Original Article

Hand-assisted laparoscopic versus open radical resection of gastric remnant cancer: a clinical comparison

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Abstract: Objective: To compare the perioperative clinical data between hand-assisted laparoscopic and open radical resection of gastric remnant cancer, and analyze the feasibility and advantages of hand-assisted laparoscopic resection of gastric remnant cancer. Methods: The clinical data of 18 patients with gastric remnant cancer who underwent hand-assisted laparoscopic (n=9) or open surgery (n=9) were retrospectively analyzed to compare the perioperative outcomes and recovery between December 2007 and October 2014. Results: All 18 patients underwent surgery without post-operative complications. In the hand-assisted laparoscopy group, none required conversion to open surgery, and no intraoperative auxiliary injury occurred. The incision length was (8.78±0.62) cm in the hand-assisted laparoscopy group, and (14.06±0.81) cm in the open surgery group (t=15.565, P=0.000). The duration of the operation averaged (221.11±19.48) min in the hand-assisted laparoscopy group, and (212.89±14.30) min in the open surgery group (t=-1.021, P=0.323). The intraoperative blood loss was (105.56±35.04) ml in the hand-assisted laparoscopy group, and (147.78±41.92) ml in the open surgery group (t=2.319, P=0.034). The number of lymph nodes scavenged was (16.22±2.99) and 16.67±3.28 in the hand-assisted laparoscopy group and in the open surgery group, respectively (t=-.300, P=0.768). The postoperative time to passage of gas by anus was (16.22±2.99) hr in the hand-assisted laparoscopy group, and (16.67±3.28) hr in the hand-assisted laparoscopy group and in the open surgery group, respectively (t=0.300, P=0.768). The postoperative time to passage of gas by anus was (68.67±10.00) hr in the hand-assisted laparoscopy group, and (79.78±9.16) hr in the open surgery group (t=2.458, P=0.026). Mild postoperative hemorrhage occurred at the anastomotic site in one patient in each surgery group. These complications resolved after treatment. And no serious perioperative complications, such as anastomotic site fistula, massive hemorrhage in the peritoneal cavity or digestive tract or death occurred in either group. Conclusions: Hand-assisted laparoscopic radical resection of gastric remnant cancer is feasible, is of comparable efficacy to open surgery, and offers several advantages including small incisions, mild intraoperative hemorrhage, rapid postoperative recovery, and few postoperative complications.

Keywords: Hand-assisted laparoscopic, open surgery, radical resection, gastric remnant cancer

Introduction

Aided by the development of laparoscopic instruments and techniques, laparoscopy assisted radical resection of gastric remnant cancer has recently become feasible [1, 2], and the clinical efficacy of this modality has been shown to be satisfactory. Nevertheless, this modality has some disadvantages, such as challenging procedures and high rates of conversion to open surgery [3]. In order to improve the minimally invasive treatment of gastric remnant cancer, we have performed hand-assisted laparoscopic radical resection of gastric remnant cancer since December 2007, and the clinical efficacy of this method is ideal.

Data and methods

Inclusion criteria

The inclusion criteria include: (1) Intraoperative TNM staging of gastric remnant cancer: T2-4N0-3M0; stage II-III. (2) Surgical procedure for gastric remnant cancer: simple radical resection of gastric stump+D2 lymph node scavenging, with-out resection of the spleen, left hepatic lobe, transverse colon or other organs, and with
Hand-assisted laparoscopic resection

Figure 1. Positioning hand-assisted device with a blue butterfly base, observational and manipulative trocars.

Roux-en-Y anastomosis of the esophagus and jejunum.

Clinical data

The hand-assisted laparoscopy group was comprised of 9 patients (7 males, 2 females), with an average age of 73.67 (68-80) years. The interval between the diagnosis of gastric remnant cancer and subtotal gastrectomy ranged between 19 and 41 years (mean=28.89 years). Four patients were diagnosed as stage II, and five as stage III. The tumors were localized to the anastomotic site of the gastric stump (N=6), the cardiac orifice (N=2), and the gastric fundus (N=1). The primary disease was benign in 5 patients, and gastric remnant cancer developed some time after radical resection of gastric cancer in 4 patients. Four cases presented with underlying diseases (including 1 case of hypertension, 1 case of coronary heart disease, and 2 cases of type II diabetes).

