Application of Oesophagogastric Cervical Mechanical Anastomosis in Oesophagectomy for Cancer

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Abstract We aimed to explore the safety and the feasibility of the application of digestive tract-specific circular anastomats in oesophagogastric cervical anastomosis after oesophagectomy for cancer. We retrospectively analysed the clinical data of 241 patients undergoing oesophagogastric cervical anastomosis using disposable circular staplings after oesophagectomy in the People's Hospital of Henan Province, from August 2009 to July 2012. A total of 240 patients were anastomosed successfully. One patient had a partially torn oesophagus and underwent repair because the wrong stapler size was used. No operative death occurred. Seven patients (2.9 %) had postoperative cervical anastomotic leakage but recovered after short-term conservative treatment, and three patients had obvious gastro-oesophageal reflux after eating. No intrathoracic anastomotic leakage or other anastomotic instrument-related complications occurred. During a median follow-up period of 13.8 months, no anastomotic stricture was found in each patient. The application of oesophagogastric cervical anastomosis using circular anastomat after oesophagectomy for cancer was safe and feasible.

Keywords Oesophageal carcinoma · Oesophagectomy · Anastomosis · Anastomat

Introduction

Oesophagectomy for cancer can be performed with intrathoracic or cervical anastomosis. Intrathoracic anastomosis is relatively simple but not suitable for thoracic middle or upper oesophageal carcinoma. Patients are likely to suffer from emphysema, respiratory failure and other serious complications and consequently require a secondary thoracotomy if anastomotic leakage occurs [1, 2].

Oesophagogastric cervical anastomosis can ensure the complete resection of the tumour. If anastomotic leakage occurs, digestive juice may be drained out from the cervical incision and can be cured gradually by conservative treatment, but emphysema, respiratory failure or other serious complications do not occur. Therefore, oesophagogastric cervical anastomosis can reduce the fatality rate of the anastomotic leakage. The incidence rate of reflux oesophagitis caused by cervical anastomosis is much lower than that caused by intrathoracic anastomosis. Patients that underwent cervical anastomosis have better postoperative quality of life than those that received intrathoracic anastomosis. Therefore, cervical anastomosis has been widely applied clinically and accepted by thoracic surgeons [3–6].

Traditional cervical anastomosis requires manual stitching and a long operation time. The quality of the operation is dependent on the skill of the surgeon, and the incidence rate of postoperative complications varies. Therefore, an increasing number of thoracic surgeons attempt to use oesophagogastric staplings in cervical anastomosis to shorten the operation time and to reduce the operation steps for consistency of anastomotic quality [7–9].

A total of 241 patients with oesophageal carcinoma hospitalised in the People's Hospital of Henan Province from August 2009 to July 2012 were included in this study. Patients at stage IV or with severe comorbidities were excluded to reduce influencing factors. All the patients received

Ethics Committee Letter This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of the People's Hospital of Henan Province. Written informed consent was obtained from all participants.

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oesophagogastric cervical anastomosis by the same surgery team using disposable circular anastomats after oesophagectomy. Satisfactory effects were achieved. The results were summarised and reported in this retrospective study.

Materials and Methods

General Data

Among the 241 patients with oesophageal carcinoma, 159 males and 82 females aged 35 years old to 87 years old (mean age of 63.6 years old) were included. The regions of oesophageal carcinoma included in the study were the thoracic superior segment ($n=25$), thoracic middle segment ($n=156$) and thoracic inferior segment ($n=60$). The histological type was squamous cell carcinoma. Thirty-one patients had preoperatively received new adjuvant chemotherapy, and 11 patients preoperatively received synchronous half-dose of radiotherapy to reduce the tumour. In terms of preoperative TNM staging and after enhanced CT scan treatment, patients were divided into stage 0–I ($n=10$), stage II ($n=138$) and stage III ($n=93$). One patient with middle thoracic oesophageal carcinoma underwent emergency surgery because of the oesophageal perforation caused by gastroscopy; the rest of the patients all underwent routine preoperative preparation [10]. This study was conducted in accordance with the declaration of Helsinki and with the approval of the Ethics Committee of the People's Hospital of Henan Province, China. Written informed consent was obtained from all participants.

Surgical Methods

All patients received surgery under combined inhalation and intubated vein anaesthesia. When the tumour was removed completely, all patients underwent oesophagogastric cervical anastomosis with left thoracotomy and left neck incision ($n=236$) or with right thoracotomy, median abdominal incision and left neck incision ($n=5$).

Operating Procedure

The thoracic oesophagus and oesophageal cancers were isolated conventionally, and the thoracic lymph nodes were scavenged. The diaphragm was opened to dissociate the stomach from the pylorus, maintain the gastroepiploic vessel bow and scavenge the abdominal lymph nodes. The stomach was cut starting from the gastric fundus and along the lesser curvature side and its corresponding greater curvature side to obtain a tubular stomach using a linear stitching instrument for preparation. Subsequently, the anterior border of the left neck sternocleidomastoid was incised to isolate the cervical oesophagus between the jugular vein and the thyroid. The

oesophagus and the stomach were pulled out from the incision site. The site of the cut on the oesophagus was clamped by a pouch purse-string suture forceps, and a purse-string suture was performed to remove the distal oesophagus. The purse-string suture forceps was loosened, and the circular stapling anvil was placed into the oesophagus; the purse line was then wrapped and ligatured on the centibar of the anvil [3]. At the highest point of the gastric fundus or at 1 cm below, the paries anterior gastricus was incised, and the centibar of the anvil was pulled out through the paries posterior gastricus anastomosis and connected to the host of stapling through the incision of the paries anterior gastricus under the guidance of the curved forceps. Anastomosis was completed after firing by tightening the stapler as the cursor entered the green zone and checking that no surrounding tissue was clipped. After confirming that no active bleeding occurred at the anastomotic stoma as the stapler exited, gastric canal and duodenal feeding tubes were intubated into the stomach and the duodenum, respectively. Stomach incision was closed with a straight-line stapler. Finally, along the anastomotic stoma, the entire circumference of the stomach stoma was sutured to the oesophageal muscle on the top of the anastomotic stoma.

