Clinical study of laparoscopic operation in the treatment of gastric schwannoma

Yunlei Wang1, Dehong Xie2, Jianwei Zheng3, Xiaofeng Han1

1Department of General Surgery, Beijing Chaoyang Hospital Jingxi Campus, Beijing 100043, China; 2Department of General Surgery, Beijing Chaoyang Hospital, Beijing 100020, China; 3Department of General Surgery, The Affiliated Beijing Chaoyang Hospital, Capital Medical University, Beijing 100043, China

Received December 8, 2015; Accepted December 28, 2015; Epub February 15, 2016; Published February 29, 2016

Abstract: Objective: To investigate the effect of laparoscopic gastrectomy for gastric schwannoma. Methods: From January 2009 to December 2014, 63 patients with gastric schwannoma, who underwent laparoscopic gastric resection or traditional operation, were analyzed retrospectively. All tumors were originated single, with 28 cases in gastric body, 21 cases in gastric antrum, and 14 cases in gastric fundus. The diameters of tumor ranged from 2.5 to 5 cm with an average of (3.7±1.6) cm. Results: All 30 cases were successfully completed laparoscopic surgery without conversion to open surgery. There was no peri-operative death in laparoscopic surgery group. Mean operative time was (75±25) min, mean blood loss during operation was (30.7±10.2) ml and the average stay was 3.5~7.5 d. After the operation, the patients recovered well, and there was no complication such as gastric leakage, abdominal cavity infection and wound disruption, postoperative infection and so on. Negative surgical margin was confirmed by pathological test. There were 27 cases of benign schwannoma and 3 cases of malignant gastric schwannoma confirmed by immunohistochemical examination. All patients were followed up with an average follow-up time of 31.8±15.7 months. There was one patients died of myocardial infarction 1 year after the operation, others were survived without metastasis or recurrence. S-100, CD56 and Vimentin was expressed in all schwannoma tumors instead of α-SMA, c-Kit and HMB-45. The survival time of patients with benign schwannomas was longer than those of the malignant. Conclusion: Laparoscopic gastric resection could completely remove the gastric schwannoma and assure negative surgical margins. And it is a safe, effective surgery for the treatment of gastric schwannoma, which can be promoted in clinic.

Keywords: Gastric schwannoma, Laparoscope, gastric resection

Introduction

Schwannomas may occur in any nerve tissue with Schwann cell membrane, also known as Schwann cell tumor (schwannoma), which originates in the tumors of the peripheral nerve sheath and endoneurium cells [1]. The schwannoma tissue mainly comes from two kinds of cells. One is Schwann cells (from the development of neuroectoderm), and the other is endoneurial cells (from the development of mesoderm). It is clinically confirmed that schwannomas could occur in the parts of the nerve tissue with Schwann cell membrane, commonly in the parts like limbs, head and neck, juxtaspinal but rarely in the digestive tract. The pathological study shows that schwannomas could be divided into Antoni type A and type B. The two types of pathological tissue can exist in the same tumor or coexist in a transitional state. After occurred and developed in peripheral nervous system or digestive system, Schwannoma will show some characteristic differences in morphology, for example, digestive tract schwannomas has no envelope, but surrounded by lymphocytes and with formation of germinal center. Clinical data showed that the digestive tract schwannomas accounts for only 0.2% of the systemic schwannoma. However, the gastric schwannoma accounts 90% of the entire digestive tract schwannomas [2, 3]. Surgical excision is the first choice for the treatment of gastric schwannoma. The current operation methods include endoscopic operation, open surgery and laparoscopic surgery. The previous treatments of gastric schwannoma were open surgery. Some patients even chose radical subtotal gastrectomy, which
caused great trauma. Since gastric schwannoma belongs to the mesenchymal tumor, it extents by direct invasion and hematogenous metastasis, rarely by lymphatic metastasis, so conventional surgery with lymph node dissection is unnecessary as well as the expanded operation. Compared with conventional open surgery, the laparoscopic surgery has advantages of small trauma and quick recovery; however, current clinical research of laparoscopic surgery in the treatment of gastric schwannoma is few with several cases reported. By comparing the way of laparoscopic operation and open surgery, this study selected 63 cases of patients with gastric schwannoma in our hospital from January 2009 to December 2014 to explore the feasibility of laparoscopic resection of gastric schwannoma, and provided reference for clinical practice and further research.