The open surgery group was comprised of 9 patients (6 males, 3 females) with an average of 73.11 (67-79) years. The interval between the diagnosis of gastric remnant cancer and subtotal gastrectomy ranged between 20 and 42 years (mean=29.89 years). Five patients were diagnosed with stage II disease, and 4 stage III disease. The tumors were located in the anastomotic site of gastric stump (N=6), the cardiac orifice (N=1), and the body of gastric stump (N=2). The primary disease was benign in 6 patients, and gastric remnant cancer occurred following radical resection of gastric cancer in 3 patients. Three cases presented with underlying diseases (including 1 case of hypertension, and 1 case of type II diabetes, 1 case of chronic bronchitis). The underlying diseases in patients of both groups were treated and well-controlled prior to surgery and had met the requirement for surgery.

Statistical analysis indicated no significant differences in the clinical data between the two groups (P>0.05). All patients attended this study voluntarily with informed consents. The study was approved by the Institutional Review Board of the People’s Liberation Army General Hospital of Chengdu Command.

Preoperative clinical data

All 18 recruited patients scheduled for surgery underwent preoperative examinations including routine blood tests, tests for liver and kidney function, electrolytes, blood coagulation, blood gas analysis, inspection, Chest CT, abdominal computed tomography (CT), cardiac color ultrasound, lung function and electrocardiogram examination revealed no obvious anomalies. The results showed no contraindications and indicated that all patients could safely undergo hand-assisted laparoscopic treatment and laparotomy. The two groups of patients were comparable since the preoperative clinical data was not statistically different (P>0.05), preoperative routine exams revealed no surgical contraindications in these patients, and all patients were expected to tolerate the laparoscopic procedure well.

Diagnosis

The major symptoms of these patients included vague pain and discomfort in the upper abdomen, water rash, belching, decreased appetite and melena. Physical examination revealed no obvious abdominal abnormalities. All patients
Hand-assisted laparoscopic resection was established with CO\(_2\), and the intraabdominal pressure was set at 12-14 mmHg. (4) Positioning manipulative trocar: A manipulative trocar was placed at 3 cm left of the umbilicus. (5) The remaining procedure steps were carried out as described previously [4].

The open radical resection of gastric remnant cancer was performed as described previously [5].

Perioperative complications

Mild postoperative hemorrhage occurred at the anastomotic site in one patient of the hand-assisted laparoscopy group and one patient of the open surgery group. Fat liquefaction of the incision occurred in one patient of the open surgery group. These complications resolved after treatment and no serious perioperative complications, such as anastomotic site fistula, massive hemorrhage in the peritoneal cavity or digestive tract or death occurred in either group.

Follow-up and treatment effect evaluation

The patients’ postoperative quality of life: Postoperative follow-up occurred 1, 3 and 6 months. At which time patients were asked to complete a follow-up questionnaires using the Chew-wun Wu [6] special symptom scale. The scale is comprised of 14 items of Chew-wun Wu’s special symptoms. Where each item is worth 0, 1, or 2 points, based on increasing severity of symptoms. Higher scores means reflect better the quality of life for patients.

The survival condition of the patients in postoperative one year: All 18 patients were followed for a minimum of 12 months or until death. In each surgical group, one death occurred during the study period. One case of hepatic metastasis and one case of transverse mesocolon micrometastasis occurred in the hand-assisted laparoscopic treatment group. While there were one case of hepatic metastasis and one case of thoracic vertebra metastasis in the laparotomy group.

Figure 2. Dissecting adhesions between the gastric stump and pancreas using fingers and an ultrasound knife.
Hand-assisted laparoscopic resection

Statistical analysis

All statistical analyses were performed using SPSS version 16.0 software (IBM Corporation, Somers, NY, USA). We report the categorical variables as absolute value and percentage value, continuous variables as average ± standard deviation. Comparison between the averages of continuous variables was assessed by a Student t test for unpaired data. Comparison between the frequencies of the categorical variables was assessed by Fisher exact test. Repeated ANOVA followed by Scheffe’s comparison was used to compare the Quality of Life between the two groups. Differences with P value of 0.05 or less were considered to be statistically significant.

Results

As shown in Table 1, short incision lengths, reduced intraoperative blood loss, and faster postoperative intestinal functional recovery were observed in the hand-assisted laparoscopy group compared to the open surgery group (P<0.05 for all parameters). However, the duration of surgery and number of lymph nodes scavenged were not significantly different between the two groups (P>0.05).

No conversion to open surgery or intraoperative auxiliary injury occurred in the hand-assisted laparoscopy group. Mild postoperative mild hemorrhage at the anastomotic site occurred in each patient in the hand-assisted laparoscopy group and the open surgery group. Fat liquefaction occurred in the incision in one patient in the open surgery group. All of these complications were resolved after treatment.

