Surgical Technique

Effect of sternocleidomastoid flap repair and endoscopic injection of emulsified adipose tissue stromal vascular fraction in the treatment of refractory cervical anastomotic leak contaminating mediastinum

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Abstract: Mediastinal infection caused by anastomotic leak is hard to cure, mainly because the poor drainage at the site of mediastinal infection leads to persistent cavity infection, which in turn becomes a refractory mediastinal abscess cavity after minimally invasive esophagectomy (MIE)-McKeown. Herein, we explored sternocleidomastoid (SCM) muscle flaps and emulsified adipose tissue stromal vascular fraction containing adipose-derived stem-cells to address this issue. We studied 10 patients with esophageal cancer who underwent MIE-McKeown + 2-field lymphadenectomy and developed anastomotic and mediastinal leak and received new technology treatment in the Affiliated Cancer Hospital of Zhengzhou University from June 2018 to March 2022. The clinical data and prognosis of the patients were collected and analyzed. A total of 5 patients received this surgery, and no other complications occurred during the perioperative period. Among the 5 patients, 1 patient was partially cured, and 4 patients were completely cured. During the follow-up 3 months postoperatively, all these 5 patients could eat regular food smoothly, and no relapse of leak and mediastinal infection occurred. The new surgical method has achieved good results in the treatment of anastomotic leak. Compared with the traditional thoracotomy, it is a less invasive and feasible surgical approach, which can be used as a supplement to the effective surgical treatment of cervical anastomotic leak contaminating the mediastinum.

Keywords: Minimally invasive esophagectomy (MIE); anastomotic leak; sternocleidomastoid muscle flaps; emulsified adipose tissue stromal vascular fraction

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Introduction

Minimally invasive esophagectomy (MIE)-McKeown is a main therapy for resectable esophageal cancer. Esophagogastric anastomotic leak is a common serious complication after esophagectomy (1). Most cervical esophagogastric anastomotic leak occurring in the early postoperative period can be healed successfully through drainage, antibiotics, and other treatment measures (2). Nevertheless, in some patients, the cervical esophagogastric anastomotic stoma may lead to thoracic and mediastinal infection, bronchomediastinal pleural leak, and tracheal fistulization. In some patients, it may cause refractory cervical anastomotic leak contaminating the mediastinum, which results in patients' failure to feed orally for an extended period, significantly reducing the patients' quality of life and even causing death (1).

Most early anastomotic leaks can be detected by some examination and corrected by aggressive surgical drainage, but a small number of cervical esophagogastric anastomotic intrathoracic leaks extend downwards to the right thoracic cavity and mediastinum, causing empyema and mediastinal infection (1,3). Conventional thoracotomy for anastomotic leak is a high-risk surgery, requiring candidates to have better physical conditions, such as infection control measures and individuals with a higher body mass index (BMI). Some studies have shown that both sternocleidomastoid (SCM) muscle and emulsified adipose tissue stromal vascular fraction can effectively treat anastomotic mediastinal leak, but there is still a certain failure rate (2,4).

Hence, it is imperative to explore a safe and straightforward surgical method. We employed the use of SCM muscle flaps and emulsified adipose tissue stromal vascular fraction to treat the mediastinal abscess cavity caused by refractory esophagogastric anastomotic leak, while simultaneously sealing the anastomotic. We present this article in accordance with the SUPER reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-442/rc).

Highlight box

Surgical highlights

- Sternocleidomastoid (SCM) muscle flaps and emulsified adipose tissue stromal vascular fraction to solve the mediastinal infection caused by anastomotic leak.

What is conventional and what is novel/modified?

- The conventional treatment of anastomotic leak is adequate drainage and nutrition.
- SCM muscle flaps and emulsified adipose tissue stromal vascular fraction to treat anastomotic leak.

What is the implication, and what should change now?

- New surgical procedures and techniques should be explored to treat anastomotic leak.

Preoperative preparations and requirements

From June 2018 to March 2022, a total of 1,900 patients with esophageal cancer received MIE-McKeown + 2-field lymphadenectomy in the Affiliated Cancer Hospital of Zhengzhou University. The conduit used to maintain the digestive tract was the stomach. Inclusion criteria: (I) patients with an anastomotic leak; (II) anastomotic leak did not respond to continuous negative pressure for greater than a month. Exclusion criteria: Surgical treatment was not tolerated. This surgical approach was approved by the Ethics Committee of the Affiliated Cancer Hospital of Zhengzhou University (No. 2018113) and informed consent was taken from all the patients. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Step-by-step description

SCM muscle flaps

During surgery, after an incision of the anterior edge of the cervical SCM, the right wall of the cervical esophagus was dissected along the anterior edge of the SCM and the anterior pace of the vessel to explore downward. The guiding drainage tube was moved at the same time to determine the location of the esophagogastric anastomotic leak (*Figure 1A*).

