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Application of modified neck drainage in the management of cervical anastomotic fistula in esophageal cancer patients

Song Wu[1], Zhe Zhang[1] and Zhonghua Qin[1*]

Abstract

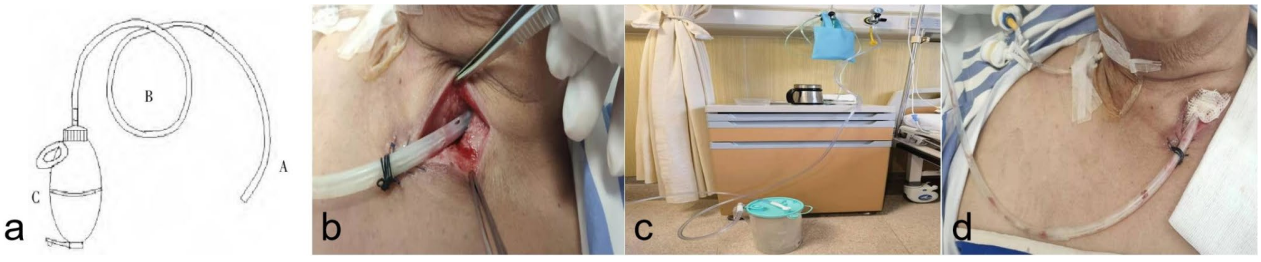
Background Anastomotic fistula is a rare but life-threatening complication of esophageal cancer, and its treatment remains challenging.We aimed to evaluate the clinical efficacy of modified cervical drainage in the management of cervical anastomotic fistula in patients after esophageal cancer surgery.

Methods From June 2017 to December 2021, 25 esophageal cancer patients who developed cervical anastomotic fistula were enrolled in the study. Among them, 14 patients were treated with modified cervical drainage, which served as the observation group, while the remaining 11 patients underwent open incision and drainage, which served as the control group. The treatment outcomes of the two groups were compared and analyzed.

Results The observation group had a significantly shorter healing time, fewer dressing changes, shorter hospital stay, and lower hospitalization costs compared to the control group ($P < 0.05$). The incidence of complications in the neck was not significantly different between the two groups ($P > 0.05$). All patients resumed a normal diet without experiencing fever, coughing or other discomfort, and were discharged after a smooth recovery.

Conclusions Modified neck drainage, as a treatment method for cervical anastomotic leakage in esophageal cancer patients, has preliminarily demonstrated potential in promoting patient recovery. However, its efficacy still requires further validation and confirmation through studies with larger sample sizes.

Graphical abstract



*Correspondence:
Zhonghua Qin
qzh1346@163.com

Full list of author information is available at the end of the article

Keywords Esophageal cancer, Anastomotic fistula, Drainage

Background

Esophageal cancer is one of the most common malignant tumors in China, and comprehensive treatment mainly involves surgery for early and intermediate stages of esophageal cancer [1, 2]. With the advancement of surgical techniques and the updated concept of accelerated perioperative recovery, the incidence of complications during the perioperative period of esophageal cancer has significantly reduced [3, 4]. However, esophagogastric anastomotic fistula is still a significant problem with an incidence rate of about 4.9–23.2%[5, 6]. Once anastomotic fistula occurs, the patient's recovery process is hindered, and in severe cases, it can be life-threatening. Therefore, the treatment of anastomotic fistula has always been a focus of esophageal surgery. Currently, skin flap drainage or drainage tube connection with negative pressure ball is commonly used for cervical drainage in esophageal cancer surgery patients. However, there are problems such as poor drainage, frequent dressing changes, and frequent inflation of the negative pressure ball. From June 2017 to December 2021, we used modified cervical drainage and open incision and drainage for the treatment of cervical anastomotic fistula in esophageal cancer patients, and report the results as follows.

Methods

General information

A retrospective analysis was conducted on 231 esophageal cancer patients who visited our department and underwent esophagectomy between June 2017 and December 2021. Patients who developed cervical anastomotic leakage postoperatively were included in the study. The inclusion criteria were as follows: (1) pathological biopsy confirming a diagnosis of esophageal cancer; (2) surgical anastomosis performed at the neck; (3) complete clinical records; and (4) signed informed consent. The exclusion criteria were: (1) pre-existing esophageal fistula; (2) previous esophageal surgery. After review, 25 patients were identified who developed cervical anastomotic leakage postoperatively. These patients were divided into an observation group and a control group based on the drainage method used. The observation group was treated with a modified drainage device, while the control group underwent open wound dressing for drainage. This study was approved by the Ethics Committee of Jiangyin People's Hospital.