As shown in Table 2, the quality of life of patients at postoperative month 1, 3 and 6 was not significantly different between the two groups (P>0.05).

As shown in Table 3, postoperative recurrence and cancer metastasis within 1 year were also not significantly different between the two groups (P>0.05).

Discussion

The clinical definition of gastric remnant cancer remains controversial. Yu et al [7] defined gastric remnant cancer as gastric stump cancer that occurs within the 5 years following subtotal gastrectomy for benign gastric and/or duodenal diseases. In contrast, Tanigawa et al [8] defined gastric remnant cancer as gastric stump cancer that occurs over 10 years after subtotal gastrectomy for primary gastric and/or duodenal diseases, regardless of the nature of the primary disease. According to Mezhir et al [9], the incidence of gastric remnant cancer is 2.4%. According to Chen et al [10], the incidence of gastric remnant cancer in China is 2.0%-3.0%, and the pathogenesis of gastric remnant cancer was thought to be associated with bile regurgitation [11].

Table 1. Perioperative clinical data of the hand-assisted laparoscopy group and the open surgery group

<table>
<thead>
<tr>
<th></th>
<th>Length of incision (cm)</th>
<th>Operative duration (min)</th>
<th>Intraoperative blood loss (ml)</th>
<th>Lymph nodes scavenged (n)</th>
<th>Postoperative time to passage of gas by anus (h)</th>
<th>Postoperative complications (case)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand-assisted laparoscopy (n=9)</td>
<td>8.78±0.62</td>
<td>221.11±19.48</td>
<td>105.56±35.04</td>
<td>16.22±2.99</td>
<td>68.67±10.00</td>
<td>1</td>
</tr>
<tr>
<td>Open surgery (n=9)</td>
<td>14.06±0.81</td>
<td>212.89±14.30</td>
<td>147.78±41.92</td>
<td>16.67±3.28</td>
<td>79.78±9.16</td>
<td>2</td>
</tr>
<tr>
<td>P value</td>
<td>0</td>
<td>0.323</td>
<td>0.034</td>
<td>0.768</td>
<td>0.026</td>
<td>—</td>
</tr>
</tbody>
</table>

Table 2. To compare the Quality of Life between the hand-assisted laparoscopy group and the open surgery group

<table>
<thead>
<tr>
<th></th>
<th>Preoperative point</th>
<th>Postoperation 1 mon point</th>
<th>Postoperation 3 mon point</th>
<th>Postoperation 6 mon point</th>
</tr>
</thead>
<tbody>
<tr>
<td>The hand-assisted laparoscopy group n=9</td>
<td>21.00±2.74</td>
<td>22.33±2.24</td>
<td>23.89±1.17</td>
<td>23.89±1.62*</td>
</tr>
<tr>
<td>the open surgery group n=9</td>
<td>20.44±3.05</td>
<td>20.78±1.48</td>
<td>23.44±1.81</td>
<td>123.78±3.86*</td>
</tr>
<tr>
<td>Total n=18</td>
<td>20.72±2.82</td>
<td>21.56±2.01</td>
<td>23.67±1.50</td>
<td>23.83±1.69</td>
</tr>
</tbody>
</table>

Note: *Compared with the preoperative time of the same group P<0.05; The Quality of Life were not significantly different between the hand-assisted laparoscopy group and the open surgery group by Repeated ANOVA (F=1.442, P=0.247).
Hand-assisted laparoscopic resection

Table 3. To compare the survival condition of the patients in postoperative 1 year between the hand-assisted laparoscopy group and the open surgery group

<table>
<thead>
<tr>
<th></th>
<th>Survival patients cases</th>
<th>Death of the patient case</th>
<th>The patients with tumor recurrence and metastasis cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>The hand-assisted laparoscopy group n=9</td>
<td>8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>The open surgery group n=9</td>
<td>8</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>$P$ value</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>

The principles used in treating gastric remnant cancer are essentially the same as those for treating primary gastric cancer. Gastric remnant cancer is primarily treated by surgical resection, and its adjuvant treatments include chemotherapy- and radio-therapy [12-14]. As with primary gastric cancer, gastric remnant cancer metastasizes to lymph nodes surrounding the stomach in most patients [15-17]. Nevertheless, since the primary surgery changes lymphatic drainage and anatomy of the gastric stump, new routes of lymph node metastasis develop in gastric remnant cancer [18, 19], e.g., metastasis to the mesojejunum. Based on these findings, some authors recommended that [20, 21] during gastric remnant cancer surgery, in addition to radical gastrectomy and scavenging lymph nodes that surround the gastric stump, the jejunum and mesojejunum adjacent to the anastomotic site should be resected, and that the lymph nodes should be scavenged. It was also reported that following the primary surgery, adhesions may form between the gastric stump and surrounding organs, including the left lobe of liver, spleen, and transverse colon, giving rise to new lymphatic vessel networks [22]. Therefore, gastric remnant cancer cells are likely to metastasize to these organs via these networks [23]. Hence, the surgical procedure for gastric remnant cancer differs from that for primary gastric cancer. Based on the intraoperative findings on cancer metastasis, the left hepatic lobe, spleen, and transverse colon may require resection. Therefore, the surgical procedure should be individualized.