The anterior half of the SCM was freed (incision made according to the actual size of the abscess, and the muscle was cut at the level of the mastoid to make a pedicled muscle flap) (*Figure 1B*).

Special attention was paid to maintain the blood supply of the SCM near the sternum. The pedicled SCM flap was turned downward to tightly fit and seal the leak to fill the mediastinal abscess cavity (*Figure 1C*).

Emulsified adipose tissue stromal vascular fraction

All operations were performed under local anesthesia. Approximately 30 mL of fat was collected from abdominal

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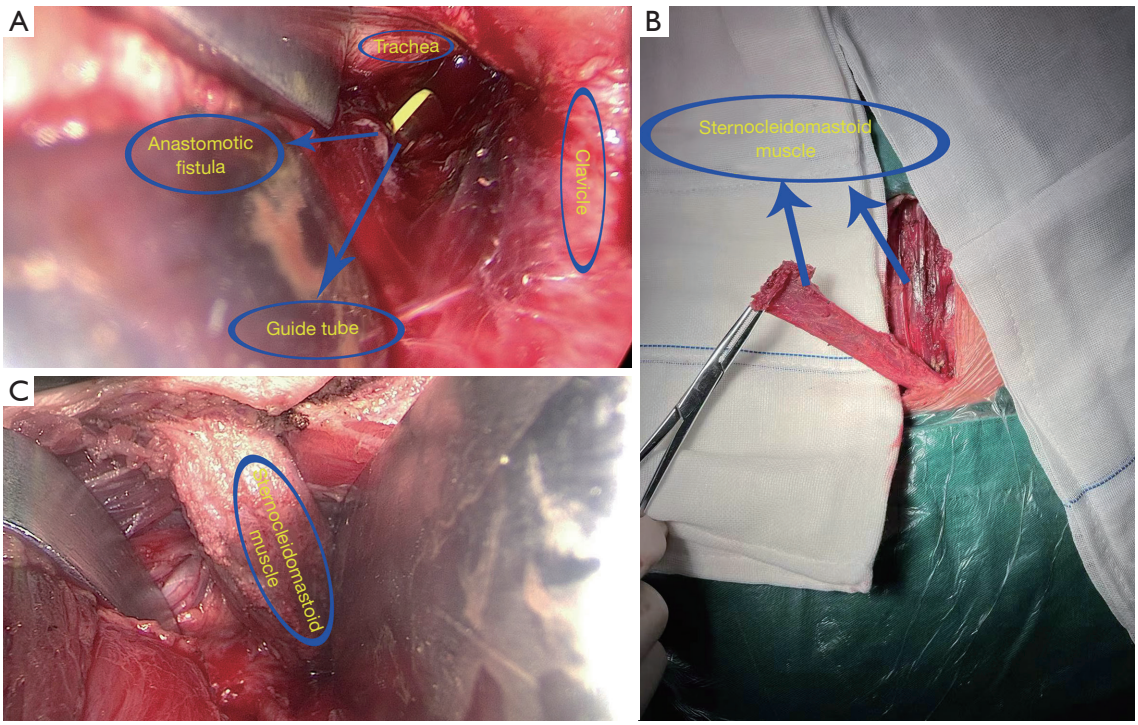

Figure 1 SCM muscle flaps. (A) The anastomotic leak was found through the neck; (B) the SCM muscle was dissociated; (C) the SCM muscle fills the mediastinal space. SCM, sternocleidomastoid.

subcutaneous adipose tissue using a 2.1 mm microcatheter and four 1 mm holes to collect fat particles. Emulsified adipose tissue stromal vascular fraction (tSVFem) was then obtained by mechanically emulsifying 20 mL of harvested fat particles through a filter (0.4–1.2 mm) and centrifuging to remove the supernatant fraction and oil released during mechanical destruction of mature adipocytes (*Figure 2A*).

Subsequently, an esophagoscopy was performed and the anastomotic leak was identified (*Figure 2B*).

A quantity of 10 mL of the fat pellet was injected into the leak (through a 6F catheter) until it was fully filled. This was followed by a 22 G endoscopic needle with a total of 1–2 mL tSVFem. The leak was closed by tSVFem injection into the submucosal boundary of the 4 quadrants of the leak (*Figure 2C*).