Materials and methods

General information

From January 2009 to December 2014, 63 cases of patients with gastric schwannoma were diagnosed and treated in our hospital, of which, 21 cases were male, 42 cases were female, aged from 28 to 68, with a median age of (47.3±10.7). The main clinical manifestations included: epigastric discomfort, pain, acid regurgitation and belching in 35 cases, abdominal mass in 14 cases, asphalt samples in 14 cases. Inclusion criteria: patients underwent fiber gastroscopy, upper gastrointestinal angiography and CT examination before surgery, initially identified the location and nature of lesions the masses, and had no contraindications with laparotomy or laparoscopic operation. Exclusion criteria: patients with distant metastasis of tumor, other malignant tumors with history of distant metastasis, preoperative radiotherapy, chemotherapy or immunotherapy, etc., combined resections with other organs such as gall bladder, spleen. Of the all 63 cases, tumor diameters ranged 2.5~5 cm with an average of (3.7±1.6) cm, all single; there were 28 cases occurred in gastric body, 21 cases in gastric antrum, and 14 case in gastric fundus. The course was 2 weeks to 3 years, 30 cases of patients with gastric schwannoma underwent laparoscopic surgery while the other 33 cases with traditional open operation treatment. The evaluation indexes of two groups included operation time, haemorrhage volume, hospitalization days, gastrointestinal exhaust time, the nature, recurrence and metastasis of the tumor, and the occurrence of postoperative nausea, vomiting and pain.

Laparoscopic operation

Patients were anesthetized with endotracheal intubation anesthesia, took herringbone position with head higher than feet, right-side inclined, the specific inclined angle depended on the operation regulation. The “five-port method” was used in the operation, a 10 mm conventional observation port was punctured in the umbilicus, a 12 mm main Trocar operating port was punctured at left anterior-axillary line under costal margin, a 5 mm auxiliary Trocar operating port was punctured at the 5 cm above the left side of umbilicus, and two 5 mm assistant Trocar operating ports were punctured at the right mid-calvicular line at the upper level of umbilicus and the right mid-calvicular line under costal margin respectively. Pneumoperitoneum pressure was kept at 12~15 mmHg. Abdominal cavity exploration was carried by 30° laparoscopy to find the size, morphology, lesion location as well as activity etc. of the tumor. Electronic gastroscopy could be combined at the same time in the cases with small diameter, lesion beneath gastric mucosa and positioning difficulty. After fully grasp the related situation of tumor lesion, we chose appropriate surgical resection method. 28 cases of lesions located in the gastric body and anterior/posterior walls of gastric fundus; after isolate the greater and lesser omentum and retinal tissue around tumor by the help of laparoscopy, tumor was completely resected on the edge 2~3 cm away from the lesion; 21 cases of lesions located in the antral gastric mucosa, distal subtotal gastrectomy was performed under laparoscopy; 14 cases of tumors located at the gastric fundus, of which one was near cardiac part and another was quite large, proximal subtotal gastrectomy was performed under laparoscopy; Among the 14 cases, 7 cases located in gastric body, 7 cases located in the antral gastric mucosa, due to small lesions and difficult laparoscopic positioning, a completed resection of lestion was performed after positioned with the help of gastroscope according to the above method. Non-tumor per-
Laparoscopic operation, gastric schwannoma

Formance was strictly followed to avoid tumor cells implanting at the edge of the incision. Tissue samples were sent for pathologic examination after fully packed by specimen bags and took out from umbilica port. Routine gastrointestinal decompression and intraperitoneal drainage was performed after surgery.

**Immunohistochemical assay**

Postoperative specimens of tumor slices were observed by a senior pathologist, who was responsible for the immunohistochemical test of all patients. Antibodies included S-100, HMB45, CD56, CD34, alpha SMA, c-Kit, Ki-67 and Vimentin. All antibodies were purchased from Beijing Zhongwei Company. Tumor specimens were fixed by 10% neutral formaldehyde solution and embedded by paraffin, then made into 4 um slices; after de-waxing by xylene and de-hydrating by gradient ethanol, the specimens were examined in accordance with the immunohistochemical test procedures. Different antigen retrieval methods were used according to different antibodies. All slices were colored by DAB, and nucleas were double stained by hematoxylin. Scoring criteria for staining percentage: 0 for ≤ 10%, 1 point for 11%-25%, 2 points for 26%-50%, 3 points for 51%-75%, and 4 points for > 75%. Scoring criteria for staining intensity: light brown for 1 point, brown for 2 points, and dark brown for 3 points. Finally, the combined scores of staining percentage and staining intensity were used for statistical analysis of the degree of staining.

**Follow-up**

All patients were followed up for at least 1 year, by the way of outpatient or telephone follow-up. The survival, tumor recurrence, distant metastasis, nausea, vomiting, and pain were observed during the follow-up period.

