

Individualized treatment of deep neck space infections A retrospective analysis of 51 patients

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Abstract

Objectives Aim of this study was to investigate clinical characteristics and individualized treatment experience of different types of deep neck space infections(DNSI) . **Design** Retrospective study. **Setting** Tertiary Referral Otolaryngology Centre. **Participants** 51 subjects with deep neck space infections. **Main outcome measures** In 51 subjects with DNSI, 15 cases were not treated with abscess incision and drainage; 36 cases were treated by incision, drainage and dressing change: 23 cases were treated with traditional incision and drainage and dressing change; 13 cases were given the combined treatment of incision and drainage, pyogenic cavity aerobic therapy and negative pressure drainage. The average number of days of dressing change and average hospital stay were compared between the two groups **Results** The average hospitalization days in the traditional dressing group were (26.74±3.393) days, and the average days of postoperative dressing change were (25.91±3.427) days. The average hospitalization days in pyogenic cavity aerobic therapy + negative pressure drainage were (11.08±2.108) days, and the average days of postoperative dressing change were (3.692±0.208) days. All 51 patients were cured. **Conclusion** Individualized treatment can minimize the trauma of patients according to each patient's own situation. The pyogenic cavity aerobic therapy has proved to be a good method for dressing change after deep neck space infections, and the satisfactory curative effect.

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Conclusion

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Keypoints

- Deep neck space infections (DNSI) is a rapidly developing disease that can lead to serious consequences if not treated effectively in time
- Different sites and severity of DNSI should be treated differently
- There is no unified standard for the treatment of DNSI
- Keeping the airway unblocked at all times is considered the key to successful treatment
- Pyogenic cavity aerobic therapy is a good treatment method for patients who need to be cut open to discharge pus

Keywords: Deep neck infections; Neck abscess; Therapy; Drainage

1 | Introduction

Many potential fascial spaces with loose tissue structure are continuous with each other in maxillofacial and neck, which lead to infection easy to spread(1). Deep neck space infections (DNSI) refer to the infections of deep neck space and fascia plane, which can induce cellulitis and even the formation of abscess. It is a common emergency in department of otorhinolaryngology and head and neck surgery. If not given effective treatment in time, it is easy to cause multi-space fusion infection because of its rapid development. It can induce severe complications such as dyspnea, carotid sheath infection, laryngeal edema, mediastinitis, mediastinal abscess and intracranial infection(2,3). How to distinguish the severity of abscess, the indications and timing of surgery, how to ensure airway patency, nutritional support and post-treatment after sepsis incision and drainage have become the main factors to successfully treat DNSI.

2 | Data and methods

2.1 Clinical data

A retrospective study reviewed hospital records of 51 subjects with DNSI who were admitted to the Department of Otolaryngology- Head and neck surgery of the First Affiliated Hospital of Anhui Medical University from November 2017 to October 2019 (Table1), including 26 males and 25 females with an average age of 54.82 years old (range: 24-89 years old). The average length of stay was 17.55 days (range: 3-87 days). There were 25 cases (49.0%) with type 2 diabetes mellitus, 5 cases with hypertension, 2 cases with hematological diseases and 1 case with panniculitis. 34 cases underwent tracheotomy. Exclusion criteria: peritonsillar abscess, patients with pharyngeal leakage or esophageal fistula, and patients with infection secondary to malignant tumor. This study was approved by the local ethics committee.

2.2 Treatment

All patients underwent laboratory tests, electrocardiogram and neck CT. According to the clinical manifestations, signs, neck CT examination and general physical conditions of patients, individualized treatment plan was made. All patients were initially treated with amoxicillin/clavulanic acid and metronidazole, and then adjusted according to culture and sensitivity reports. If the abscess has been formed in a large area,

the abscess should be cut and drained as soon as possible according to the scope of the abscess. Vascular forceps were used for blunt separation and wide opening of the abscess cavity. Fingers were used to explore and open the dangerous abscess cavity, so as to facilitate the full drainage of the pus. The abscess cavity were repeatedly washed with hydrogen peroxide, diluted complex iodine and normal saline. The dressing was changed daily to wash the pus cavity, and the drainage gauze was placed in the traditional treatment group. The dressing was changed twice a day if too more pus in the cavity and then reduced according to the situation until the incision healed. In the pyogenic cavity aerobic therapy + negative pressure drainage group, the patients were treated with oxygen therapy in the pus cavity (oxygen flow tube was placed in the pus cavity) after the operation. The oxygen flow rate was 1-4 L/min, 18-24 h/day. When there was no obvious purulent secretion, the incision was sutured and negative pressure drainage was placed. The color of the drainage fluid was observed every day. When the color of the drainage fluid is clear and less than 10 mL, the negative pressure drainage was removed. Tracheotomy was performed according to the patient's respiratory condition and the scope of abscess. If the abscess has not yet formed or formed in a small range, it should be paid close attention to the condition, actively anti-inflammatory, strengthen nutritional treatment, and adjust the treatment plan according to the change of the condition.