All patients with esophageal cancer underwent McKeown surgery. Based on preoperative enhanced CT or PET-CT guidance and intraoperative findings, mediastinal lymph nodes (including those paralaryngeal on both sides, subcarinal, paratracheal, parabronchial, paravascular, and paraesophageal) and abdominal lymph nodes (surrounding the stomach and para-abdominal aortic) were dissected during the surgery. For all esophageal cancer surgeries, the anastomosis was performed by pulling the tubular stomach through the esophageal bed from the chest to the neck and connecting it to the cervical esophagus using a circular stapler for end-to-side anastomosis, followed by intermittent reinforcement. Skin flap drainage or drainage tube connection with negative pressure ball was used for cervical drainage. A total of 5 patients from both groups received neoadjuvant chemotherapy, with the treatment regimen consisting of paclitaxel plus carboplatin. Among them, 3 cases were in the observation group and 2 cases were in the control group. None of the patients in either group underwent radiotherapy prior to surgery.

The time of anastomotic fistula in both groups ranged from 3 to 7 days after surgery, accompanied by fever. In some patients, the fistula was visible during dressing changes, and in the remaining patients, upper gastrointestinal radiography was performed to confirm the presence of anastomotic fistula. Some patients underwent chest and neck computerized tomography (CT) scans to further understand the location and size of the fistula based on the imaging data from the radiography and CT. There was no significant difference in the characteristic data between the first two groups of patients before treatment of anastomotic fistula (all $P > 0.05$, Tables 1 and 2).

Materials and methods

After both groups of patients developed fever, the neck incision was promptly opened, and purulent fluid was found to be discharged, some with a foul smell. After confirming the presence of anastomotic fistula, the neck treatment methods were as follows:

Observation group: Improved drainage device for drainage. The drainage material is a disposable negative pressure suction ball (Fig. 1a) produced by Suzhou Huasheng Medical Equipment Co. Ltd. The material is a disposable sterile silicone product, which consists of a catheter and a negative pressure ball. The catheter is 80 cm long, of which the front section (Fig. 1a-A) is 25 cm long, flat and oval in shape, with a soft and thin wall, side holes, grooves inside and an inner diameter of 8 mm; the rear section (Fig. 1a-B) is 55 cm long, round in shape, with an inner diameter of 6 mm, and is connected by a fixed protrusion between the front and rear sections; the negative pressure ball (Fig. 1a-C) has a volume of 100 ml, a one-way valve at the top, and is connected to the rear section and the negative pressure ball by an

Table 1 Patient characteristics before surgery

	Group A($n=14$)	Group B($n=11$)	P
Gender, Male	9(64.3%)	7(63.6)	1.000
Age(years)	69.36 ± 5.92	66.91 ± 7.89	0.384
Admission weight (kg)	62.14 ± 10.26	63.00 ± 10.92	0.842
Admission BMI (kg/m^2)	22.29 ± 2.97	21.82 ± 3.06	0.703
Diabetes	6(42.9%)	4(36.4%)	1.000
KPS scores	92.86 ± 4.69	92.73 ± 4.67	0.946
Albumin levels (g/L)	44.50 ± 5.37	46.64 ± 5.55	0.341
Absolute lymphocyte counts (10^9/L)	1.96 ± 0.62	1.87 ± 0.60	0.732
Alanine aminotransferase (IU/L)	48.50 ± 9.72	42.18 ± 8.16	0.097
Aspartate aminotransferase (IU/L)	30.93 ± 9.80	37.18 ± 10.32	0.135
Blood urea nitrogen (mmol/L)	6.15 ± 1.71	6.30 ± 1.35	0.814
Creatinine (umol/L)	77.03 ± 10.28	82.14 ± 11.50	0.254
Tumor location, n(%)			
Middle section	7(50%)	8(72.8%)	0.284
Lower section	5(35.8%)	1(9%)	
Middle and lower sections	2(14.3%)	2(18.2%)	
Tumor stage, n(%)			
Stage I	4(28.6%)	2(18.2%)	0.200
Stage II	4(28.6%)	7(63.6%)	
Stage III	6(42.8%)	2(18.2%)	

Table 2 Surgical method and anastomotic fistula status

	Group A($n=14$)	Group B($n=11$)	P
Surgical method, n(%)			
Minimally invasive surgery△	10(71.4%)	6(54.5%)	0.434
open operation	4(28.6%)	5(45.5%)	
Average time of fistula occurrence (days)	4.50 ± 1.29	4.18 ± 1.47	0.570
Size of fistula, n(%)			
Thread-like	4(28.6%)	3(27.3%)	1.000
<5 mm	7(50%)	6(54.5%)	
5–10 mm	3(21.4%)	2(18.2%)	
Location of fistula, n(%)			
Lateral wall	7(50%)	6(54.5%)	1.000
Posterior lateral wall	7(50%)	5(45.5%)	

△:The surgery was performed using thoracoscopy and laparoscopy

movable connection. The bottom of the negative pressure ball is equipped with a opening and closing function.

