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Analysis of the Application Effect of Tracheal Stent Placement in the Nutritional Support Treatment of Tracheoesophageal Fistula

Xiaoqing An[1], Xiaoting An[2], Yiqing Qu[1]*

[1]Qilu Hospital of Shandong University, Jinan 250012, Shandong Province, China
[2]Shandong Public Health Clinical Center, Jinan 250012, Shandong Province, China

***Corresponding author:** Yiqing Qu, quyiqing@sdu.edu.cn

Abstracts: *Objective:* To evaluate and analyze the application effect of tracheal stent placement in nutritional support therapy for tracheoesophageal fistula. *Methods:* Clinical data of 32 patients who underwent nutritional support therapy for tracheoesophageal fistula in our hospital from September 2021 to September 2022 were collected, and all patients underwent tracheal silicone stenting, comparing dyspnea classification and Karnofsky score before and after stenting, and conducting post-treatment follow-up. *Results:* In 32 patients with tracheoesophageal fistula, dyspnea grading improved from grades III and IV to grades 0 to II. Before treatment, 10 patients (31.06%) were in grade IV, 17 patients (53.12%) were in grade III, and five patients (15.62) were in grade II; after treatment, 13 patients (40.63%) were in grade I, 12 patients (37.50%) were in grade I, and seven patients (21.87%) were in grade 0 ($P < 0.05$); Karnofsky score (37.52 ± 4.86 before treatment) improved significantly to 71.39 ± 8.24 one week after treatment ($P < 0.05$). Nine patients with tracheoesophageal fistula were placed with silicone Y14-10-10 stent, 11 with silicone 18-14-14 stent, three with silicone Y15-12-12, and seven with silicone stent 16-13-13. *Conclusion:* Silicone tracheobronchial stent placement for the treatment of tracheoesophageal fistula is technically feasible, simple, and safe, with reliable near-term efficacy, and is worthy of popularization and application.

Keywords: Tracheal stent placement; Tracheoesophageal fistula; Nutritional support

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1. Introduction

Tracheoesophageal fistula is a fistula between the trachea and esophagus, which are originally like two parallel tracks, and secretions and food from the digestive tract will enter the lungs through the fistula. Tracheoesophageal fistula can lead to mild choking after eating and food and digestive fluids entering the lungs, causing lung infections, and in severe cases, can lead to life-threatening respiratory failure [1]. The etiology of tracheoesophageal fistula is complex, and trauma, tumor, foreign body, and infection are its common causes [2,3]. Clinical features are characterized by paroxysmal choking after swallowing or eating, and some patients may present with

recurrent pneumonia. Tracheoesophageal fistula will affect the patient's feeding, which will inevitably lead to malnutrition, so nutritional support is necessary. Commonly used tracheal stents include silicone stents, metal-coated stents, and bare metal stents. Silicone tubular stents can be placed for a long time and need to be replaced if the stent dislocates, and recurrent infections and bleeding occur [4]. Metal-coated stents are prone to mucosal damage, increased secretion products, and granulation tissue proliferation. In comparison, silicone stents have the advantages of better safety, fewer complications, easy removal, long-term implantation, and less likely to cause granulation tissue proliferation than metal stents, and the surgical procedure relies on rigid bronchoscopy, which puts higher demands on the skill level of the surgeon. The clinical data of 32 patients who underwent nutritional support therapy for tracheoesophageal fistula from September 2021 to September 2022 were collected, and tracheal silicone stent placement was adopted, with precise efficacy. Based on this, this study evaluates and analyzes the application effect of tracheal stent placement in nutritional support therapy for tracheoesophageal fistula, which is reported as follows.

2. General information and methods

2.1. General information

The clinical data of 32 patients who underwent nutritional support therapy for tracheoesophageal fistula in our hospital from September 2021 to September 2022 were collected, of which 20 cases were male and 12 cases were female; the minimum age was 44 years old, the maximum age was 78 years old, and the average age was 58.92 ± 4.63 years old; and there were 23 cases of esophageal cancer and nine cases of lung cancer, and there were 19 cases with a history of smoking. The patients and their families signed the informed consent, and the study was approved by the Ethics Committee.