3 | Results

15 cases were not treated with abscess incision and drainage; 36 cases were treated by incision, drainage and dressing change: 23 cases were treated with traditional incision and drainage and dressing change; 13 cases were given the combined treatment of incision and drainage, pyogenic cavity aerobic therapy and negative pressure drainage. The data were analyzed by Graphpad prism 6. The comparison of hospitalization days and dressing change days between the two groups was performed by *t*-test. $P < 0.05$ was considered statistically significant (Table2, Figure1 & Figure2). Finally all 51 patients were cured.

Case 1

A 43 year old female patient was admitted with "neck pain for more than 10 days and shortness of breath for 1 day". She had a history of type 2 diabetes for 15 years with poor control. The patient had panniculitis for 13 years, stiffness of both hips and knees, and bedridden for 10 years. Speciality check-up: swelling of lateral neck and submandibular area was obvious, tenderness was positive. After admission, emergency neck CT showed: deep neck multi-space pneumatosis (Figure. 3A), invasion of the upper mediastinum (Figure. 3B). The diagnosis was necrotizing myofasciitis. She underwent emergency "tracheotomy + lateral neck incision and exploration + drainage". Intraoperative result showed necrosis of left sternocleidomastoid muscle and deep cervical fascia (Figure. 3C). Dry gauze was filled in the cavity for drainage after the necrotic tissue was removed, and the balloon cannula was replaced (Figure. 3D). On the first day after operation, an oxygen tube was placed in the pus cavity with several side holes opened in the front of the oxygen tube (Figure. 3E). The oxygen flow was adjusted to 3L/min. this method was called "pyogenic cavity aerobic therapy". On the fifth day after operation, when the pus was less or disappeared, the incision was sutured intermittently. Two negative pressure drainage tubes were placed in the operation cavity, one was placed in the parapharyngeal and retropharyngeal space, and the other was placed in the upper mediastinum (Figure. 3F). The suture was removed 14 days later, and the pus cavity disappeared 24 days later (Figure. 3G). The drainage tube was removed when the drainage fluid was clear (Figure. 3H), and the patient was cured and discharged.

Case 2

A 66 year old female patient was admitted with "pharyngeal pain for 4 days and dyspnea for 1 day". She had a history of type 2 diabetes for 2 years with poor control. Speciality check-up: swelling and tenderness in submaxillary and bilateral cervical areas was obvious, tenderness was positive. Emergency neck CT showed infections in retropharyngeal space, submental space and parapharyngeal space, and no large-scale abscess was found (Figure. 4A). Tracheotomy was performed under emergency local anesthesia (Figure. 4B). After the operation, anti-inflammatory, detumescence and blood glucose control were given, and the neck CT was reexamined every day. The general condition of the patient was improved day by day. Half a month later, the neck CT showed that the infection focus had disappeared (Figure. 4C), and the neck swelling was obviously

improved. The tracheotomy cannula was removed (Figure. 4D), and the patient was cured and discharged.

4 | Discussion

Deep neck spaces are multiple spaces including the parapharyngeal space, the posterior pharyngeal space, the sublingual space and the lower jaw space(4). DNSI is often secondary to infection of tonsil, teeth, upper respiratory tract or deep neck surgery(5). If the infection can not be controlled in time, it can spread to each other through the deep neck spaces, even up to the skull base and down to the mediastinum. It can also cause other parts of the abscess, and even systemic symptoms. DNSI also lead to upper respiratory tract obstruction, and eventually cause serious consequences and even death.

Our study showed that the most frequently involved deep neck spaces were parapharyngeal space (27 cases) and submandibular space (11 cases), which were consistent with the results of Huang *et al* (6). Some studies also supported that parapharyngeal space and submandibular space were the most frequently involved deep neck spaces(5,7,8).

In case 1, the patient was diagnosed as necrotizing myofascitis of the neck. In general, there was not much pus during the operation. Once the drainage cavity was exposed, the pus would increase sharply, even up to 150 ml of drainage per day. In view of this situation, we used the pyogenic cavity aerobic therapy, which was to pass the oxygen tube to the operation cavity, and the oxygen flow is initially adjusted to 3L/min. After the first use, the pus exudation was reduced to about 10-15 ml the next day, and then according to the amount of exudation in the operation cavity, the oxygen flow was gradually reduced until the removal. During this period, we observed that if the oxygen flow rate was adjusted to more than 4L/min, the operation cavity would be too dry. It would induce the gauze adhere to the deep neck tissue, which was not easy to separate. This kind of situation was not conducive to the growth of granulation tissue and wound healing. Secondly, during the period of aerobic treatment, the neck bandage should be loose, so as to facilitate the outflow of oxygen, to prevent the infection from spreading to the surrounding spaces due to excessive air pressure. The oxygen flow tube should not be plugged into the dead cavity, avoiding serious consequences. When the drainage fluid is clear or reduced to less than 10 ml, the drainage should be removed during using negative pressure drainage with suture of operation cavity. If the pus cavity is connected with the gas incision stoma, it needs to be blocked by suture (Figure. 3F, shown by the yellow arrow), so as to avoid the sputum drainage into the infection cavity during negative pressure drainage. For this kind of patients, the previous treatment methods are mostly incision and drainage of pus, dressing change 1 to 2 times a day, until the pus disappeared or granulation tissue filled the operation cavity, suture the incision, or even change dressing until the incision healed. It often takes half a month to a few months. This patient underwent postoperative dressing change for only 4 days, and the volume and situation of drainage fluid were observed daily after negative pressure drainage. It greatly reduces the psychological and physical trauma of patients and the workload of clinicians.

