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Single-Port Thoracoscopic Minimally Invasive Esophagectomy for Esophageal Cancer

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Abstract

Background This study was to explore the safety and feasibility of single-port thoracoscopic esophagectomy for esophageal cancer.

Methods The patients were placed in left lateral prone position, and a 4-cm incision through the 4th–5th intercostal space was taken on the post-axillary line. Except for a surgical wound protector, no other special instruments were used for single-port technique. The 10-mm camera and two or three thoracoscopic instruments were used for the thoracic phase. Mobilization of stomach with celiac lymph node dissection was performed via multiple-port laparoscopic approach. Cervical double-layered anastomosis was completed by hand-sewn technique.

Results A total of twenty-eight patients with esophageal squamous cell carcinoma underwent the single-port thoracoscopic surgery. All of the patients underwent R0 resection. The median time taken for thoracic phase and total operation time were 126 min (range, 121–153) and the 253 min (range, 197–309), respectively. The median number of resected thoracic lymph nodes was 16 (range, 12–24). There were no deaths or severe postoperative complications in this study, with no conversion of minimally invasive surgery to open procedure.

Conclusions Our preliminary results demonstrate that this technique is safe and feasible for treating esophageal cancer within an acceptable length of operation time, which does not compromise the surgical radicality.

Introduction

Single-incision thoracoscopic technique has been widely adopted in various kinds of lung surgeries, which is associated with reduced postoperative pain compared with that of multi-portal video-assisted thoracic surgery (VATS) [1]. However, single-port esophagectomy is usually technically challenging and studies are very limited [2–4]. We herein introduce our simplified single-port minimally invasive McKeown esophagectomy.

Technique

Thoracic phase

Anesthesia and position

The patient was placed in a left lateral prone position (30°–40°) under general anesthesia and double-lumen tube intubation. The operator and scopist stood on the left side of the patient with the assistant on the other side (Fig. 1a). A 3–4-cm incision was made through the fourth intercostal

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space on the posterior axillary line of the right chest wall, and a wound protector was inserted into the wound (Fig. 1a, b). A 12-mm trocar was placed between the wound and the wound protector for placing the camera (Fig. 1a). The scopist stood on the left side of the operator, when mobilizing upper part of the esophagus and dissecting upper mediastinal lymph nodes. Then, the scopist's position was changed to the right side of the operator for dissecting middle and lower part of the esophagus.

Esophageal mobilization and radical lymph node dissection

After a thorough exploration of tumor, we started with dividing the mediastinal pleural overlying on the azygos vein. Then, we proceeded with the dissection and division of azygos arch with endoscopic bio-clip and linear stapler. Esophageal mobilization, including the para-esophageal tissue and lymph nodes, was firstly from the azygos arch to the thoracic inlet up to the level of subclavian artery with good exposure of right recurrent nerve, and then the middle and lower part of esophagus was mobilized to the hiatus. Dissection was performed with regular hook cautery and ultrasonic harmonic scalpel (Fig. 1c). The mobilization of esophagus was assisted by an elbow suction apparatus (Fig. 1c), which could be used for exposing as well as sucking to achieve clean operative field. And an esophageal traction belt was used for assisting esophageal retraction during single-port procedures (Fig. 1c). Mediastinal lymph node dissection including subcarinal lymph node and the bilateral recurrent laryngeal nerve was performed as regular (Fig. 2a, b, c). A 28F chest tube was inserted through the port when the incision was closed (Fig. 1d).

Abdominal and cervical phase

Patients were placed in standard supine position. Mobilization of stomach with celiac lymph node dissection was performed by total laparoscopic approach using five ports technique. Extracorporeal gastric conduit (3-cm wide) formation and removal of specimen were completed via an additional small (3-cm) upper mid-abdominal incision [5]. Then, the gastric tube was pulled up to the left neck through the posterior mediastinal route and abdominal incision was closed. For cervical anastomosis, a hand-sewn double-layered anastomosis was performed under the assistance of a three-leaf clipper (Fig. 2d) [5]. After the anastomosis was completed, a nasogastric tube was intubated with the assistance of the surgeon and the cervical incision was closed.