Drainage Materials and Effect Diagram

We used the front and rear sections of the catheter, cut off a part of the front section of the catheter, and inserted the head end into the neck incision (generally keeping 2–3 side holes of the catheter in the incision). The length of insertion varied among patients, typically ranging from 3 to 5 cm, ensuring that the tip of the catheter was positioned near the lower edge of the anastomotic leak (care was taken not to insert it into the leak itself or place it too tightly against the fistula). The catheter was then secured to the skin at the lower edge of the neck incision using silk sutures (Fig. 1b). The tail end of the catheter is connected to a disposable suction connecting tube, and then the suction connecting tube is connected to a sputum suction bucket (with a disposable drainage bag built in). The joint of the suction bucket is connected to the negative pressure gauge head beside the patient's bed using a disposable connecting tube (Fig. 1c).Adjust the suction of the negative pressure gauge to maintain a continuous low suction state at the end of the catheter, just enough to suction out the pus.To prevent damage caused by the suction of the surrounding tissue into the side hole of the catheter, Vaseline gauze can be wrapped around the end of the catheter (Fig. 1d). When the patient got out of bed to move around, the end of the catheter was clamped, and the catheter was disconnected from the connecting tube. Upon returning to the bedside, the nurse reconnected the catheter to the connecting tube. The nurse regularly checked to ensure that the tip of the catheter had not dislodged from the incision.

According to the drainage situation of the patient's neck incision, gradually remove the drainage tube until the neck incision is closed. The criteria for removing the drainage tube include the following: ① Normal body temperature (excluding fever caused by non-anastomotic fistula reasons such as lung infection, urinary tract infection, etc.); ② No fluid drainage from the tube for 2–3 consecutive days; ③ Upper gastrointestinal radiography

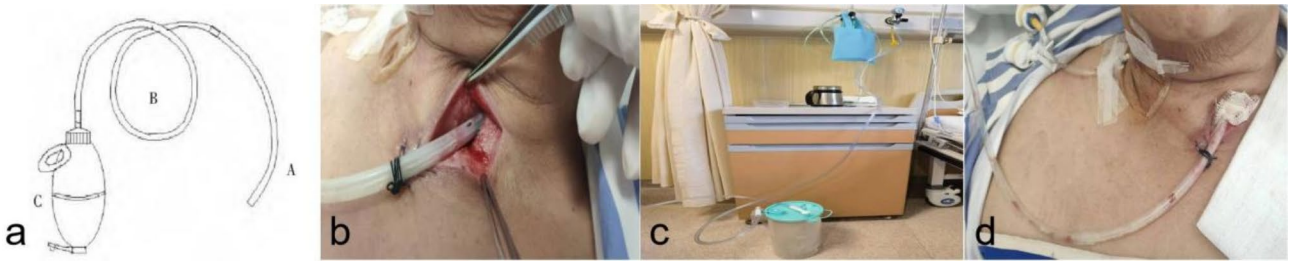


Fig. 1 Materials and methods used in modified neck drainage. **a** Disposable negative pressure suction ball, consisting of a catheter and a negative pressure ball. **b** The neck incision is opened to insert the catheter. **c** The tail end of the catheter is connected to the suction bucket through a connecting tube, and the suction bucket is connected to the negative pressure gauge head through another connecting tube. **d** The catheter head is loosely wrapped with Vaseline gauze and fixed to the skin beside the incision with a suture

and neck-chest CT to exclude anastomotic leakage. During the placement of the drainage tube, the neck incision is changed once a day to understand the healing of the fistula.

Control group: open wound dressing and drainage. The neck incision is completely opened to fully expose the fistula, and the purulent fluid in the incision is cleared as much as possible. A small gauze strip is placed near the fistula for drainage, and the dressing is changed when the incision gauze is soaked with purulent fluid. Change the dressing every day and observe the healing of the fistula. When the purulent fluid decreases, the frequency of dressing changes can be reduced until the fistula is healed.