**Statistical method**

Statistical software SPSS19.0 was used to analyze the data of this study. Measurement data were examined by t test and expressed by X±S, while quantitative data were examined by chi-square test and expressed by %. The comparison of clinic pathological parameters of benign and malignant Gastric schwannoma, such as age, gender, location and size of tumor, were summarized by Fisher exact test. And the survival rate was compared by Kaplan Meier method. P < 0.05 were considered statistically significant.

**Results**

**The basic situation of patients**

Barium X-ray examination showed 14 cases with ulcer lesions in mucosa, and the other 49 cases with localized uplift and smooth surface masses. For these 63 cases, only 7 cases were diagnosed as schwannoma, 28 cases were misdiagnosed as gastrointestinal stromal tumors, and the rest 28 cases were misdiagnosed as gastric leiomyoma. Abdominal CT scan showed: 49 cases with lesions beneath the mucosa, which were homogenzid solid mass without internal bleeding and calcification, shaped like circular with well defined edge; 14 cases with ulcer in the contact surface of lesion and gastric mucosa; abdominal CT enhanced scan on tumor showed 28 cases with mild enhancement, and 35 cases with

---

**Table 1. Comparison of Basic data in two groups of patients (cases)**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Cases</th>
<th>Male/Female</th>
<th>Average age (years)</th>
<th>Barium meal radiography</th>
<th>Abdominal CT scan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laparoscopic group</td>
<td>30</td>
<td>10/20</td>
<td>46.1±8.7</td>
<td>6</td>
<td>23</td>
</tr>
<tr>
<td>Laparotomy group</td>
<td>33</td>
<td>11/22</td>
<td>48.5±11.8</td>
<td>8</td>
<td>26</td>
</tr>
</tbody>
</table>

**Table 2. Comparison of indexes in two groups of patients**

<table>
<thead>
<tr>
<th>Group</th>
<th>Operation time (min)</th>
<th>Bleeding volume (ml)</th>
<th>Length of Hospital Stay</th>
<th>Gastrointestinal exhaust time (Cases)</th>
<th>Tumor size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 h</td>
<td>48 h</td>
</tr>
<tr>
<td>Laparoscopic group</td>
<td>75±25</td>
<td>30.7±10.2</td>
<td>3.5-7.5</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Laparotomy group</td>
<td>135±47.3</td>
<td>40.3±15.4</td>
<td>12.2±5.4</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>
Laparoscopic operation, gastric schwannoma

Comparison of the basic data such as age, gender, etc, between the patients underwent laparoscopic operation and traditional laparotomy, are shown in Table 1, the difference between the two groups was not statistically significant (P > 0.05).

Comparison results of evaluation index in two groups

Index in surgery: Laparoscopic surgery was performed successfully in 30 patients, and there was no case conversed to open surgery or peri-operation death. In laparoscopic group, the average operation time was (75±25) min; the average bleeding volume during operation was (30.7±10.2) ml; and the average length of hospital stay after operation was (3.5~7.5) d. The cases with gastrointestinal tract recovery (exhaust) in 24 h, 48 h and 72 h after operation were 10, 13 and 7 respectively. After exhausted, we removed the gastric tube and feed patients with fluid, and removed the abdominal drainage tube the next day, see Table 2. From the table, we can see, compared with laparotomy group, patients in laparoscopic group showed significant difference in the time of surgery, hospitalization days, gastrointestinal exhaust time and tumor size (P < 0.05). There was no postoperative complication such as abdominal infection, incision infection, gastric leakage, incision split etc. in both groups. The postoperative pathology test all confirmed gastric schwannoma with negative lymph node metastasis.

Comparison of tumor data in two groups of patients

Table 3. Comparison of tumor data in two groups of patients

<table>
<thead>
<tr>
<th>Groups</th>
<th>Parts (Example)</th>
<th>Follow-up time (Month)</th>
<th>Properties (Example)</th>
<th>Recurrence (Example)</th>
<th>Distant metastasis (Example)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gastric body</td>
<td>Gastric antrum</td>
<td>Fundus</td>
<td>Benign</td>
<td>Canceration tendency</td>
</tr>
<tr>
<td>Laparoscopic group</td>
<td>14</td>
<td>10</td>
<td>6</td>
<td>31.8±15.7</td>
<td>27</td>
</tr>
<tr>
<td>Laparotomy group</td>
<td>14</td>
<td>11</td>
<td>8</td>
<td>29.5±13.6</td>
<td>29</td>
</tr>
</tbody>
</table>