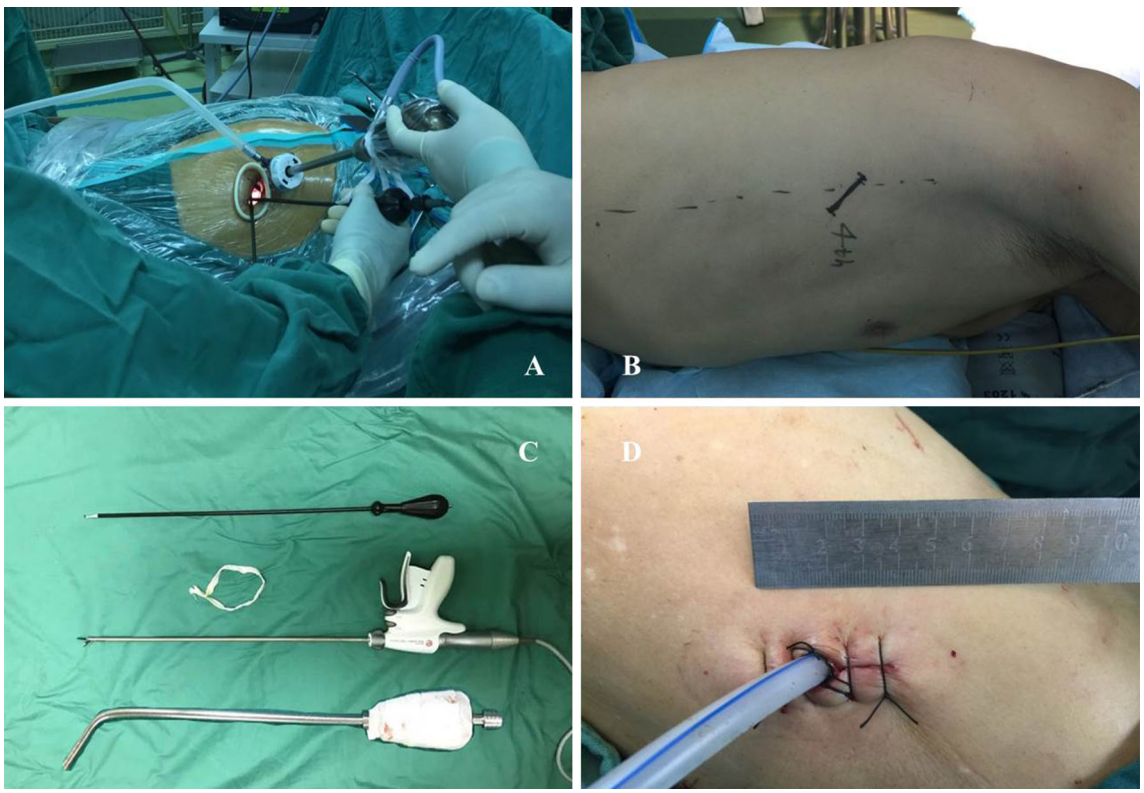

Fig. 1 **a** Position of instruments and operators; **b** Site of chest incision; **c** Hook cautery, ultrasonic harmonic scalpel, esophageal traction belt and elbow suction apparatus; **d** Postoperation chest incision