Patients should be paid close attention to the general situation, especially blood glucose and blood pressure. Without good blood glucose control, ketoacidosis, hypertonic syndrome, lactic acidosis or hypoglycemia may occur, which is not conducive to the follow-up treatment. In this study, 25 cases were accompanied with type 2 diabetes, accounting for 49.0%. Most of them had large fluctuation of blood glucose level with poor control. After admission, we should actively contact doctors of the Department of Endocrinology for consultation, adjust the application of hypoglycemic drugs, especially for patients with oral feeding difficulties and needing nasal feeding nutrition. We chose insulin to control blood glucose as much as possible. According to the results of blood glucose monitoring, the type and dosage of insulin should be adjusted in time. Nutritional support is very important for patients with DNSI. Because the lesions are located in the neck and oropharynx, many patients have oral feeding difficulties. In this regard, we can indwelling gastric tube for nasal feeding nutrition and guide the family members of patients with nasal feeding knowledge, also can use nutrition liquid 500ml-1500ml every day. During this period, blood routine and biochemical indexes should be reexamined daily or every other day to understand the infection index, electrolyte status and nutritional status of patients. For patients with poor general conditions, especially those with poor cardiopulmonary function, they need to be transferred to the intensive care department for further treatment.

The most effective treatment for DNSI is incision and antibiotic therapy (9-11). Flushing and dressing change, intermittent suture of wound and the negative pressure drainage of pus cavity were used. For first-line clinical doctors, more doctors still use traditional flushing and dressing change treatment. It was reported that the drainage tube placed in the pus cavity was used to treat the infections of the deep neck space, and had obtained good efficacy and cosmetology effect(12,13).

This method is a good way for small single abscess. We consider that when the abscess in the deep neck spaces has formed in a large area, incision and drainage should be carried out as early as possible, especially for the multiple lacunar abscess. During the operation, all the septa should be separated as far as possible without dead space left, and the necrotic tissue should be completely removed while the important nerves and blood vessels are preserved.

If the abscess has not yet formed or the scope is small, the patients can be followed up by CT examination or color Doppler ultrasound examination according to the general situation. It was reported that combined with thorough clinical examination, the accuracy of CT imaging in differentiating drainable abscess and cellulitis can reach 89%(14-15). Mark *et al* reported that the diameter of abscess > 2.5 cm on imaging examination was an important predictor of surgical intervention [15]. This indicator has important value for clinical treatment. For patients who choose conservative treatment, if the scope of abscess is not reduced or further expanded within 48 hours, incision and drainage should be carried out as soon as possible. In any case, once the diagnosis is made, we should first closely observe the patient's breathing condition, and tracheotomy should be performed as soon as possible if dyspnea occurs. Local anesthesia is recommended with the help of an anesthesiologist because the patient may have airway distortion, tissue stiffness, and limited mouth opening. Because intubate may make the damaged airway worse, so we should not use laryngoscope tracheal intubation(16). Case 2 diagnosed as deep neck space infection only underwent tracheotomy under local anesthesia. After active anti-inflammatory treatment and close follow-up CT examination, she was found that the scope of inflammation did not further expand, and gradually reduced. Finally, after the inflammation disappeared, the tracheotomy cannula was removed. And the patient finally recovered. The treatment method avoids the pain of debridement and dressing change.

5 | CONCLUSION

Each patient with DNSI develops individualized treatment plan according to his own situation. Conservative treatment and surgical treatment are feasible treatment plans, which can complement each other. In view of the pyogenic cavity aerobic therapy proposed by us, it has been proved that it is a good treatment method for patients with DNSI and incision and drainage of pus, and the operation process is simple. Combined with negative pressure drainage, it shortens the treatment time of dressing change, reduces the physical and psychological pain of patients. The method not only reduces the workload of clinical doctors, but also reduces the risk of rupturing large blood vessel rupture and damaging important nerve structure during dressing change. The materials used in the treatment process are common clinical materials. Therefore, we believe that this method is worthy of clinical promotion. Our team has summed up the experience, but many of the mechanisms are not yet fully clear, and need to be further studied and verified.

