

ORIGINAL ARTICLE

Comparison of postoperative complications between different operation methods for esophageal cancer

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Abstract

Background: We explored the selection of surgical method and differences in postoperative complications in patients with esophageal cancer (EC).

Methods: The data of 434 patients with EC who underwent thoracic surgery at the Jiangsu Provincial People's Hospital between January 2011 and December 2016 were collected. Patients were divided into three groups: Sweet surgery (143 cases), Ivor–Lewis surgery (232 cases), and minimally invasive esophagectomy (MIE, 59 cases). The number of postoperative days, number of lymph nodes dissected, and incidence of pulmonary infection, serous membrane fluid, arrhythmia, chylous fistula, gastric emptying dysfunction, and anastomotic leakage were recorded.

Results: A statistically significant number of female stage I patients with upper EC underwent MIE ($P < 0.05$). Postoperative complications were observed in all three groups but were not statistically significant ($P > 0.05$). A greater number of lymph nodes were dissected in the Ivor–Lewis group compared to the other groups ($P < 0.05$).

Conclusion: Clinically, MIE is often selectively used for women with upper and mid-early EC, especially in stage I. In our sample, more lymph nodes were dissected in the Ivor–Lewis than in the MIE group, which can reduce recurrence and improve the survival rate. Ivor–Lewis surgery is often used in mid-lower and terminal EC, while MIE is often used in upper and mid-early EC. Compared to the other surgical methods, MIE does not increase the risk of postoperative complications. The gradual maturation of MIE technology will further expand indications and increase the number of lymph nodes dissected.

Introduction

Esophageal cancer (EC) has a high incidence worldwide, ranking eighth in morbidity and sixth in mortality.^{1,2} The majority of EC cases in China are squamous cell carcinoma, which is very common in men and is often detected at middle or late stage. Surgical treatment remains the first choice. Presently, the main radical surgical methods for EC include: Sweet surgery (left thoracic, one incision), Ivor–Lewis surgery (right chest posterolateral and upper abdomen median, two incisions), and minimally invasive esophagectomy (MIE). In this study, we retrospectively analyzed 434 cases of different esophagectomy methods

and observed the different effects and complications after surgery to provide a reference for the surgical selection of EC.

Methods

Patients

Between January 2011 and December 2016, 434 patients were scheduled for surgery for EC at our Department of Thoracic Surgery. The patients were divided into three groups: Sweet surgery (left thoracic, one incision,

143 cases), Ivor–Lewis surgery (right chest posterolateral and upper abdomen median, two incisions, 232 cases), and MIE (59 cases). Postoperative EC staging was based on the 7th edition American Joint Committee on Cancer (AJCC) Cancer Staging Manual.

Patients were pathologically confirmed with EC after surgery and were included in the study if preoperative imaging examination showed no obvious tumor invasion of surrounding tissues or distant metastasis, and organ function was tolerable to surgery. Patients with tumor invasion; distant metastasis; heart, kidney, lung and other functional abnormalities; serious infection of the body; and other malignant tumors were excluded.

The ethics committee of our hospital approved this study and patients and their families signed informed consent.

Esophagectomy procedure

Sweet

All operations were performed via the left thorax. One postural change was performed intraoperatively and one surgical field disinfection. The right lateral position was taken to free the esophagus from the left thoracic cavity, the diaphragm was cut open, the stomach was dislodged from the abdomen, the esophagus was cut off, the free stomach was pulled from the abdominal cavity to the thoracic cavity, and the tubular stomach was made. Finally, the tubular stomach was anastomosed with the esophagus in the thoracic cavity and the diaphragm was sutured.

Ivor–Lewis

The right upper right thorax incision and two postural changes were performed intraoperatively, with two surgical field disinfections. The stomach was dissected from the abdomen and the abdominal lymph nodes were dissected in the supine position. The esophagus and mediastinal lymph nodes were dissected from the right thoracic cavity in the left lateral position. The esophagus was cut off and the dissected stomach was pulled from the abdominal to the thoracic cavity through the hiatus of the esophagus to make a tubular stomach.