Nursing and nutritional support

The bedside nurse regularly inspects the patient according to the requirements of primary care, assists the patient to get out of bed and perform respiratory exercises. The observation group observes the drainage situation of the neck drainage tube in the patient (including the color, amount, and presence of odor of the drainage fluid) and records it. If the tube falls out or shifts, it is adjusted promptly. The tube condition is evaluated daily (whether it is blocked, and whether the negative pressure suction is changed). The control group observes the dryness of the gauze on the neck incision. If the gauze is wet, the doctor is notified to change it. All patients are given enteral nutrition suspension (produced by Nutricia Pharmaceutical Company) for nutritional support.

Statistical analysis

Data were expressed as mean ± standard deviation and analyzed by paired t-test. Qualitative data were expressed in percentage, and data between Observation group and Control group were analyzed by Fisher's exact test. Statistical significance was considered when $p < 0.05$.

Results

The duration of wound drainage tube placement ranged from 8 to 21 days in the observation group, while the wound gauze drainage time ranged from 12 to 30 days in the control group. After treatment, when clinical assessment indicated that the fistula had healed in both groups of patients (i.e., the incision on the neck was clean and dry for 2 consecutive days after dressing change), upper gastrointestinal radiography and neck-chest CT scans were performed to confirm the absence of contrast extravasation. They were then transitioned from liquid to semi-liquid diet gradually. After eating, there were no discomforts such as fever or coughing. Postoperative complications in both groups, excluding anastomotic leakage, included pulmonary infection, chylothorax, recurrent laryngeal nerve injury, and abdominal incision infection. In the observation group, there was 1 case of pulmonary infection, 1 case of chylothorax, and 1 case of abdominal incision infection. In the control group, there was 1 case of recurrent laryngeal nerve injury. During the treatment of cervical anastomotic leakage, 1 case of minor cervical vascular bleeding occurred in the control group, which improved after intervention. All patients recovered smoothly and were discharged. All patients had good postoperative follow-up results in our clinic. The observation group had a significantly shorter healing time, fewer dressing changes, shorter hospital stay, and lower hospitalization costs compared to the control group ($P < 0.05$,Table 3). The incidence of complications in the neck was not significantly different between the two groups ($P > 0.05$,Table 3).

Table 3 Clinical outcomes after treatment

	Group A($n = 14$)	Group B($n = 11$)	P
Fistula healing time (days)	12.93 ± 3.93	19.73 ± 5.29	0.001
Complication rate*	21.4%(3/14)	9.1%(1/11)	0.604
Incidence of cervical complications#	0(0/14)	9.1%(1/11)	0.440
Cumulative dressing change times	14.93 ± 3.93	37.91 ± 9.77	0.000
Length of hospital stay (days)	22.36 ± 4.39	29.00 ± 5.79	0.003
Hospitalization cost (ten thousand yuan)	11.02 ± 1.73	13.50 ± 2.43	0.007

*: Complications other than anastomotic leakage; *:Bleeding from small cervical blood vessels

Discussing

Common surgical procedures for esophageal cancer include Ivor-Lewis operation (abdominal and right chest incision for esophageal cancer resection), Mckeown operation (three incisions in the right chest, abdomen, and neck for esophageal cancer resection), and left chest esophageal cancer resection. With the development of minimally invasive techniques, thoracoscopic surgery is increasingly used in thoracic surgery, and the Mckeown operation has gradually become the mainstream surgical procedure for esophageal cancer, which is advantageous for lymph node dissection in the three fields and can improve patients' survival rates [7–9]. Anastomotic fistula is one of the serious complications after esophageal cancer surgery [10]. The rapid recovery of esophageal cancer patients after surgery largely depends on whether anastomotic fistula complications occur. Although surgical techniques have made great progress, anastomotic fistula is still a difficult problem that surgeons need to face and deal with [11, 12]. The tension at the anastomosis site is closely related to anastomotic leakage, and the length of the remaining esophagus and whether the tumor is located in the cervical esophagus on the oral side are two important considerations for predicting the tension of esophagogastric anastomosis. If the remaining esophagus

is short, the anastomosis may be subjected to greater tension during esophagogastric anastomosis. This tension can not only affect the healing of the anastomosis, but also increase the risk of complications such as postoperative anastomotic leakage. Therefore, we will retain sufficient length during the dissection of the esophagus and the trimming of the gastric tube to avoid excessive tension. In addition, due to its special anatomical location and physiological characteristics, the cervical esophagus is more susceptible to tension during anastomosis. Therefore, during the anastomosis process, we ensure the apposition and fixation of the anastomosis by maintaining the integrity of the mucosal layer and reinforcing the anastomosis with micro-joint suture.

