Effect of the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma on pulmonary function

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ABSTRACT

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Objective: To explore the effect of the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma on pulmonary function and its clinical efficacy. Methods: A total of 200 esophageal carcinoma patients with complete medical materials, admitted in our hospital from January, 2011 to December, 2014 were included in the study and divided into the observation group and the control group with 100 cases in each group. The patients in the observation group were undergoing the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma, while the patients in the control group were undergoing open esophagectomy for the treatment of esophageal carcinoma. The operation indicators, postoperative complications, short-term efficacy, and the effect of operation on pulmonary function in the two groups were compared. Results: The comparison of operation time, lymph node dissection number, and the occurrence rate of postoperative complications between the two groups was not statistically significant. The intraoperative amount of bleeding, thoracic duct indwelling time, and hospitalization time in the observation group were significantly lower than those in the control group. FEV1 the 5th day after operation in the observation group was not statistically different from that before operation, while in the control group it was statistically different from that before operation. FEV1/FVC after treatment in the observation group was significantly higher than that in the control group. PaO2 and SaO2 after operation in the observation group were not statistically different from those before operation, while PaO2 and SaO2 after operation in the control group were significantly lower than those before operation. Conclusions: The combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma has an accurate efficacy with no obvious effect on respiratory function, so that it is superior to the traditionally open operations.

1. Introduction

Esophageal carcinoma is one of the malignant tumors with a high morbidity in the clinic, and surgical operation is the first therapy, while the radical resection of esophageal carcinoma is the first choice of surgical treatment[1]. The traditionally open radical resection of esophageal carcinoma has disadvantages of large trauma, slow and poor postoperative recovery[2]. With a continuous maturity of minimally invasive technology, the indications of the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma are constantly expanding, so that the radical resection of esophageal carcinoma can be getting minimally invasive[3,4]. The study is aimed to observe the feasibility of the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma and its effect on pulmonary function.
2. Subjects and methods

2.1. Subjects

A total of 200 esophageal carcinoma patients with complete medical materials, admitted in our hospital from January, 2011 to December, 2014 were included in the study and were confirmed by the pathological tissue biopsy through a gastroscopy. The patients in the observation group were undergoing the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma, among which 74 cases were male, 26 cases were female, aged from 47 to 75 years old, with an average age of (57.5±9.6) years old, 87 cases had squamous carcinoma, 13 cases had adenocarcinoma, 71 cases had lesions in the middle esophagus, 29 cases had lesions in the lower segment, 72 cases were at stage II, and 28 cases were at stage I. The patients in the control group were undergoing open esophagectomy for the treatment of esophageal carcinoma, among which 70 cases were male, 30 cases were female, aged from 46 to 73 years old, with an average age of (59.0±10.8) years old, 91 cases had squamous carcinoma, 9 cases had adenocarcinoma, 65 cases had lesions in the middle esophagus, 35 cases had lesions in the lower segment, 73 cases were at stage II, and 27 cases were at stage I.

2.2. Methods

The operation was completed under a total intravenous anesthesia with tracheal intubation. One-lung ventilation and artificial pneumothorax were performed at the time of thoracoscopic operating. Two-lung ventilation was performed at the time of laparoscopic pneumoperitoneum and cervical operating.

2.2.1. Thoracoscopic surgery

A left prone position was taken. The upper limb on the affected side was fastened to the hand bracket. The Trocar hole location was decided according to the tumor site and thoracic anatomical characteristics. A hole with a length of 10 mm was punctured in the fifth intercostal space between the inferior angle of scapular and the posterior axillary line, and a lens was placed to explore whether there was an adhesion and tumor invasion in the thoracic cavity or not, and then a niple was inserted. The thoracoscopic hole with a length of 10 mm was chosen in the seventh and eighth intercostal space after the midaxillary line. A hole with a length of 5 mm was punctured in the fourth intercostal space of the midaxillary line, and then an ultrasound knife was placed. A hole with a length of 10 mm was punctured in the eighth and ninth intercostal space before the posterior axillary line. A five-leaf drag hook was used to pull the pulmonary lobes open to fully expose the esophagus in order to explore whether there was an implantation metastasis or not. An ultrasound knife was used to split the mediastinal pleura along with the longitudinal esophagus to dissociate the azygos vein. The esophagus was dissociated from the above and below tumors. The lymph nodes located in the subcarina, inferior pulmonary vein, superior mediastinum, esophagus, left and right recurrent laryngeal nerves were dissected. After a thorough hemostasis, the thoracic cavity was washed, the bronchial membrane was examined, a drainage tube was placed, and the incision was closed.