2.2. Methods

All patients underwent tracheal silicone stenting, which was done in the operating room with the help of rigid tracheoscopy under general anesthesia and muscle relaxation. During the operation, the location of the fistula was clarified, the length of the fistula was measured accurately, the rigid bronchoscope was inserted, the silicone stent was placed in the left and right main bronchi of the trachea through the stent pusher, and the position of the stent was adjusted by biopsy forceps to seal the fistula. After the operation, the patients were closely observed for the presence or absence of dyspnea and choking, anti-infective treatment of pulmonary inflammation was applied, and nebulized inhalation was used to promote sputum discharge.

2.3. Observation indexes

The dyspnea classification and Karnofsky score of the subjects before and after stenting were compared and follow-up after treatment was carried out. The grade of dyspnea was divided into 0 to IV, grade 0 means that the subjects would not suffer from dyspnea except for strenuous exercise, and grade IV means that the subjects had dyspnea to the extent that they could not go outdoors or felt dyspnea when putting on or taking off the clothes, and the higher the grade, the more serious the dyspnea. Karnofsky score is a score for the functional status, with a total score of 100, and the higher the score, the more normal the functional status.

2.4. Statistical processing

SPSS26.0 software was applied for processing. The Karnofsky score before and after treatment was tested by *t*-test, which was expressed by mean ± standard deviation (SD); and the dyspnea grading was tested by χ^2 test, which was expressed by [n (%)], and $P < 0.05$ indicated that the difference was statistically significant.

3. Results

3.1. Model of silicone tracheal stent applied in subjects

Among them, nine patients with tracheoesophageal fistula were placed with silicone Y14-10-10 stent, 11 cases were applied with silicone 18-14-14 stent, three cases were applied with silicone Y15-12-12, and seven cases were applied with silicone stent 16-13-13.

3.2. Comparison of dyspnea grading before and after treatment

In 32 patients with tracheoesophageal fistula, the dyspnea grading improved from grade III and IV to grade 0 to II, including 10 cases of grade IV (31.06%), 17 cases of grade III (53.12%), and five cases of grade II (15.62) before the treatment, and significantly improved after the treatment, with 13 cases of grade II (40.63%), 12 cases of grade I (37.50%), and seven cases of grade 0 (21.87%), and the difference had a statistical significance ($P < 0.05$). The results are shown in **Table 1**.

Table 1. Dyspnea grading before and after treatment, $n = 32$, [n (%)]

Time	Level IV	Level III	Level II	Level I	Level 0
Pre-treatment	10 (31.06)	17 (53.12)	5 (15.62)	0 (0.0)	0 (0.0)
Post-treatment	0 (0.0)	0 (0.0)	13 (40.63)	12 (37.50)	7 (21.87)
χ^2			12.395		
P			0.000		

3.3. Comparison of Karnofsky score before and after treatment

Karnofsky score improved significantly from the pre-treatment Karnofsky score of 37.52 ± 4.86 to the postoperative Karnofsky score of 71.39 ± 8.24 after one week of treatment, the difference was significant ($P < 0.05$). The results are presented in **Table 2**.

Table 2. Comparison of Karnofsky scores before and after treatment (mean ± SD, points)

Time	*n*	Karnofsky score
Pre-treatment	32	37.52 ± 4.86
Post-treatment	32	71.39 ± 8.24
t	-	8.794
P	-	0.005

4. Discussion and conclusion

Tracheoesophageal fistulas are both primary and secondary, and are most commonly secondary to advanced esophageal cancer, foreign bodies in the esophagus, tracheotomy injury to the posterior wall of the trachea, thoracic trauma, instrumental injuries, and corrosive injuries to the esophagus [5,6]. Associated cancers include esophageal cancer, lung cancer, tracheal cancer, thyroid cancer, and other tumors including lymph node metastases. If not treated aggressively, patients tend to die within days to months, with more than 90% of patients dying from lung infections and the next most common cause of death being hemoptysis. Most secondary tracheoesophageal fistulas are not amenable to surgical eradication and cannot be cured with medications, making them a challenge for physicians. The surgical principle of conventional tracheal stenting is to isolate the digestive tract from the respiratory tract and control lung infection [7]. If traditional metal-coated

stents are used to seal the fistula, the incidence of granulation tissue formation secondary to airway stenosis caused by the stent is also high; postoperative sputum retention and lung infection in patients will also seriously affect the quality of life.