Table 4. Comparison of postoperative data in two groups of patients

<table>
<thead>
<tr>
<th>Groups</th>
<th>Nausea (Example)</th>
<th>Vomit (Example)</th>
<th>Pain scores (VAS scores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laparoscopic group</td>
<td>5</td>
<td>4</td>
<td>1.05±0.46</td>
</tr>
<tr>
<td>Laparotomy group</td>
<td>13</td>
<td>10</td>
<td>3.17±1.54</td>
</tr>
</tbody>
</table>

Results of immunohistochemistry

CD34, CD117, Des and SMA were all negative, while S100 was positive. Among the 30 cases in laparoscopic group, 27 cases were benign schwannoma, 3 cases had local malignant tendency. All the Laparoscopic patients were followed up with an average follow-up time of 31.8±15.7 months.

Follow-up

Patients regularly re-examined during the follow-up period. Except for 1 patient died of myocardial infarction 1 year later, the rest patients in laparoscopic group all survived during the follow-up period with no tumor recurrence or distant metastasis. From Table 3, we can see, compared with the Laparotomy Group, there was no statistical difference (P > 0.05). From the comparison of the postoperative data of two groups (Table 4), we can seen, compared with laparotomy group, patients in laparoscopic group showed an obvious less incidence of postoperative nausea, vomiting and pain, which was statistically different (P < 0.05).

Immunohistochemical results

The immunohistochemical results of gastric schwannoma are shown in Table 5. We can see, all the tumors widely expressed CD56 and S-100. There were 45 tumor specimens locally expressed Ki - 67. Vimentin were expressed in all tumor tissues. A few cells from 12.7% of the cases expressed CD34. All 63 cases of tumor tissues did not express α-SMA, c-Kit or HMB-45, as shown in Figure 1 and Table 5.

Comparison of the average survival time between patients with benign and malignant Gastric schwannoma

Median disease-free survival time of patients with benign gastric schwannoma was (132 +
4.2) months, compared with the (58 + 3.7) months of malignant patients. Benign group had significantly longer disease-free survival time than malignant group, and the difference was statistically significant (P < 0.05), as shown in Figure 2.

Discussion

The main symptom of patients with Gastric schwannoma is upper gastrointestinal ulcer without other specific clinical manifestations, parts of patients can be touched of ovoid solid mass, which could be detected early if it is in the special position that causes obstruction. Gastric schwannoma can usually result in stimulation-induced mechanical injury on gastric mucosa, or oppression-caused local blood circulation disorder on gastric mucosa, or other complications like bleeding, perforation and infection etc. by stimulating vagus nerve to promote gastric acid secretion that destroy mucosal barrier. Most of the patients enrolled in this study were hospitalized with atypical symptoms, and the gastric submucosal lesions were found in the routine gastroscopy examination. There were 2 cases found with ulcer on tumor surface mucous and excluded gastric cancer by endoscopic biopsy. Studies have shown that female patients with gastric schwannoma are more than male patients [4]. In this study, 42 cases of female patients and 21 cases of male patients were selected. Most of the gastric schwannoma were benign, with very few cases

Figure 1. Staining result for 1 case of malignant gastric schwannoma A: HE staining, ×200; B: Immunohistochemical staining of S - 100, ×200; C: Immunohistochemical staining of CD56, ×200; D: Immunohistochemical staining of Vimentin, ×200.
of malignant; studies have reported the canceration rate of gastric schwannoma was 6% ~ 7% [5]. Gastric schwannoma occurred in the gastric body for the most and posterior gastric wall for the least. In this study, gastric schwannoma occurred mainly in anterior gastric wall and gastric body, and 11.1% of the gastric schwannoma resected by laparoscopic operation were malignant.

Preoperative diagnosis of gastric schwannoma rely on radiographic examination [6], the tumor usually is a limited and homogeneous mass with clear boundary in B-scan ultrasonography; a solid mass that causes stomach filling defect or gastric intraluminal projecting in barium radiography; and a hemisphere shaped uplift with local mucosa damage and mucosal venous dilation in gastroscopy. However, these imaging technologies and endoscopy can only locate, but not determine the nature of the tumor. The diagnosis of gastric schwannoma should depend on immunohistochemical examination. In this study, 63 patients were diagnosed by endoscopy examination and biopsy before surgery, but it was difficult to clarify the nature, only 7 case was diagnosed as schwannoma, 28 cases were misdiagnosed as gastric leiomyoma, and other 28 cases were misdiagnosis for gastrointestinal stromal tumors. The diagnosis was confirmed by pathological examination after operation, and the results of immunohistochemistry suggested that all tumor tissues expressed S-100, CD56 and vimentin, but not expressed α-SMA, c-kit and HMB-45. In addition, the survival time of patients with benign gastric schwannoma is longer than the patients with malignant gastric schwannoma.