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Diagnosis	Frequency	Percentage (n%)
Parapharyngeal space infection	27	52.9
Submandibular space infection	11	21.6
Multi-space infection	9	17.6
Necrotizing myofascitis	2	3.9
Retropharyngeal space infection	2	3.9
Total	51	100.0

Table 1 Clinical data

Group	n	The average hospitalization days (d)	The aver
Traditional dressing group	23	26.74±3.393	25.91±3.
Pyogenic cavity aerobic therapy + negative pressure drainage group	13	11.08±2.108	3.692±0.
<i>P</i>	.	0.0025	<0.0001

Table 2 Comparison of treatment effect between the two groups ($\bar{x} \pm s$)

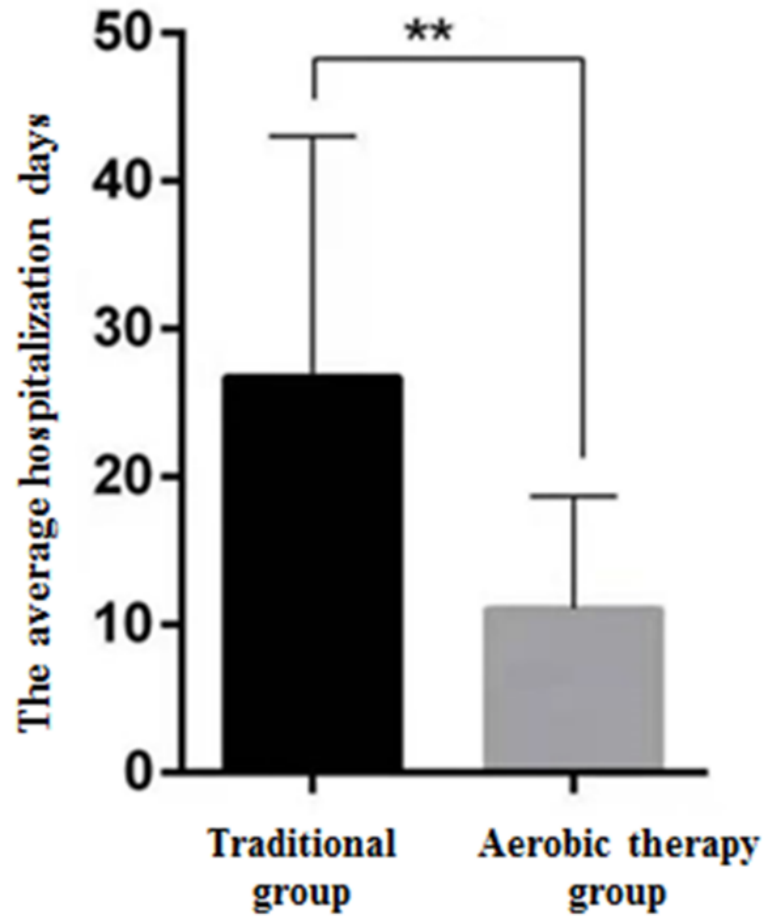


Figure 1: Comparison of hospitalization days between the two groups. The average hospitalization days in the traditional dressing group were (26.74 ± 3.393) days and the average hospitalization days in pyogenic cavity aerobic therapy + negative pressure drainage were (11.08 ± 2.108) days. (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$)