Minimally invasive esophagectomy (MIE)

Cervicothoracic and abdominal incisions were performed via endoscopy. Two postural changes were performed intraoperatively and two surgical field disinfections. The esophagus and mediastinal lymph nodes were dissected from the right thoracic cavity in the left lateral position, and then the upper esophagus was dissected and cut off in the left cervical incision. The stomach was dissected from the abdomen, and the tubular stomach was made to replace the esophagus. The abdominal lymph nodes were

dissected. Finally, the tubular stomach was extracted from the left neck from the abdomen through the right thoracic esophageal bed to the left neck, and the tubular stomach and esophagus were anastomosed from the neck.

Statistical analysis

The number of postoperative days, number of lymph nodes dissected, and the incidence of pulmonary infection, serous membrane fluid, arrhythmia, chylous fistula, gastric emptying dysfunction, and anastomotic leakage in the three groups were recorded and compared. Data were processed using SPSS version 23.0. The counting data were expressed as percentages, and chi-square and Fisher’s exact probability tests were used for comparison between groups. Measurement data were indicated with $x \pm s$, using one-way analysis of variance. $P < 0.05$ was considered statistically significant.

Results

The clinical data of different surgical methods in EC patients were compared. Postoperative pathological data of the patients is shown in Table 1. A statistically significant number of female stage I patients with upper EC underwent MIE ($P < 0.05$).

The number of postoperative days, the number of lymph nodes dissected, and the incidence of pulmonary infection, serous membrane fluid, arrhythmia, chylous fistula, gastric emptying dysfunction and anastomotic leakage in the three groups are shown in Table 2. A significantly higher number of lymph nodes were dissected in the Ivor–Lewis group than in the other two groups ($P < 0.05$). The number of postoperative days, and the occurrence of pulmonary

Table 1 Clinical data of different surgical methods in 434 patients with esophageal cancer

| Characteristics | Sweet (n = 143) (%) | Ivor–Lewis (n = 232) (%) | MIE (n = 59) | | χ^2 | P |
|-----------------|------------------------|-----------------------------|-----------------|-----|----------|---------|
| | | | (n) | (%) | | |
| Gender | | | | | 8.227 | 0.016 |
| Male | 111(77.6) | 163(70.3) | 34(57.6) | | ND | ND |
| Female | 32(22.4) | 69(29.7) | 25(42.4) | | ND | ND |
| Tumor | | | | | 84.179 | < 0.001 |
| Upper | 4(2.8) | 4(1.7) | 12(20.3) | | ND | ND |
| Middle | 39(27.3) | 138(59.5) | 34(57.6) | | ND | ND |
| Lower | 100(69.9) | 90(38.8) | 13(22.1) | | ND | ND |
| TNM staging | | | | | 17.639 | 0.007 |
| Stage I | 31(21.7) | 63(27.2) | 24(40.7) | | ND | ND |
| Stage II | 57(39.9) | 84(36.2) | 21(35.6) | | ND | ND |
| Stage III | 43(30.1) | 80(34.5) | 13(22.0) | | ND | ND |
| Stage IV | 12(8.3) | 5(2.1) | 1(1.7) | | ND | ND |

MIE, minimally invasive esophagectomy; ND, no data; TNM, tumor node metastasis.

