Tokyo, Japan).

Access for tumor resection in the right side was facilitated
by performing the Kocher maneuver on the duodenum, mo-
bilizing the hepatic flexure and ascending colon, and retract-
ing the right liver upward. Right retroperitoneal structures, in-
cluding the right adrenal gland, the posterior portion of the
pancreaticoduodenal unit, the right renal vein, and the IVC,
were approached using these maneuvers (Figure 2). Tumors
in the left side were exposed by mobilizing the splenic flexure
of the colon and dividing the splenorenal ligament from the
inferior splenic pole, thereby allowing the spleen and tail of
the pancreas to move upward or medially. Using these proce-
dures, left retroperitoneal structures, including the left adre-
nal gland, the left renal vein, and the aorta, could be ap-
proached. When a tumor was located in the right or left lower
area, it was approached via retroperitoneal dissection after ap-
plying upward medial traction to the bowel and mesentery.

Tumors were dissected and mobilized from adjacent struc-
tures, and feeding vessels were divided using either metallic
clips or Hem-o-lok clips (Weck Teleflex Medical, Research Tri-
angle Park, North Carolina). After meticulous hemostasis and
saline irrigation, a drain was placed around the surgical field.
The resected specimens were placed in individual protected bags
and extracted through a small incision that was created by ex-
tending the 10-mm working port.

Figure 1. Distribution of retroperitoneal tumors. A, We classified tumor locations into 5 groups depending on their relationships with the IVC and renal vein. The numbers within the circles are the number of tumors in each location. B, Tumor locations in individual patients. The numbers in circles are the patient numbers shown in Table 1. Underlined patient numbers are tumors that adhered to an adjacent major vessel. Adhered to the IVC: 1, 6, 13, 15, and 16; adhered to the splenic vessel: 5 and 11; adhered to the renal vein: 2 and 9; and adhered to the SMV: 17. IVC indicates inferior vena cava; LL, left lower area; LU, left upper area; Post, posterior to the IVC area; RL, right lower area; RU, right upper area; and SMV, superior mesenteric vein.
STATISTICAL ANALYSIS

All values are expressed as median (range) or as mean (SD). Statistical analysis was performed using the Mann-Whitney test, Pearson χ² test, and Fisher exact test in the Statistical Package for the Social Science for Windows (release 15.0; SPSS Inc, Chicago, Illinois). Differences were considered significant at \( P < .05 \).

RESULTS

CHARACTERISTICS OF PATIENTS AND TUMORS

The detailed characteristics of the tumors are summarized in Table 1. The patients included 12 men and 8 women with a median age of 45.5 years (range, 21-69 years). Tumors in asymptomatic patients that were detected incidentally during health screening were most common (13 [65.0%]), followed by tumors in patients with abdominal or flank pain (4 [20.0%]). The median tumor diameter was 4.7 cm (range, 2.0-9.5 cm). The most common tumor site was the left upper area (7 [35.0%]), followed by the right upper area (4 [20.0%]), right lower area (4 [20.0%]), left lower area (3 [15.0%]), and posterior to the IVC (2 [10.0%]) (Figure 1A). In 10 patients, tumors were adherent to adjacent major vessels: IVC (5 [50.0%]), renal vein (2 [20.0%]), splenic vein (2 [20.0%]), and superior mesenteric vein (1 [10.0%]) (Figure 1B). Among 5 patients with tumor adherence to the IVC, tumors were located along the posterior aspect of the IVC in 2 patients (40.5%) (patients 10 and 16). Patient 10 had a large tumor (9.5 cm), but this tumor was resected without difficulty (Figure 2). A concomitant left adrenalectomy was performed in patients 1 and 11 because of adhesion. All tumors were benign based on the final histologic examination, as follows: lymphangioma (7 [35.0%]), ganglioneuroma (3 [15.0%]), schwannoma (2 [10.0%]), paraganglioma (2 [10.0%]), Castleman disease (2 [10.0%]), cavernous hemangioma (1 [0.5%]), neurofibroma (1 [0.5%]), gastric duplication cyst (1 [0.5%]), and bronchogenic cyst (1 [0.5%]).

PERIOPERATIVE OUTCOMES

One procedure (5.3%) was converted to a laparotomy (patient 17) because of bleeding from veins draining into the adhered superior mesenteric vein. The median operative
time was 117.5 minutes (range, 20-330 minutes) and median estimated blood loss was 50.0 mL (range, 5-500 mL). No patient needed a blood transfusion.