Postoperative considerations and tasks

After the operation, gastrointestinal decompression and nasogastric nutrition support were provided, and blood glucose level was controlled. Two weeks after the operation, gastrografin in the upper gastrointestinal tract and gastroscopy were performed to confirm that the anastomotic leak was healed, after which the gastrointestinal decompression was stopped, and the gastrogavage tube was removed. After confirming that the patient's general condition had improved, oral feeding was initiated. Once the purulent fluid in the neck started to reduce, the cervical drainages were removed in turn. After discharge, the patient was followed up for 1–3 months.

Tips and pearls

(I) Preoperative imaging was used to measure the depth of anastomotic leak, and the corresponding length of SCM was cut off while protecting the vascular tissue around the muscle as much as possible.

(II) tSVFem was first injected into the mediastinal space through the leak, and then injected into the submucosa around the anastomotic leak, so that the mucosa closed the leak.

Results

Anastomotic leak and mediastinal abscess occurred in 10 patients, among whom, 5 patients had leak lasting for

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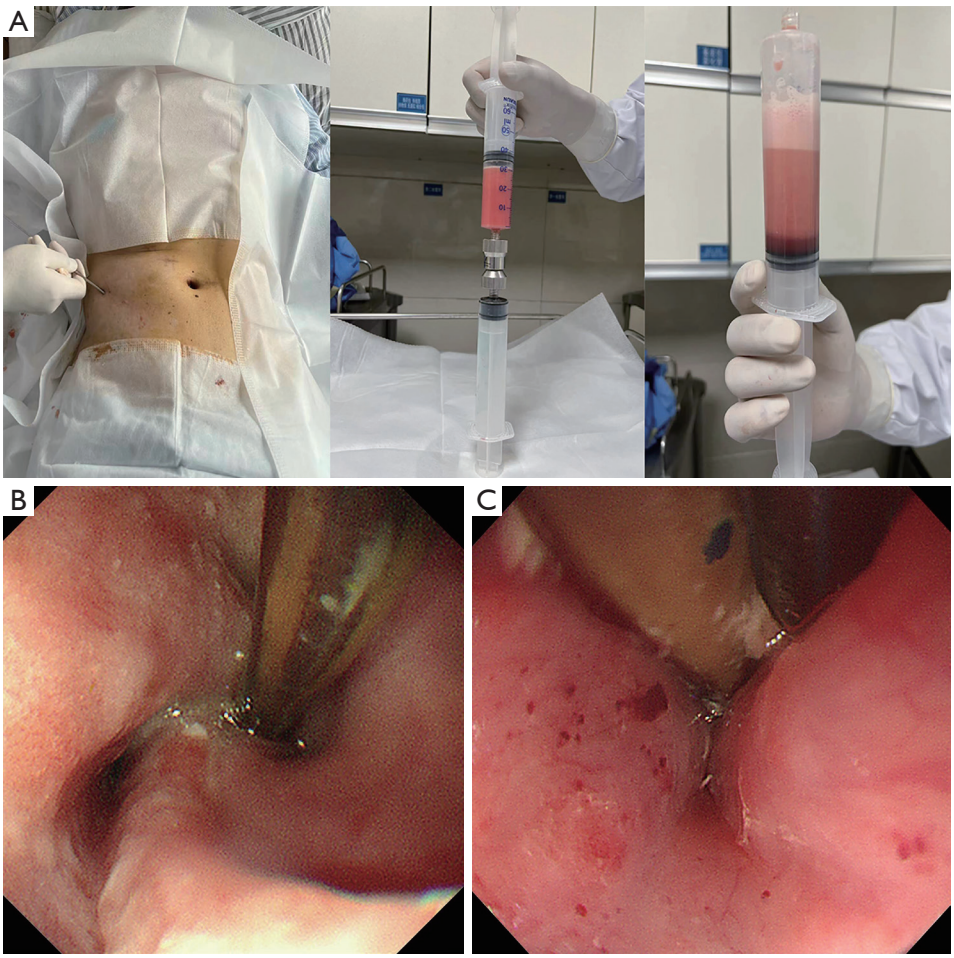

Figure 2 Emulsified adipose tissue stromal vascular fraction. (A) Abdominal subcutaneous adipose tissue was collected to obtain tSVFem; (B) anastomotic leak without tSVFem injection; (C) anastomotic leak with tSVFem injection. tSVFem, emulsified adipose tissue stromal vascular fraction.

more than 3 months after drainage and anti-inflammatory treatment, and the mediastinal abscess cavity also persisted, causing refractory cervical anastomotic leak contaminating the mediastinum, and 1 patient developed mediastinal bronchopleural leak and lung abscess. The other 5 patients did not complete the entire procedure due to financial reasons. The general data of the patients are shown in *Table 1*.