Table 2 Comparison of postoperative complications between different surgical methods in patients with esophageal cancer

| Outcome | Sweet (<i>n</i> = 143) | Ivor–Lewis (<i>n</i> = 232) | MIE (<i>n</i> = 59) | F | <i>P</i> |
|---|-------------------------|------------------------------|----------------------|--------|----------|
| Postoperative days ($\bar{x} \pm s$) | 11.4 \pm 2.7 | 12.0 \pm 1.9 | 11.5 \pm 1.8 | 3.641 | 0.27 |
| Number of lymph nodes dissected ($\bar{x} \pm s$) | 14.1 \pm 7.8 | 19.8 \pm 8.5 | 15.5 \pm 7.3 | 23.365 | < 0.001 |
| Pulmonary infection (%) | 51 (35.7) | 93 (40.1) | 29 (49.2) | 3.18 | 0.204 |
| Serous membrane fluid (%) | 100 (69.9) | 151 (65.1) | 34 (57.6) | 2.879 | 0.237 |
| Arrhythmia (%) | 35 (24.5) | 35 (15.1) | 11 (18.6) | 5.138 | 0.077 |
| Chylous fistula (%) | 1 (1.0) | 1 (0.4) | 0 (0.0) | 0.455 | 0.797 |
| Gastric emptying dysfunction (%) | 1 (1.0) | 0 (0.0) | 0 (0.0) | 2.040 | 0.361 |
| Anastomotic leakage (%) | 2 (1.4) | 4 (1.7) | 0 (0.0) | 1.026 | 0.599 |

MIE, minimally invasive esophagectomy.

infection, serous membrane fluid, arrhythmia, chylous fistula, gastric emptying dysfunction, and anastomotic leakage were not statistically significant between the groups ($P > 0.05$).

Discussion

EC is one of the most common malignant tumors, both in China and worldwide, and is often discovered at middle or late stage. Methods to reduce the risk of surgery and postoperative complications^{3,4} and to improve the thoroughness of the operation remain controversial.^{5,6}

The number of lymph nodes dissected is one of the most important indexes to evaluate the thoroughness of EC surgery, which is closely related to the total survival of patients.^{7,8} Because of the disadvantages of lymph node dissection, the use of Sweet surgery has gradually been reduced. Ivor–Lewis surgery now is the main surgical method used for EC in China. In recent years, with the development of combined thoracoscopic and laparoscopic techniques, endoscopy has the potential advantages of less trauma, quicker recovery, and clear vision of the surgical field. Minimally invasive radical resection of EC has gradually been promoted in clinical practice.⁹

This study showed that, compared to the other two methods, Ivor–Lewis surgery is effective for the treatment of lymph nodes in EC patients and can reduce recurrence and improve survival. Our results were inconsistent with those of Peng *et al.*, who suggested that a greater number of lymph nodes are dissected during MIE.¹⁰ However, compared to open surgery, Guo *et al.* reported that the incidence of anastomotic fistula after MIE surgery increased and the postoperative hospital stay was significantly prolonged.¹¹ Our retrospective study showed that the postoperative complications after MIE were similar to those of the other two open surgery methods, and most of the patients considering endoscopic surgery were at early stage which reduces the risk of postoperative complications. This is consistent with results in research by Khan *et al.*² In addition, fewer lymph nodes are dissected

via MIE than by Ivor–Lewis surgery. Considering that MIE is primarily performed in women with early and upper EC, anastomotic fistula is prone to occur. The gradual maturity of MIE technology will further expand indications and increase the number of lymph nodes dissected.^{12,13}

In our study, early tumor stage, and female patients tended to undergo MIE. We posit that this is because female patients are generally small in size, short in the thoracic esophagus, and difficult in free esophagus and anastomosis. Early stage patients experience less tumor invasion and thus there is less risk of intraoperative injury to the aorta, bronchial membrane, and other important structures. Patients of advanced age and in late tumor stages are more likely to choose open surgery because lymph node dissection is easier to carry out under open conditions, and can better prevent bleeding, protect important organs, and control risk.

In conclusion, Ivor–Lewis surgery is considered to be more thorough for lymph node dissection than other surgical methods, and remains the mainstream surgical method.² However, it is expected that with the increasing number of minimally invasive operations performed, the advantages of MIE will gradually emerge.

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Disclosure

No authors report any conflict of interest.

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