In gastric remnant cancer, abdominal organ adhesions develop at various anatomical locations and levels. Adhesions have been found between the abdominal wall and organs, particularly between the abdominal wall at the incision, greater omentum, and transverse colon. Adhesions may also develop between the transverse colon, the afferent and/or efferent loop of jejunum and the anastomotic site. Lastly, adhesions may form between the gastric stump and surrounding tissues and organs, such as the left liver and spleen. For most surgeons, a secondary surgery in the presence of abdominal adhesions is challenging. The history of abdominal surgery was one of the contraindications of laparoscopic procedure.

With the development of endoscopic instruments and techniques, Nagai, et al [24] succeeded in performing laparoscopy-assisted surgery for gastric remnant cancer, which supported the technical feasibility of laparoscopy-assisted radical resection of gastric remnant cancer. Laparoscopy-assisted surgery was superior to open surgery with respect to the overall efficacy and postoperative recovery, and the two modalities were comparable in terms of postoperative survival. Laparoscopy-assisted surgery of gastric remnant cancer does have important drawbacks, such as increased incidence of intraoperative auxiliary injury, difficulty in controlling massive intraoperative hemorrhage, and high rates of conversion to open surgery, all of which are major safety concerns.

Since December 2007, we have performed hand-assisted laparoscopic radical resection of gastric remnant cancer, and thus far the results have been satisfactory. In the hand-assisted laparoscopic procedure, the surgeon inserts one of his/her hands through a special hand-assisted device into the patient’s abdominal cavity and then uses his/her hand to perform operation. The assisting hand may receive tactile feedback and counteract traction, thus facilitating the operative manipulations [25]. The abdominal cavity can be observed and accessed safely through the hand-assisted device and trocar placement and liberation of dense adhesions can be performed under direct visualization, thus helping avoid auxiliary
injury and improve safety of the surgical procedure.

In our experience, gastric remnant cancer typically develops a long time after the initial gastrectomy. As a result, abdominal adhesions differ from inflammatory adhesions that develop soon after surgery, especially those adhesions between the omentum or intestine and abdominal wall. In the presence of artificial pneumoperitoneum, the locations of adhesions are taut, and the spaces are obvious, allowing adhesion liberation with an ultrasound knife. We performed hand-assisted laparoscopic radical resection of gastric remnant cancer by first making a longitudinal 7 cm-long incision along the midline of upper abdomen into the peritoneal cavity. A hand-assisted device was placed through the incision, and adhesions adjacent to the peritoneum beneath the incision could be liberated under direct visualization. Moreover, with the use of hand-assisted device, we could explore the surgical field under direct visualization, and position the manipulative and laparoscopic trocars properly, without damaging the tissues and organs or causing auxiliary injury.

During hand-assisted laparoscopic radical resection of gastric remnant cancer, the cardiac orifice, fundus of the stomach, and hilum of the spleen can be exposed satisfactorily, widening the operating space. Moreover, the magnifying feature of laparoscopy improves visualization with the visual field. Hence, hand-assisted laparoscopy achieves superior exposure of the operating field than in open surgery [26-28]. In addition, most patients with gastric remnant cancer develop adhesions between the left hepatic lobe and anterior abdominal wall. Hence, a good exposure of the operating field can be achieved without needing to lift the liver, which facilitates liberation of the lesser curvature of gastric stump and scavenging lymph nodes.

All 9 cases in which we carried out hand-assisted laparoscopic surgery were successful, without intraoperative auxiliary injury or requiring conversion to open surgery. Our experience supports the feasibility and safety of hand-assisted laparoscopic treatment of gastric remnant cancer. Comparison of the numbers of lymph nodes scavenged in hand-assisted laparoscopic and open surgery suggests the rationality of hand-assisted laparoscopic surgery. Moreover, hand-assisted laparoscopic surgery exhibits additional advantages such as limited trauma and rapid postoperative recovery.

Disclosure of conflict of interest

None.

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Hand-assisted laparoscopic resection