A total of 5 patients received this surgery, and no other complications occurred during the perioperative period. Among the 5 patients, 1 patient was partially cured, and 4 patients were completely cured. In 1 partially cured patient, the leak became smaller after the surgery, and finally healed after cervical drainage, anti-inflammatory treatment, and nutritional support. The leak healed in the remaining 4 patients after the mediastinal abscess cavity was packed and the anastomotic leak was sealed. Gastrografin in the upper gastrointestinal tract and gastroscopy confirmed that no digestive juice had leaked to the thoracic cavity and mediastinum from the anastomotic leak. The shortest healing time (eat regular food smoothly) was 3 weeks, whereas the longest was 8 weeks. During the follow-up 3 months postoperatively, all of these 5 patients could eat smoothly, and no relapse of leak and mediastinal infection occurred.

Discussion

It has been reported that the incidence of cervical esophagogastric anastomotic leak after MIE-McKeown procedure is 12–30% (5), with an average rate of 12.3%

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Table 1 Clinical data of the patients

Patient	Sex	Age (years)	Tumor location	Diagnosis	Time of leak (days after operation)	Time of cure (day)	Treatment effectiveness	Comorbidity
1	Male	42	Middle	Cervical anastomotic leak contaminating mediastinum/ bronchopleural leak	28	32	Partial	Diabetes mellitus
2	Male	66	Lower	Cervical anastomotic leak contaminating mediastinum	13	14	Yes	Diabetes mellitus
3	Male	71	Middle-upper	Cervical anastomotic leak contaminating mediastinum	8	10	Yes	Diabetes mellitus
4	Female	68	Middle	Cervical anastomotic leak contaminating mediastinum	16	12	Yes	Diabetes mellitus
5	Male	58	Lower	Cervical anastomotic leak contaminating mediastinum	10	16	Yes	Diabetes mellitus

(2,6). There is no standard treatment for esophagogastric anastomotic leak contaminating the mediastinum. A long-term gastrointestinal decompression tube may lead to electrolyte disturbance and loss of nutrients, aggravate postoperative malnutrition in patients with esophageal cancer, and increase the risk of complications such as respiratory tract infection and epistaxis caused by aspiration (7). For patients with intractable mediastinal pleural leak, the drainage tube, as a foreign body retained in the body for a prolonged period throughout the leak, negatively affects the healing of the leak (8). Some researchers have made progress in treating intrathoracic anastomotic leak by endoscopic injection of emulsified adipose-derived stem cell (ASC) glue, but further data are needed to confirm its effect (4). Other researchers have applied SCM tamponade to occlude refractory cervical esophagogastric anastomotic leak and have achieved good results (9). The results of 5 patients in this study showed that the occlusion of anastomotic leak with SCM muscle through cervical incision can be effective and can eliminate the abscess cavity caused by mediastinal infection. As a result, the patient can resume oral feeding and the mediastinal and pulmonary infections caused by cervical anastomotic leaks are effectively healed. In addition, an incision through the neck is less traumatic and less demanding for the patient's physical condition, avoiding the secondary pulmonary trauma and high mortality caused by transthoracic surgery.

tSVFem has the potential of immunosuppression, immunoregulation, angiogenesis, and regeneration, and is a promising new method for promoting healing (4). According to its mechanism, tSVFem has anti-inflammatory and tissue regeneration effects, which can safely and effectively promote tissue healing (10). Since the graft material used in this study was autologous, there was no risk of rejection. Previous studies have also shown that tSVFem has been used in other areas to treat diseases using fat transplantation and ASCs, such as neurosurgery for maxillofacial surgery, spinal cord injury, and orthopedics for joint diseases (11). A recent study showed its role in the treatment of anastomotic leak (4). However, for cases with a large range of mediastinal anastomotic leak, tSVFem injection alone cannot completely cover the scope of anastomotic leak. The SCM muscle can be used to fill the mediastinal anastomotic leak, and then tSVFem injection can be more effective in the treatment of mediastinal anastomotic leak.

Conclusions

The surgery has achieved a better therapeutic effect by making an incision at the anterior edge of the right cervical SCM, freeing SCM flaps and emulsified adipose tissue stromal vascular fraction to fill the mediastinal abscess cavity caused by the refractory esophagogastric anastomotic leak, and occluding the esophagogastric cervical anastomotic leak at the same time. Compared with the traditional thoracotomy, it is a less invasive and feasible surgical approach, which can be used as a supplement to the effective surgical treatment of cervical anastomotic leak contaminating the mediastinum. The further therapeutic effect needs to be confirmed based on more clinical cases.

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Footnote

Reporting Checklist: The authors have completed the SUPER reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-442/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-442/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This surgical approach was approved by the Ethics Committee of the Affiliated Cancer Hospital of Zhengzhou University (No. 2018113) and informed consent was taken from all the patients.

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