The main treatment for gastric schwannoma is surgery. With the rapid development of laparoscopic surgery in recent years, its application in the treatment of gastrointestinal tumor has become increasingly common. There are clinical studies reported [7, 8], laparoscopic resection of gastricstromal tumors had benefits of better efficincy, good postoperative recovery and fewer complications. At present, laparotomy is mostly adopted while laparoscopic surgery is less used in the treatment of gastric

<table>
<thead>
<tr>
<th>Antibody</th>
<th>The number of cases</th>
<th>The number of positive cases</th>
<th>The proportion of the number of cases of positive tumor cells</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;20%</td>
</tr>
<tr>
<td>S-100</td>
<td>63</td>
<td>63</td>
<td>3</td>
</tr>
<tr>
<td>HMB-45</td>
<td>63</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CD56</td>
<td>63</td>
<td>63</td>
<td>3</td>
</tr>
<tr>
<td>CD34</td>
<td>63</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>α-SMA</td>
<td>63</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>c-Kit</td>
<td>63</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ki-67</td>
<td>63</td>
<td>45</td>
<td>11</td>
</tr>
<tr>
<td>Vimentin</td>
<td>63</td>
<td>63</td>
<td>14</td>
</tr>
</tbody>
</table>

Figure 2. Comparison of cumulative survival time between patients with benign and malignant gastric schwannoma.
Laparoscopic operation, gastric schwannoma

In recent years, there are more and more reports on the laparoscopic surgery applied in the treatment for schwannoma on different parts, such as retroperitoneal [9, 10], adrenal gland [11, 12] and colon [13] and they all achieved satisfactory results. A clinical paired study from abroad showed that [14, 15], compared to open surgery, hemorrhage volume and postoperative hospital stay after laparoscopic surgery were significantly reduced, suggesting that laparoscopic surgery for schwannoma has obvious advantages with smaller surgical trauma and faster postoperative recovery. Domestic pathology report showed patients recovered smoothly without obvious complications after laparoscopic resection of huge submucosal schwannoma, which had hemorrhage on the upper segment of gastric body and posterior gastric wall, suggesting that laparoscopic surgery is safe and feasible in treating submucosal schwannoma that close to gastric cardia [16-18]. The results of this study showed that compared with open surgery, laparoscopic surgery has certain advantages, and it can significantly reduce the operation time, length of hospital stay and gastrointestinal exhaust time.

The reports on laparoscopic resection of schwannoma are rare, and most of them are case reports. Watanabe et al [19] reported one case of malignant schwannoma which located in the greater curvature of the gastric body with the size of 4.8 cm × 4.2 cm; laparoscopic partial gastrectomy was performed; patients didn’t have any postoperative complications and was discharged on the 8th day after surgery, postoperative follow-up showed no local recurrence or distant metastasis. Yoon et al [20] reported one case of tumor (diameter was about 2 cm) beneath antral mucosa resected by laparoscopic surgery, which was confirmed of schwannoma by postoperative pathological examination. In this study, the 30 cases of gastric schwannoma with the maximum diameter of about 4 cm, were confirmed by all resected by laparoscopic surgery was successfully. Surgery went smoothly, with no conversion to open surgery; and the patients recovered quickly without complications. Patients were closely followed up; there was 1 patient in laparoscopic group died of myocardial infarction 1 year after the surgery without local recurrence or distant metastasis. The result of this study shows, compared with open surgery, laparoscopic surgery for gastric schwannoma is safe, feasible and effective. Laparoscopic surgery can significantly reduce operation time, postoperative bleeding volume and length of hospital stay, and also reduce the incidence of postoperative complications such as gastric damage, abdominal infection, disruption and infection of wound; in addition, laparoscopic surgery also has advantages in patient’s long-term effects such as tumor recurrence and distant metastasis, nausea, vomiting, and pain. The results of this study provided an experimental basis and foundation for the application of laparoscopic surgery in clinical treatment of gastric schwannoma.

Thus, laparoscopic surgery for gastric schwannoma is safe and feasible that can be promoted in clinical application. Due to the small number of malignant cases, and small diameters of tumor the accumulation of more cases is expected for further study.

**Declaration of conflict of interest**

None.

**Address correspondence to:** Yunlei Wang, Department of General Surgery, The Affiliated Beijing Chaoyang Hospital, Capital Medical University, Beijing 100043, China. E-mail: wylbj12345@163.com

**References**