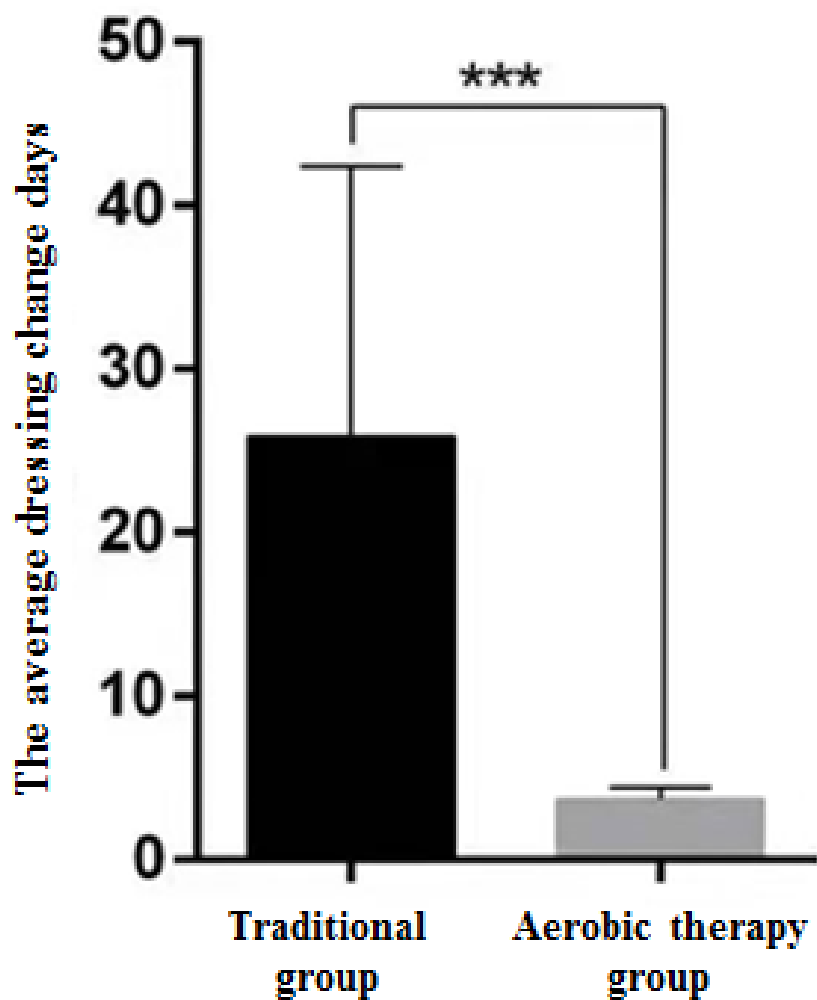
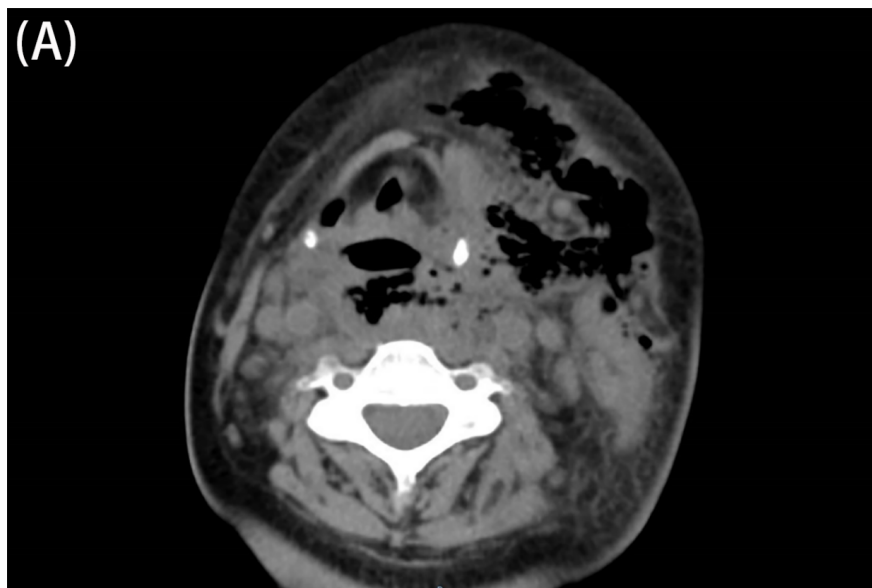
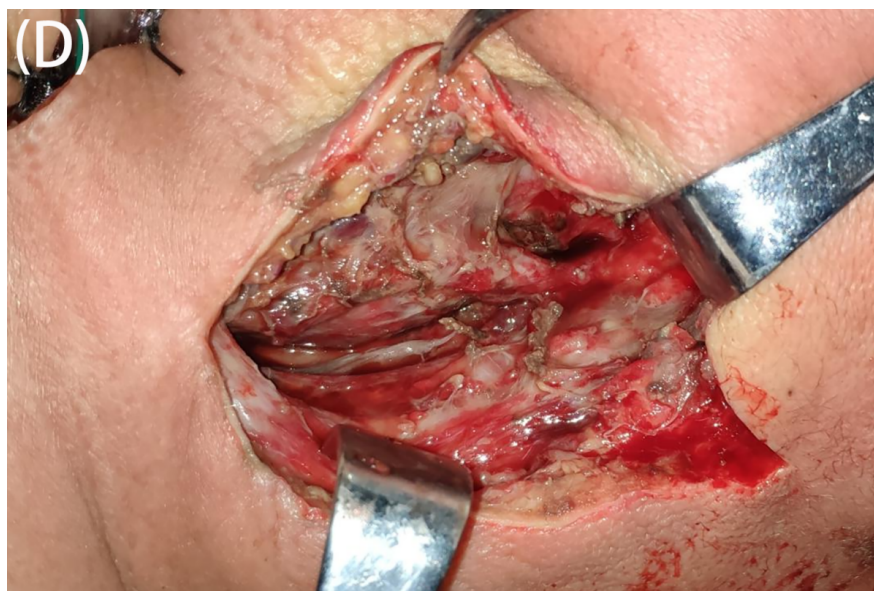