Silicone is similar to plastic and has the advantages of tough texture, good elasticity, strong support, hard to deform, etc. Using it to block leakage, it helps to fit tightly with the tracheal tissues without gaps, and it is not prone to slip or coughing out, but the silicone stent aims to block the fistula but not the other normal bronchial openings, which also puts forward a very high demand on the operating surgeon [8,9], which requires the surgeon to carry out the on-site silicone stent. The silicone stent is soft, histocompatible, and not easy to deform, so the effect of silicone stent is relatively good in this case of multiple huge fistulas. Tracheoesophageal fistula is a rare case in clinics, but the death rate of patients is very high and the surgery failure rate is also high because of the great risk of surgery. Most of the patients can only be treated conservatively, and they need to rely on the gastrointestinal tube to supplement their nutrition for the rest of their lives cannot eat on their own, at the same time, they are always facing the risk of death, such as lung infections. Silicone stents play a great role in the interventional treatment of benign and malignant airway stenosis, but silicone stent placement requires rigid bronchoscopic operation under general anesthesia, which is technically difficult. Transbronchoscopic intervention has become one of the most important means of solving difficult and critical diseases of the respiratory system [10]. Tracheal and main bronchial stenosis are life-threatening emergencies, and conventional treatment cannot directly resolve the symptoms of airway obstruction, transbronchoscopic placement of a tracheal silicone stent is a rapid and effective treatment method. In this study, while ensuring the patient's daily nutrition to reduce the chance of lung infection, and then giving symptomatic drugs to treat the lung infection, we improve the tracheal reconstruction CT examination, clear the anatomical structure of the patient's bronchial lumen, and then carry out on-site processing, cutting, and sewing silicone stent to fit the lumen of the bronchial tubes. As the stent placement requires a rigid bronchoscopy technique, general anesthesia and ventilator connection are required during the operation, and local anesthesia and sedative drugs are also needed. For patients with underlying respiratory diseases, anesthesia is difficult and risky. By improving the preoperative assessment, we discussed and formulated several sets of surgical plans, intraoperative anesthesia plans, and perioperative management strategies, and did everything possible to ensure the safety of the patients.

Of the 32 study subjects in this study, nine patients with tracheoesophageal fistula were placed in silicone Y14-10-10 stent, 11 cases were placed in silicone 18-14-14 stent, three cases were placed in silicone Y15-12-12, and seven cases were placed in silicone stent 16-13-13. The results of the study showed that the dyspnea grade of 32 patients with tracheoesophageal fistula improved from grade III and IV to grade 0 to II, of which there were 10 cases (31.06%) of grade IV, 17 cases (53.12%) of grade III, and five cases (15.62) of grade II before treatment, and significantly improved after treatment to 13 cases (40.63%) of grade II, 12 cases (37.50%) of grade I, and seven cases (21.87%) of grade 0, with statistically significant differences. The results showed that performing tracheal silicone stenting was able to improve the respiratory distress of the patients. The main reason is that the food and liquid in the esophagus enter into the trachea, stimulate the mucosa around the trachea, and line into granulation tissue, leading to airway narrowing, followed by lung infection, which together leads to respiratory difficulties; tracheal silicone stenting makes the respiration smooth, reduces the patient's pain, and improves the patient's ventilation function at the same time, it also greatly improves the patient's quality of life; the Karnofsky scoring system is often used to assess the physical condition and daily functional ability of cancer patients, and the results of this study showed that the Karnofsky score improved significantly, with the Karnofsky score of 37.52 ± 4.86 before treatment and 71.39 ± 8.24 after one week of treatment, and the difference was significant. The study showed that performing tracheal silicone stent placement significantly

improved the level of daily living in tracheoesophageal fistula. Therefore, bronchoscopic tracheal silicone stenting for tracheoesophageal fistula is technically feasible, safe, and reliable in terms of recent efficacy, and is worth popularizing and applying.

Disclosure statement

The authors declare no conflict of interest.

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