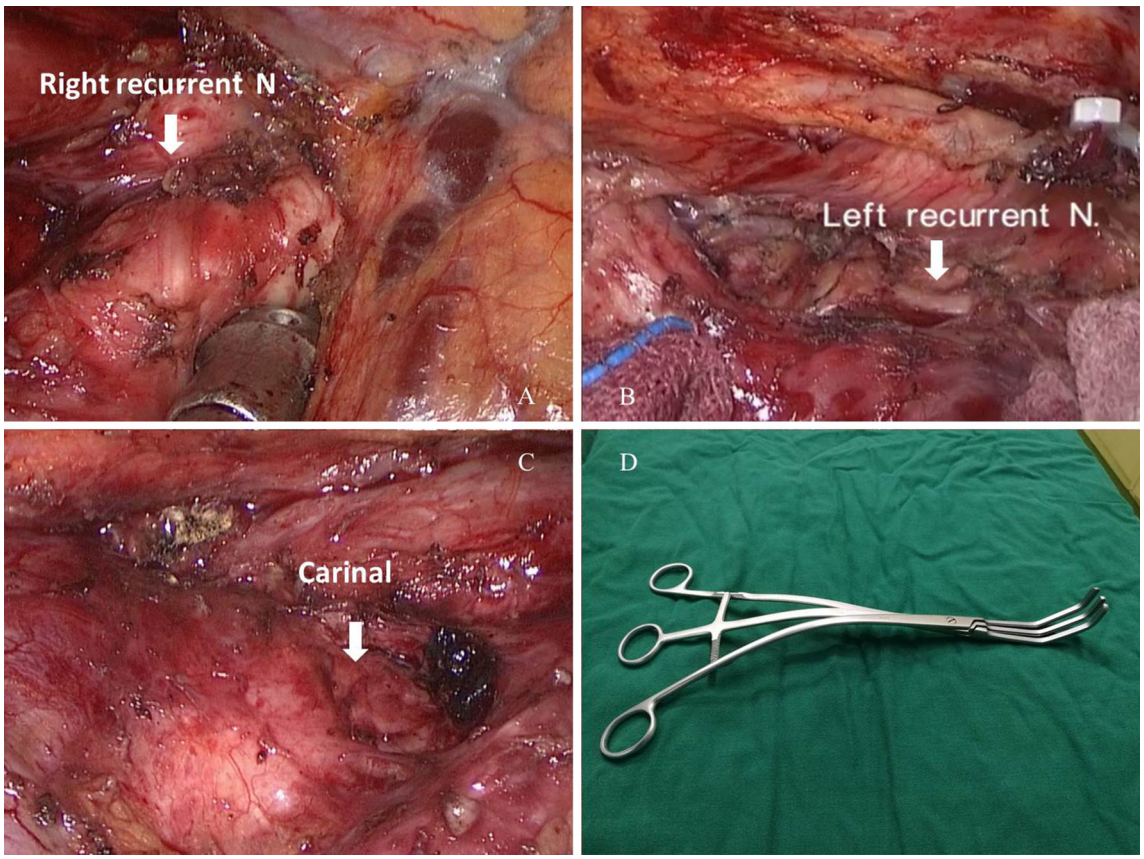

Fig. 2 **a** Lymph nodes dissection along right recurrent nerve (arrowhead); **b** Lymph node dissection along left recurrent nerve (arrowhead); **c** Subcarinal lymph node dissection; **d** Three-leaf clipper

Results

A total of twenty-eight patients underwent the single-port video-assisted thoracoscopic surgery. There was no patient with preoperative adjuvant therapy. The median age of the 24 male and 4 female patients was 65 years (range, 45–73), with the median body mass index of 22.8 (range, 19.1–23.4). Esophagectomy and esophagogastrostomy were indicated for squamous cell carcinoma, which located in the middle (n = 25) or lower part (n = 3) of the thoracic esophagus. Postoperative pathologic staging was diagnosed using the 7th edition AJCC staging system for esophageal squamous cell carcinoma (stage I, 4 patients; stage II, 19 patients; stage III, 5 patients). All patients received R0 resection. The median time taken for thoracic phase was 126 min (range, 121–153), and the median total operation time was 253 min (range, 197–309). The median number of resected thoracic lymph nodes was 16 (range, 12–24). The median postoperative time was 9 days (range, 8–12). There were no deaths or severe postoperative complications including anastomotic leakage, with no conversion of minimally invasive surgery to open operation.

Comments

Open esophagectomy is associated with significant morbidity and mortality, while minimally invasive procedures contribute to reduced postoperative pain, less morbidity and better recovery. Single-incision or single-port procedures such as lobectomy have been gaining more and more attention as the developments of endoscopic devices and techniques [1]. However, single-port access procedures usually require special surgical instruments and advanced surgical skills, which might take much longer operation time as compared with conventional multiple-port approach [2–4].

In this study, we developed a simplified method for minimally invasive McKeown esophagectomy via a single-port video-assisted thoracoscopic approach. In order to have a better view of the surgical area, the left lateral prone position was adopted for the thoracic procedure, which could achieve a good operative field without needing any extra traction device for the lung. For single-port access approach, it could be very difficult for the scopist to coordinate with the operator especially when mobilizing the upper esophagus, hiatus and dissecting the bilateral

recurrent laryngeal areas. We placed the camera above the wound protector, and a good view of surgical field could be achieved by changing the position of the scopist. Furthermore, by properly using an elbow suction apparatus and an esophagus traction belt, we could gain enough tension when circumferentially separating esophagus from surrounding tissues. The most difficult part of this single-port thoracoscopic technique was the upper mediastinal lymph node dissection, which could be completed as multiple-port technique with proper esophagus retraction and adjustment of camera position.

Although our preliminary study has shown that single-port thoracoscopic esophagectomy is feasible for treating esophageal cancer within an acceptable length of operation time, more cases of single-port thoracoscopic esophagectomy should be carried out to identify its safety and advantages over traditional minimally esophagectomy.

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