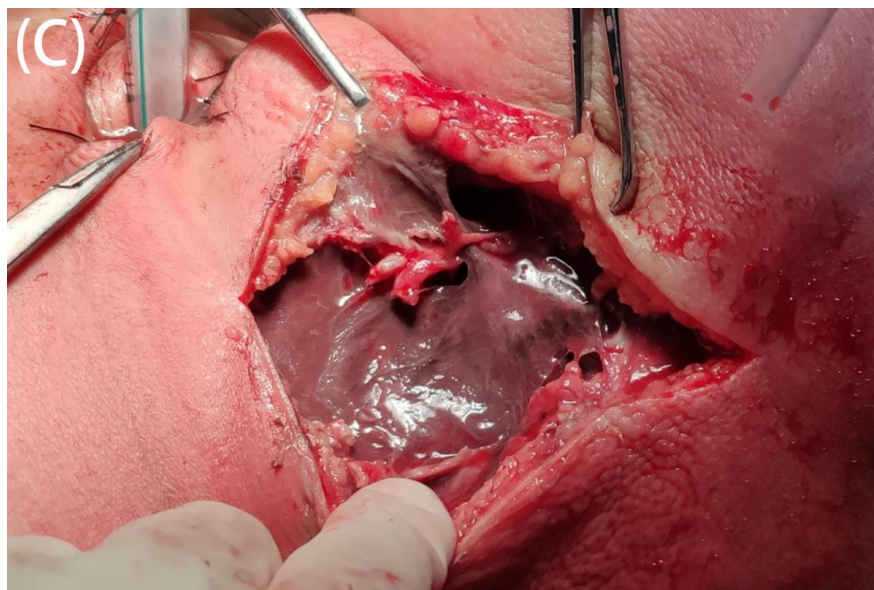
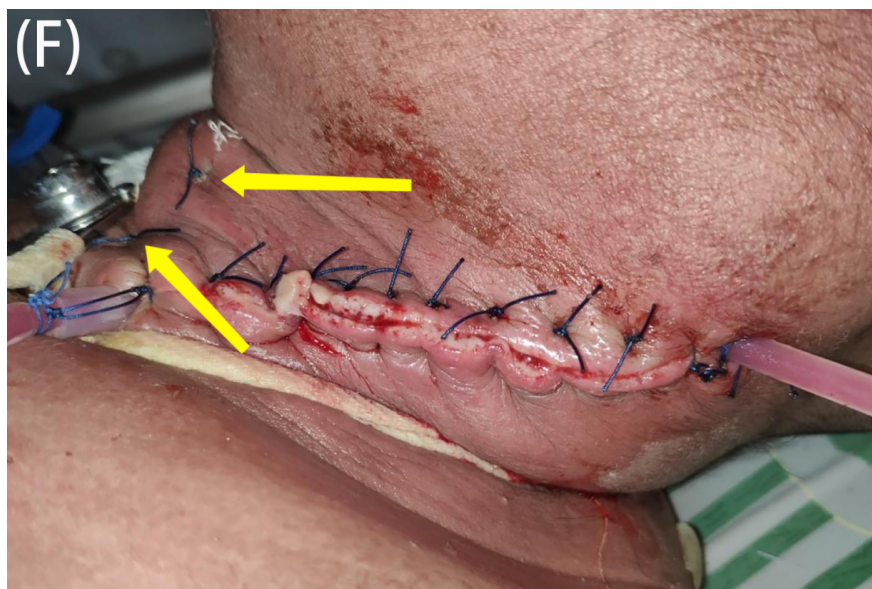
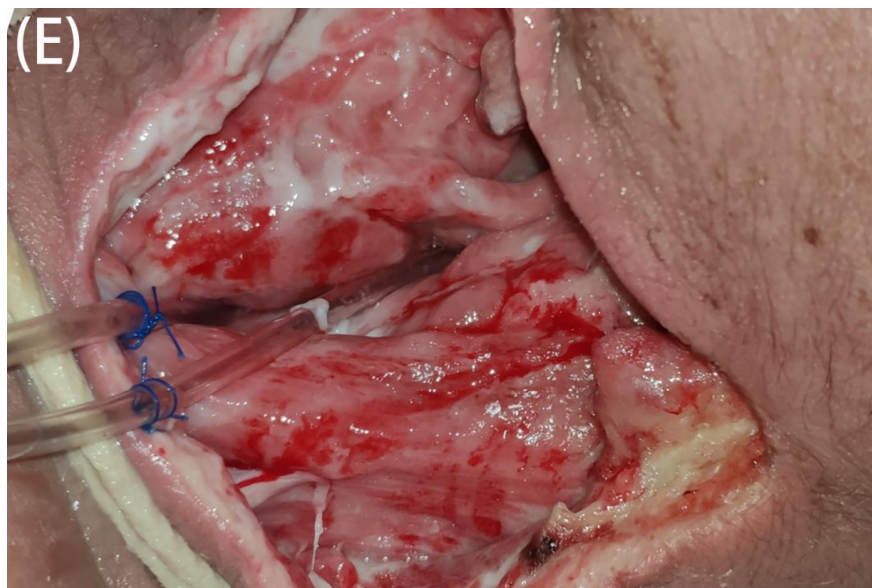