All 241 patients were operated using staplers from Johnson & Johnson (USA). Among these patients, 189 used 25 mm staplers and 52 used 21 mm staplers.

Lymph node dissection was not systemic, but the sampling included the abdominal, thoracic and cervical regions. The median number of the lymph nodes dissected was 12.

Results

The operation was completed smoothly in 240 patients, and no operative death occurred. One case showed the presence of an oesophageal tear caused by the wrong stapler size. The mean operation duration was 165 min (the duration was 187 min using a hand-sewn technique performed previously in our institution, $P<0.01$). The mean hospital duration was 9.5 days, and no patient stayed in the ICU. Patients were allowed to eat normally at 6 to 9 days after the operation. Seven cases (2.9 vs. 6.5 % before the stapling technique was used in our institution, $P<0.01$) had cervical anastomotic fistula postoperatively. Among these cases, five showed fistula at 3 to 7 days after the operation and two showed fistula at 2 and 4 days after the start of normal eating. All the seven cases were treated by expectant therapy. No other anastomat-related complication was found in the rest of the patients. Three cases had obvious gastro-oesophageal reflux at supine position after eating. These cases involved upper oesophageal cancer, in which the anastomotic position was too high for anastomosis embedding. Patients were followed up postoperation at the outpatient department from 3 to 21 months (median follow-up period was 13.8 months), and no

anastomotic stenosis was found according to upper digestive tract imaging. The 1-year survival rate was 99.6 %, and the 1-year recurrence rate was 22 %.

Discussion

Based on our experience in the clinical use of stapling in the cervical anastomosis process, the following aspects require attention. First, the surgeons should be familiar with and master the structural performance and the instructions. Moreover, the instruments must be operated strictly according to the instructions. Second, according to the surgeon's preference, either forceps or handmade purse-string suture could be used to remove the distal oesophagus. However, the proximal oesophagus should not be left unattended for too long to avoid causing an eating disorder or the collapse of anastomosis into the chest because of the postoperative distortion of the oesophagus in the neck. Third, during the surgical process, an appropriate stapler model should be chosen according to the diameter and the expansive ability of the oesophagus. A high-calibre stapler should be used to reduce the incidence of anastomotic stricture. Fourth, as the tubular stomach undergoes anastomosis, the stomach should be pulled up as straight as possible at a tension-free state, and the excess stomach region should be removed to ensure satisfactory anastomotic blood supply. Fifth, the adjacent tissues around the anastomotic site should be carefully checked to ensure that no tissue is clamped into the anastomotic site before firing. Sixth, after the anastomosis, the anastomotic stoma should be carefully checked to confirm that the severed tissue ring is complete. In case of bleeding or missing nails, manual repair should be performed. Seventh, after the anastomosis, the anastomotic stoma should be embedded in the stomach to reduce postoperative gastro-oesophageal reflux [11].

Compared with thoracic anastomosis, cervical anastomosis can lower the mortality caused by anastomotic leakage, but the incidence rate of cervical anastomosis is higher than that of intrathoracic anastomosis [3, 12]. Cervical anastomotic complications of oesophagectomy have been the problem of thoracic surgeons for a long time. Many different hand-suture techniques, such as monolayer or multilayer suture, non-absorbable or absorbable suture lines and intermittent or continuous suture, have been used, but a high incidence rate of anastomotic leakage reaching 10 to 27 % is still observed [13–15]. In this study, seven cases showed anastomotic leakage, but all these cases were cured after conservative treatment, and no operative death occurred [16]. In addition to the anastomotic tension, blood supply and the degree of pollution, surgeon's proficiency of using the stapling instrument is also a significant factor in the occurrence of anastomotic leakage. In this study, one patient suffered from oesophageal tear because of the wrong stapling size. The oesophagus was repaired

immediately, but anastomotic leakage still occurred after the operation. Therefore, during surgery, the stapler size should be considered carefully according to the calibre and flexibility of the oesophagus near the anastomosis site to reduce the incidence of anastomotic leakage. Furthermore, gentle movement must be used during the operation process to minimise the squeeze and damage of the stomach tissue and to ensure satisfactory anastomotic healing [17].

The occurrence of intrathoracic anastomotic fistula is among the serious complications of cervical anastomosis after oesophagectomy for cancer. However, no intrathoracic anastomotic leakage was observed in our study probably because of the fully isolated cervical oesophagus and the use of a high cervical anastomosis site during the operation. Moreover, after anastomosis, the stomach was pulled up to encase the anastomosis and to ensure that the oesophageal bed obtains a better seal at the superior aperture of the thorax; this process contributes to the reduction of thoracic fistula [18].

The incidence rate of reflux oesophagitis after cervical anastomosis is much lower than that of intrathoracic anastomosis, but this condition still affects the quality of life of patients with oesophageal cancer. Thus, we pulled up the stomach to encase the anastomosis by a stapler after the anastomosis procedure. This measure increases the pressure that the cervical muscles and soft tissue place on the anastomotic site, enhances the pressure difference between the oesophagus and the stomach at the anastomosis and helps relieve postoperative gastro-oesophageal reflux [19–22].

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