Ivor-Lewis operation and left chest esophageal cancer resection can cause thoracic anastomotic fistula. Once the fistula enters the thoracic cavity or mediastinum, it is difficult to treat, seriously affecting the postoperative recovery of patients [13]. However, the anastomotic site of the Mckeown operation is located in the neck, and once a fistula occurs, it is relatively easy to treat because the fistula is relatively shallow and visible, and the pus from the fistula can be drained through dressing changes, which is relatively simple, making it more convenient to handle than thoracic anastomotic fistula.

Currently, most minimally invasive treatments for esophageal cancer involve thoracoabdominal laparoscopic esophageal and gastric mobilization and anastomosis in the left neck, so neck anastomotic fistula is more common clinically. Neck drainage usually involves skin flap drainage or drainage tube connected to negative pressure ball. When anastomotic fistula occurs, there may be problems such as poor drainage, frequent dressing changes, and frequent inflation of the negative pressure ball. Once neck anastomotic fistula drainage is blocked, the patient may have symptoms such as fever, neck swelling and pain, redness and swelling at the incision site, and odor. At this time, it is necessary to open the neck incision to drain the pus, and then regularly change the dressing to maintain drainage patency. Otherwise, the accumulation of pus in the incision may lead to poor healing of the fistula, and even the pus may flow down to the mediastinum or chest, causing serious mediastinal or chest infections that endanger the patient's life. When changing the dressing for neck anastomotic fistula, gauze is used to drain the pus. Since the fistula continues to produce pus, the gauze can become damp and lose its drainage effect in a short period of time. Therefore, clinical doctors need to frequently change the dressing to keep the fistula relatively dry and clean.

Although changing the dressing is effective, it requires a lot of effort, and if the dressing is not changed in time, it can still lead to pus accumulation. Therefore, we have improved the neck drainage method to continuously drain the pus from the neck incision. The device can maintain low negative pressure suction to continuously draw out the pus near the fistula as much as possible to keep the fistula relatively dry and clean, and promote fistula healing.

There are also some details to pay attention to when using this drainage device: (1) The end of the drainage catheter cannot be placed in or close to the fistula, as continuous suction may cause the fistula wall tissue to adhere to the end of the catheter or side holes, causing damage. Therefore, an appropriate distance should be maintained between the catheter and the fistula to remove pus without damaging the wall tissue; (2) The drainage tube inside the incision can be loosely wrapped with a large Vaseline gauze to prevent soft tissue inside the incision from being adsorbed to the side holes and causing poor drainage. The Vaseline gauze needs to be changed daily; (3) The reading of the low negative pressure suction gauge should be adjusted so that the pus in the drainage tube can be slowly suctioned out. Too high pressure may cause the surrounding tissue to be adsorbed, while too low pressure may not allow the pus to be suctioned out.

The improved neck drainage method avoids the cumbersome dressing change process during the treatment. The dressing is changed once a day to evaluate the healing of the fistula. For nursing staff, the work is relatively simple. When conducting regular rounds every day, they can observe the drainage situation of the tube. After the improved drainage treatment, the fistula healing time was relatively fast in the cases presented in this article. All patients underwent double tests of upper gastrointestinal contrast and eating, which showed good healing of the fistula. It is worth noting that one patient with a larger fistula also underwent gastroscopy. The wall of the tube at the fistula site was still missing under the endoscope, but no liquid had been drawn out through the previously inserted drainage tube, indicating that the surrounding tissue of the anastomotic site had locally wrapped and adhered to the fistula, forming an "exogenous tube wall."

Conclusions

Modified neck drainage can achieve smooth drainage and promote healing after the occurrence of cervical anastomotic fistula in postoperative esophageal cancer patients. Compared with open dressing therapy, it can promote patient recovery. At the same time, a limitation of this study is the relatively small number of cases. Expanding the sample size or conducting multicenter research could further enhance the credibility and persuasiveness of this method.

Abbreviations

CT Computerized Tomography
BMI Body Mass Index

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None.

Author contributions
QZH carried out the study design, analyzed the data and wrote the manuscript. ZZ participated in the study design, data collecting and data analysis. WS participated in the study design, data collecting and helped to draft the manuscript. All authors read and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of Jiangyin People's Hospital. Written informed consents were obtained from all patients.

Consent for publication
Written informed consents were obtained from the patients for publication. A copy of the written consent is available for review by the Editor of this journal.

Competing interests
The authors declare no competing interests.

Author details
[1]Department of Thoracic Surgery, Jiangyin People's Hospital, 3 Yingrui Road, Jiangyin, Jiangsu Province 214400, China

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