2.2.2. Laparoscopic surgery

A horizontal position with head high and feet low was taken. An incision with a length of 1 cm was incised along the umbilical inferior margin. The artificial pneumoperitoneum was established. Trocar with a size of 10 mm was placed and a lens was inserted. There were 2 main operation holes. One was located between 3 cm above the umbilicus and the left mid-clavicular line. The other was located between 5 cm above the umbilicus and the left anterior axillary line. Trocar with a size of 5 mm was placed and a niple was inserted. There were 2 assistant operation holes. One was located between 3 cm above the umbilicus and the right mid-clavicular line. The other was located between 5 cm above the umbilicus and the right anterior axillary line. Trocar with a size of 5 mm was placed and a gastrointestinal pincer was inserted to explore whether there was an adhesion or an implantation metastasis existed in the visceral organs, pelvic cavity, and greater omentum. A bottom-up dissociation of greater curvature was done with an ultrasound knife. Short gastric arteries and left gastroepiploic artery were severed. The intestinal clamp was used to uplift the left liver lobe. The peritoneum and hepatogastric ligament near the esophagus in the abdominal segment were dissociated. Lymph nodes near the common hepatic artery, left gastric artery, and lesser curvature were eliminated. The esophagus in the abdominal segment was pulled to the abdominal cavity. The pneumoperitoneum was cancelled. The incision below the xiphoïd was expanded to a length of 5 cm. The stomach was pulled to the outside. A stapler was used to cut off the lesser curvature of stomachus cardiacus to make it being partial tubular stomach. An absorbable thread was used for a continuous suture of the seromuscular layer so as to close the incisal margin. Three stitches with No. 4 suture line in the peak of stomach fundus were regarded as a mark and were connected with a binding wire at the broken end of esophagus. The stomach was returned to the abdominal cavity after making sure that there was no twisting.

2.2.3. Cervical esophagogastrostomy

An incision with a length of 4 cm was made along the left sternocleidomastoid front margin. The esophagus was dissociated along the inner side of jugular vessel sheath. The stomach was pulled to the neck through the mediastinal esophagus bed. The stapler was used for gastro-esophageal anastomosis. A silk thread was used for fixation. After a thorough hemostasis, a film drainage tube was retained and the incision was stitched.
2.2.4. Laparotomy
The operation procedures were strictly in accordance with the operation steps of traditionally open operations.

2.3. Observation indicators
The operation time, intraoperative amount of bleeding, lymph node dissection number, hospitalization time, thoracic tube indwelling time, and the occurrence rate of postoperative complications in the two groups were recorded. The pulmonary function before operation and the fifth day after operation between the two groups was compared.

2.4. Statistical analysis
SPSS 12.0 software was used for statistical analysis. Chi-square test was used for enumeration data. The measurement data were expressed as mean±SD, and t test was used. \( P<0.05 \) was regarded as statistically significant.

3. Results

3.1. Comparison of the operation indicators between the two groups
The operation time, intraoperative amount of bleeding, lymph node dissection number, hospitalization time, thoracic tube indwelling time, and the occurrence rate of postoperative complications in the two groups were recorded. The pulmonary function before operation and the fifth day after operation between the two groups was compared.

3.2. Comparison of postoperative pulmonary function between the two groups
The comparison of \( \text{FEV}_1 \) in the study group between the fifth day after operation and before operation was not statistically different \( (P>0.05) \), while it was significantly lower than that before operation in the control group \( (P<0.05) \). \( \text{FEV}_1/\text{FVC} \) after operation in the study group was significantly higher than that in the control group \( (P<0.05) \). There was not a statistical difference of \( \text{PaO}_2 \) and \( \text{SaO}_2 \) in the study group before and after operation \( (P>0.05) \). The \( \text{PaO}_2 \) and \( \text{SaO}_2 \) in the control group after operation were significantly lower than that before operation \( (P<0.05) \). The \( \text{PaO}_2 \) and \( \text{SaO}_2 \) after operation in the study group were significantly higher than those in the control group \( (P<0.05) \) (Table 1).