Figure 2: Comparison of dressing change days between the two groups. The average days of postoperative dressing change days in the traditional dressing group were (25.91 ± 3.427) days and the average days of postoperative dressing change days in pyogenic cavity aerobic therapy + negative pressure drainage were (3.692 ± 0.208) days. (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$)







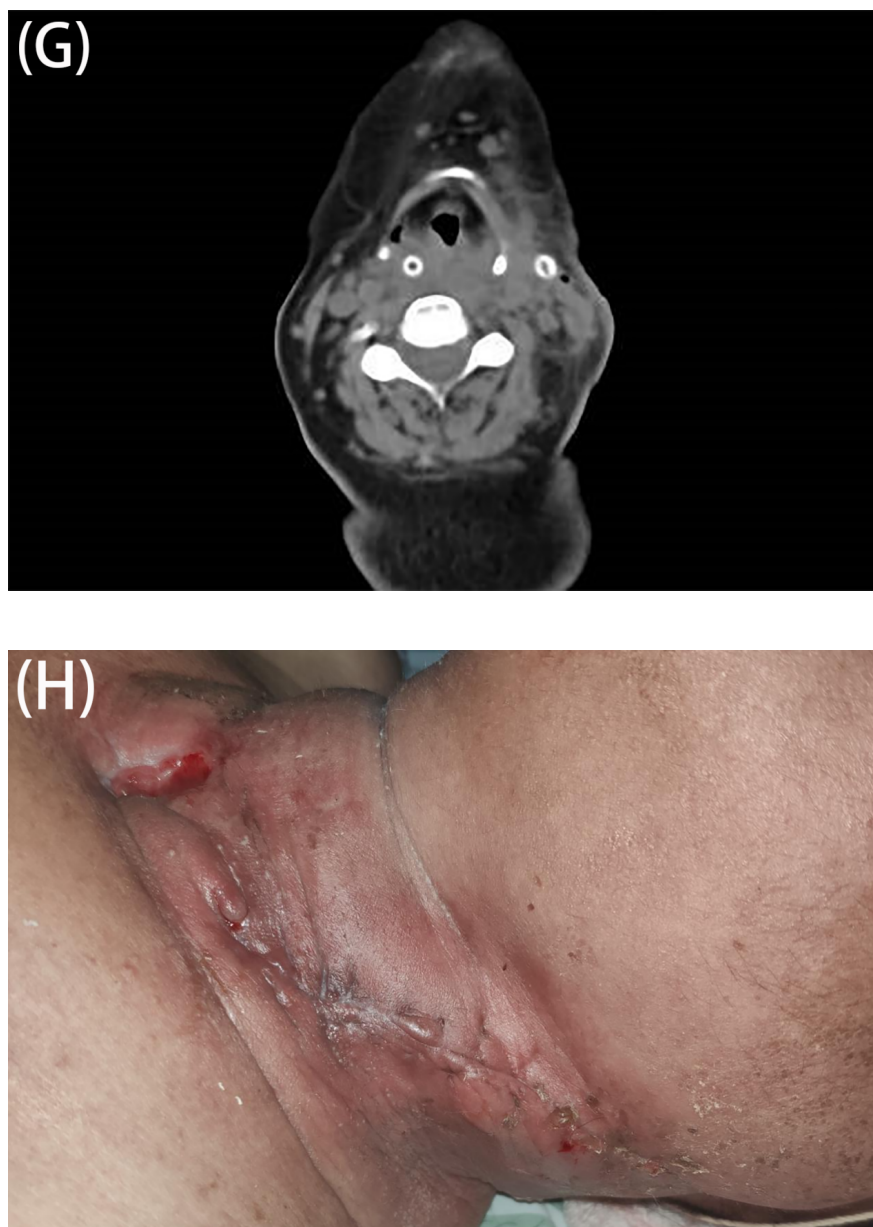
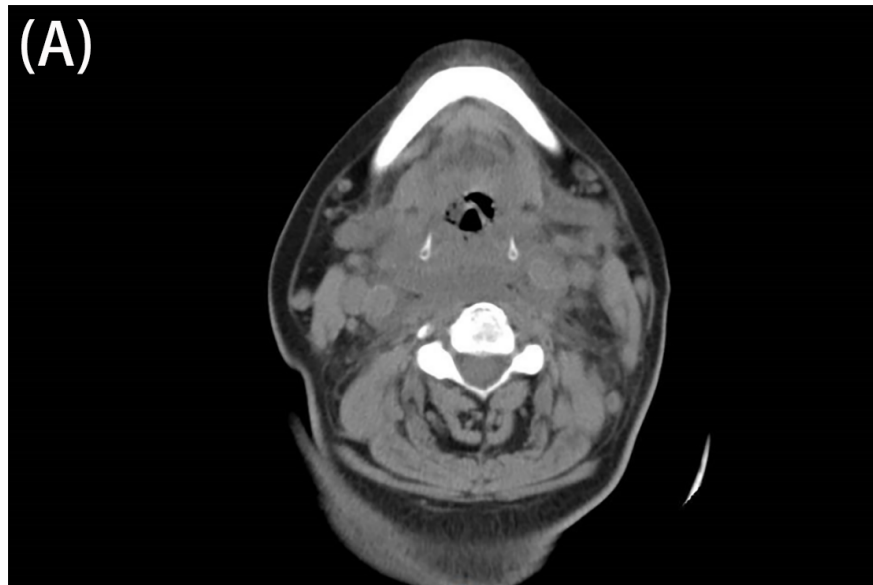