There was no perioperative mortality. Postoperative complications occurred in 2 patients (10.0%). Patient 5 had fluid collection at the surgical site (grade IIIa by the modified Clavien complication classification) and patient 20 had urinary retention (grade I). These complications were treated by percutaneous drainage and urinary catheterization, respectively, and had resolved at the time of discharge. The median length of postoperative hospital stay was 5 days (range, 2-11 days). After a mean follow-up of 18.0 months (range, 1-53 months), no patient showed evidence of recurrence.

### CLINICAL OUTCOMES ACCORDING TO TUMOR SIZE AND ADHERENCE TO MAJOR VESSELS

When perioperative outcomes were compared for patients with large (≥5 cm) or small (<5 cm) tumors, those with large tumors required longer operation times and lost more blood, but there were no significant differences between the groups (Table 2). Postoperative complication rates and postoperative hospital stays were also not significantly different between patients with large or small tumors.

Patients with tumors adhering to major vessels (ie, IVC, renal vein, splenic vein, and superior mesenteric vein) required significantly longer operative times ($P = .02$), but lost no more blood and had similar lengths of hospital stays (Table 3).

### CLINICAL OUTCOMES IN THE LAPAROSCOPIC AND OPEN GROUPS

In contrast to the benign tumors in the study population, malignant retroperitoneal tumors dominated (71.4%) in patients who underwent an open procedure (open group; Table 4). Patients in the open group had larger tumors, reported symptoms more frequently, required a longer operation, lost more blood, and spent more time in the hospital. One postoperative death occurred in the open group due to multiorgan failure in a patient who underwent pancreaticoduodenectomy due to a pleomorphic malignant fibrous histiocytoma.

### COMMENT

Few reports exist on laparoscopic resection of nonadrenal retroperitoneal tumors, and the majority are case reports.⁵⁻¹¹ To our knowledge, the present study is the larg-
successful laparoscopic resection of large (≥5 cm) tumors that are thought to be benign—even large retroperitoneal tumors. In the present study, a 9.5-cm retroperitoneal tumor that was adherent to the IVC was resected.

Table 2. Comparison Between Patients With a Large Tumor (≥5 cm) or a Small Tumor

<table>
<thead>
<tr>
<th>Variable</th>
<th>Large Tumor (n=9)</th>
<th>Small Tumor (n=11)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time, min</td>
<td>159.3 (84.2)</td>
<td>105.5 (76.4)</td>
<td>.08</td>
</tr>
<tr>
<td>Estimated blood loss, mL</td>
<td>191.1 (185.5)</td>
<td>107.7 (171.5)</td>
<td>.55</td>
</tr>
<tr>
<td>Postoperative hospital stay, d</td>
<td>5.1 (2.5)</td>
<td>5.8 (2.6)</td>
<td>.60</td>
</tr>
<tr>
<td>Complication, No. (%)</td>
<td>1 (11.1)</td>
<td>1 (9.1)</td>
<td>&gt;.99</td>
</tr>
</tbody>
</table>

Table 3. Comparison Between Patients With and Without a Tumor Adherent to a Major Vessel

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adhered Group (n=10)</th>
<th>Nonadhered Group (n=10)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time, min</td>
<td>162.4 (72.1)</td>
<td>97.0 (82.5)</td>
<td>.02</td>
</tr>
<tr>
<td>Estimated blood loss, mL</td>
<td>183.0 (174.7)</td>
<td>107.5 (182.7)</td>
<td>.09</td>
</tr>
<tr>
<td>Postoperative hospital stay, d</td>
<td>5.4 (2.2)</td>
<td>5.6 (3.1)</td>
<td>.97</td>
</tr>
<tr>
<td>Complication, No. (%)</td>
<td>1 (10.0)</td>
<td>1 (10.0)</td>
<td>&gt;.99</td>
</tr>
</tbody>
</table>

Table 4. Comparison Between Patients Who Underwent Laparoscopic vs Open Procedure

<table>
<thead>
<tr>
<th>Variable</th>
<th>Laparoscopy (n=20)</th>
<th>Open (n=14)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant/benign, No./No.</td>
<td>0/20</td>
<td>10/4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Presence of symptoms, No.</td>
<td>7</td>
<td>11</td>
<td>.02</td>
</tr>
<tr>
<td>Tumor size, mean (SD), cm</td>
<td>5.1 (2.0)</td>
<td>14.2 (5.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Operation time, mean (SD), min</td>
<td>129.7 (82.8)</td>
<td>235.6 (233.0)</td>
<td>.03</td>
</tr>
<tr>
<td>Estimated blood loss, mean (SD), mL</td>
<td>145.3 (178.3)</td>
<td>332.3 (274.6)</td>
<td>.02</td>
</tr>
<tr>
<td>Postoperative hospital stay, mean (SD), d</td>
<td>5.5 (2.6)</td>
<td>13.9 (10.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Complications, No. (%)</td>
<td>2 (10.0)</td>
<td>2 (14.3)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Mortality, No. (%)</td>
<td>0</td>
<td>1 (7.1)</td>
<td>.42</td>
</tr>
</tbody>
</table>