3.3. Postoperative adverse reactions
The occurrence rate of adverse reactions in the observation group and in the control group were 28.0% and 29.0%, respectively, but the comparison was not statistically significant \( (P>0.05) \) (Table 2).

4. Discussion
The esophageal carcinoma surgery is one of the most complicated operations in the thoracic surgery, and the surgical method is mainly by adopting the open operation. The traditionally open radical resection of esophageal carcinoma has a certain therapeutic effect, but it has many disadvantages, such as a complicated surgical

<table>
<thead>
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<th>Groups</th>
<th>( n )</th>
<th>Before operation</th>
<th>After operation</th>
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<th>After operation</th>
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<th>After operation</th>
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<tr>
<th>Groups</th>
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<th>Pulmonary atelectasis</th>
<th>Chylothorax</th>
<th>Pneumothorax</th>
<th>Respiratory failure</th>
<th>Second operation</th>
<th>Anastomotic fistula</th>
<th>Delayed gastric emptying</th>
<th>Arrhythmia</th>
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<td>7(7.0)</td>
<td>4(4.0)</td>
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<tr>
<td>Control group</td>
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<td>4(4.0)</td>
<td>1(1.0)</td>
<td>1(1.0)</td>
<td>2(2.0)</td>
<td>7(7.0)</td>
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method, large trauma, high risk, many postoperative complications, and a slow postoperative recovery[6]. With the development of minimally invasive technology of thoracic surgery, the minimally invasive surgery of radical resection of esophageal carcinoma is developed into the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma from the thoracoscope-assisted radical resection of esophageal carcinom[7]. The minimally invasive thoracic surgery has advantages of little trauma, rapid postoperative recovery, and low occurrence rate of complications[8,9]. Currently, the popularization rate of the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma in China was relatively low due to surgical difficulty and less indications[10]. The combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma, as a beneficial supplement and developmental direction of open operations, is of great research significance.

The results in the study showed that the comparison of operation time between the two groups was not statistically significant ($P>0.05$) in that the combined thoracoscopic and laparoscopic operation is more complicated, but there is a little hemorrhage time consumption, moreover, along with the proficiency and updating of surgical instruments, the operation difficulty is reduced and the operation process is accelerated. The intraoperative amount of bleeding in the observation group was significantly lower than that in the control group because the minimally invasive surgery has a little trauma and the unit interval amount of bleeding is low, while the comparison of operation time between the two groups was not statistically significant. The comparison of lymph node dissection number between the two groups was not statistically significant, which is different from the reported results[11]. The reason for that is that with the maturity of surgical method, its indications are gradually extended, and the lymph node dissection range and thoroughness in an endoscope surgery are superior to those in an open operation. The thoracic tube indwelling time in the observation group was significantly shorter than that in the control group in that the minimally invasive surgery has a little trauma and a rapid postoperative recovery, which is identical to some reported results. It’s worth noting that the comparison of the occurrence rate of postoperative adverse reactions between the two groups was not statistically significant ($P>0.05$), probably due to an insufficient mastering of minimally invasive operation, resulting in a relatively high rate of postoperative infection and anastomotic fistula[12]. Pulmonary complication is one of the most common complications after radical resection of esophageal carcinoma, and will endanger the patients’ life under a severe condition[8]. The results in the study showed that FEV$_1$, FEV$_1$/FVC, PaO$_2$, and SaO$_2$ the fifth day after operation in the observation group were significantly higher than those in the control group ($P<0.05$), indicating that the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma has a little effect on pulmonary function and is conducive to avoid the occurrence of postoperative pulmonary complications.

In conclusion, the combined thoracoscopic and laparoscopic minimally invasive esophagectomy for the treatment of esophageal carcinoma has advantages of little trauma, rapid postoperative recovery, and little effect on pulmonary function, and is superior to the traditionally open operation.

References