Figure 3

- A: Low density shadow and gas shadow in cervical subcutaneous space, parapharyngeal space, retropharyngeal space, prevertebral space and carotid space
- B: Swelling of soft tissue around sternal stalk and anterior mediastinum with fluid sonoluculent area and pneumatosis
- C: Necrotic fascia of sternocleidomastoid muscle
- D: The necrotic tissue was removed and the pus cavity was flushed
- E: An oxygen tube was placed in the pus cavity
- F: The pus cavity was sutured and negative pressure drainage was placed

G: The re-examination result of CT showed that the pus cavity disappeared and the swelling of soft tissue subsided

H: The drainage tube was removed and the incision healed well



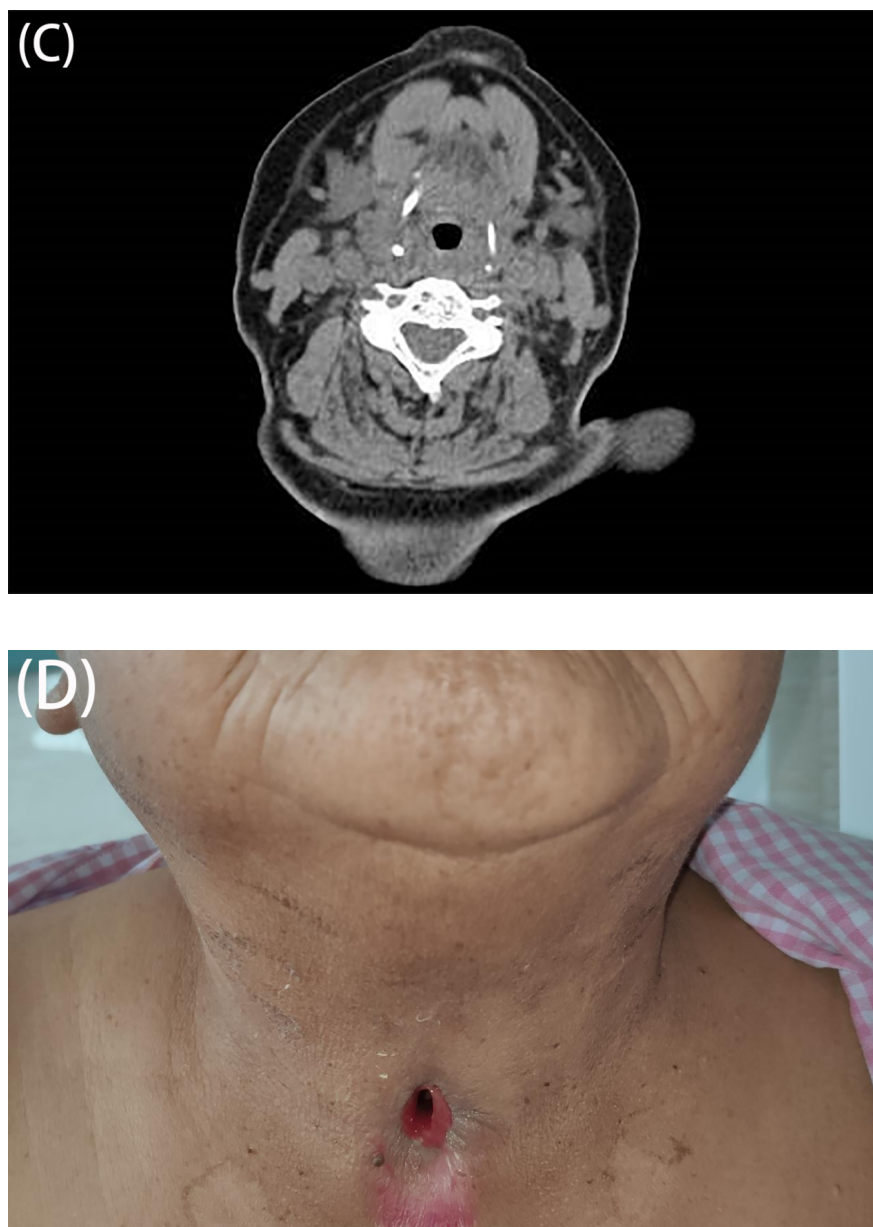


Figure 4

A: The neck CT result showed that the soft tissue swelling in submandibular space, retropharyngeal space and parapharyngeal space was obvious

B: The tracheotomy cannula was placed after tracheotomy

C: The re-examination result of CT showed that soft tissue swelling subsided

D: The neck swelling subsided after extubation of tracheotomy cannula

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