est case series to show the feasibility and safety of the laparoscopic resection of nonadenral retroperitoneal tumors. In the present study, all retroperitoneal tumors in various locations were safely approached by laparoscopy, even when a tumor was located along the posterior aspect of the IVC. Furthermore, the magnified view provided by laparoscopy enabled precise dissection of retroperitoneal tumors located in a deep, narrow space. All tumors but 1 were safely resected without injury to adjacent organs, with minimal intraoperative bleeding, and a low incidence of postoperative morbidity. In particular, large tumors (≥5 cm) and tumors adjacent to major vessels were removed without significantly affecting perioperative outcomes.

Use of the laparoscopic approach to treat large tumors remains debatable and there is no established correlation between tumor size and the possibility of malignancy. Hence, no definitive guidelines have been issued regarding use of laparoscopy to remove benign tumors based on size. However, advances in radiologic techniques have made the differentiation of benign and malignant lesions more reliable. In the present study, all tumors were shown to be benign based on postoperative histopathologic evaluation. Thus, laparoscopic resection can be viewed as a first-line treatment option for tumors that are thought to be benign—even large retroperitoneal tumors. Some case reports have described the successful laparoscopic resection of large (≥10 cm) retroperitoneal tumors. In the present study, a 9.5-cm retroperitoneal tumor that was adherent to the IVC was resected without complication. Furthermore, perioperative results did not differ between large and small tumors. However, patients with tumors larger than 10 cm were excluded for laparoscopic resection because large incisions would have been required to extract the specimen, thus reducing the benefits of minimally invasive operations. Moreover, if a tumor is large and heavy, laparoscopic manipulation is expected to be difficult.

Ten of our 20 patients had tumors adherent to neighboring major vessels. When a tumor adheres to important adjacent vessels, the risk of massive bleeding and injury to adjacent organs is increased. Therefore, meticulous dissection is necessary. In the present study, although the operative times were greater in the adhesion group, the presence of adhesions to an adjacent major vessel did not affect the clinical outcome. This suggests that laparoscopic resection of retroperitoneal tumors located near major vessels or vital structures is feasible and safe.

Although the disease entities differed between the 2 study groups, the clinical results were better in the laparoscopy group than in the open group. In particular, malignant tumors dominated in the open group and the invasion to adjacent organs and combined resection may have affected clinical outcomes unfavorably in this group. Although a number of successful trials on laparoscopic excision of malignant retroperitoneal tumors have been conducted, its use remains controversial. Usually, suspicious malignant lesions need wide surgical excision to ensure a safe surgical margin; hence, there are higher risks of injuring adjacent structures and of incomplete excision. Therefore, if a laparoscopically resected tumor is shown to be malignant on frozen section or postoperative histopathologic examination, open conversion or relaparotomy for wide excision should be considered. Still, there is a lack of long-term data on oncologic safety, such as survival and recurrence. If malignancy is suspected based on results of preoperative radiologic studies, an open operation may be preferred for oncologic safety. Thus, further evaluations are needed before the laparoscopic approach can be used routinely for malignant lesions.

The incidence of retroperitoneal tumors is too infrequent for most surgeons to gain sufficient experience in laparoscopic excision. For laparoscopic excision of a retroperitoneal tumor, techniques for approaching the retroperitoneal space, adequate mobilization of adjacent organs (eg, duodenum, spleen, and hepatic or splenic flexure of the colon) are necessary. Therefore, for an experienced surgeon who is adroit at laparoscopic adrenalectomy, distal pancreatectomy, splenectomy, or colec-
Laparoscopic Resection of Retroperitoneal Tumors

Feasible, but Appropriate?

Benefits of routine laparoscopic procedures, such as reduced pain, decreased length of hospitalization, and quicker return to normal activities, have resulted in substantial extension of indications, including routine laparoscopic resection of both benign and malignant intraabdominal tumors. Initial concern regarding such procedures focused largely on whether they constituted satisfactory anticancer operations. Recent data have largely assuaged these fears. However, the optimal approach for removal of otherwise undefined retroperitoneal tumors remains less well delineated.

In this study, Ahn et al performed laparoscopic resection for 20 benign retroperitoneal tumors and open resection for 10 malignant and 4 benign retroperitoneal...