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OPERATIVE TECHNIQUES

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Simultaneous tracheal and esophageal reconstruction for thyroid cancer involving trachea and esophagus using a free bipaddled posterior tibial artery perforator flap

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Abstract

Background: Simultaneous tracheal and esophageal reconstruction after tumor resection is a great challenge. Here we present an innovative operative technique to simultaneously reconstruct tracheal and esophageal defects, in which a free posterior tibial artery perforator flap was made into a free bipaddled flap to cover both tracheal and esophageal defects.

Methods: A free bipaddled posterior tibial artery perforator flap was utilized to conduct simultaneous tracheal and esophageal reconstruction for a 72-year-old female patient with papillary thyroid carcinoma and massive trachea and esophagus invasion, who underwent radical resection.

Results: Satisfactory breathing and swallowing functions were gained independent of nasal feeding and tracheotomy. Voice was still hoarse due to tumor invasion of left recurrent laryngeal nerve. During a period of 2-year follow-up, no sign of tumor recurrence was observed.

Conclusion: A free bipaddled posterior tibial artery perforator flap could be a decent choice for simultaneous reconstruction of large tracheal and esophageal defects.

KEYWORDS
esophageal reconstruction, free bipaddled posterior tibial artery perforator flap, simultaneous reconstruction, thyroid cancer, tracheal reconstruction

1 | INTRODUCTION

Effective surgical resection of the primary tumor is central for initial management of patients with well-differentiated thyroid carcinoma.[1] Patients with tracheal and esophageal invasions often require more aggressive surgery, which results in tracheal and esophageal defects.[2] However, simultaneous tracheal and esophageal reconstruction after tumor resection is a great challenge for head and neck surgeons. Here, we present an innovative operative technique to simultaneously reconstruct tracheal and esophageal defects, in which a free posterior tibial artery perforator flap was made into a free bipaddled flap to cover both the tracheal and esophageal defects.

2 | PATIENT

A 72-year-old woman was referred to our department with a diagnosis of papillary thyroid carcinoma. The patient had

been suffering from hoarseness for 3 years, coughing while drinking water for 1 year, and dysphagia for 6 months at the time of presentation. Gastroscopy revealed a cauliflower-like neoplasm in the esophageal lumen (18-21 cm of the esophagus from the incisors) involving one-third circumference (Figure 1A). Laryngoscopy indicated unilateral vocal fold fixation (left side). Contrast-enhanced CT scan showed a tumor located on the left thyroid involving both the trachea and esophagus (Figure 1B, C). Preoperative biopsy confirmed a diagnosis of papillary thyroid carcinoma. No pulmonary metastatic disease was noted on the chest CT. No severe signs or symptoms of heart and lung diseases, diabetes, or peripheral artery disease of the lower limb were seen. A strategy including total thyroidectomy, partial tracheal and esophageal resection, and tracheal and esophageal reconstructions, followed by postoperative adjuvant radioactive iodine-131 treatment, was decided as the first-line therapy by a multidisciplinary panel of specialists. An informed consent from this patient was obtained before operation.

2.1 | Operative technique

The surgery was conducted undergeneral anesthesia. An L-shaped skin flap was elevated, and left neck lymph node dissection was performed. Tumor resection and defects reconstruction are presented schematically in Figure 2. Blood supply of the left parathyroid glands could not be retained during surgery; therefore, the left parathyroid glands were homogenized and transplanted into the right sternocleidomastoid muscle. Left recurrent laryngeal nerve could not be preserved due to tumor invasion. Trachea and esophagus window resections were followed by thyroidectomy, and resection extent was decided by the extent of trachea and esophagus invasion (Figure 3A). Tumor-free margins were confirmed by intraoperative frozen-section pathology results. Paratracheal lymph node dissection was conducted and afterward intubation was performed through trachea. After complete tumor resection, half of cartilage rings were preserved to partially support the airway with no rigid support, the tracheal defect length of the posterior and partial left lateral wall was about 5 cm, and the defect length of the esophagus was about 5 cm with 2/3 circumference resected.

A free posterior tibial artery perforator flap (10 cm × 6 cm), which contained one single perforator artery, was harvested. It was then divided into two flaps to form a free bipaddled flap, including a smaller flap (4 cm × 6 cm) and a larger one (6 cm × 6 cm) (Figure 3B), which were used for the reconstruction of tracheal and esophagus defects, respectively. De-epithelialization was performed at the bridge between tracheal and esophageal skin paddles. Once the recipient vessels (superior thyroid artery, common facial vein, and external jugular vein) were prepared, the free bipaddled posterior tibial artery perforator flap was transferred to the defect site. As shown in Figure 4, the smaller flap was initially sutured to the residual trachea and the larger flap was sutured to the residual esophagus, followed by microvascular anastomosis (one artery and two veins). Finally, the smaller flap was sutured to the skin to form a permanent tracheostomy. Total operative duration was about 5 hours.

2.2 | Postoperative management

The free posterior tibial artery perforator flap survived well postoperatively and indicated by inspection through the opening at the site of tracheostomy. No operation-related complication was observed. Nasal feeding was started immediately on postoperative day 1 through a nasogastric tube. The patient was discharged from the hospital on postoperative day 10. The patient started thickened fluid diet on postoperative day 21 without nasogastric tube and was able to return to normal oral diet on postoperative day 24. Subsequent postoperative histopathology report demonstrated clear margins. The patient

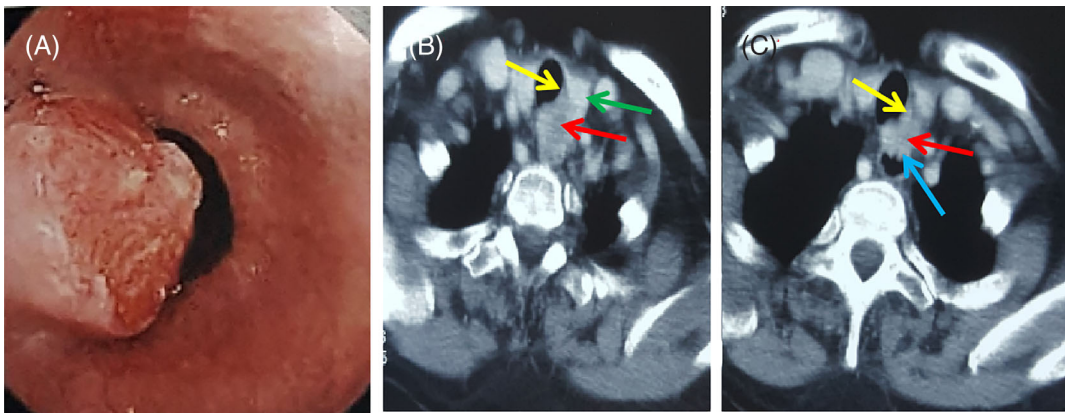

FIGURE 1 Gastroscopy and CT scan. A, Gastroscopic view of a cauliflower-like tumor situated on the inner aspect of the esophagus (18 cm to 21 cm esophagus from the incisors) involving one-third circumference of the esophagus. B and C, CT of thyroid left lobe tumor involving the cervical trachea and esophagus. Note: Red arrow indicates tumor, yellow arrow indicates tumor invades trachea, blue arrow indicates tumor invades esophagus, and green arrow indicates the left thyroid [Color figure can be viewed at wileyonlinelibrary.com]

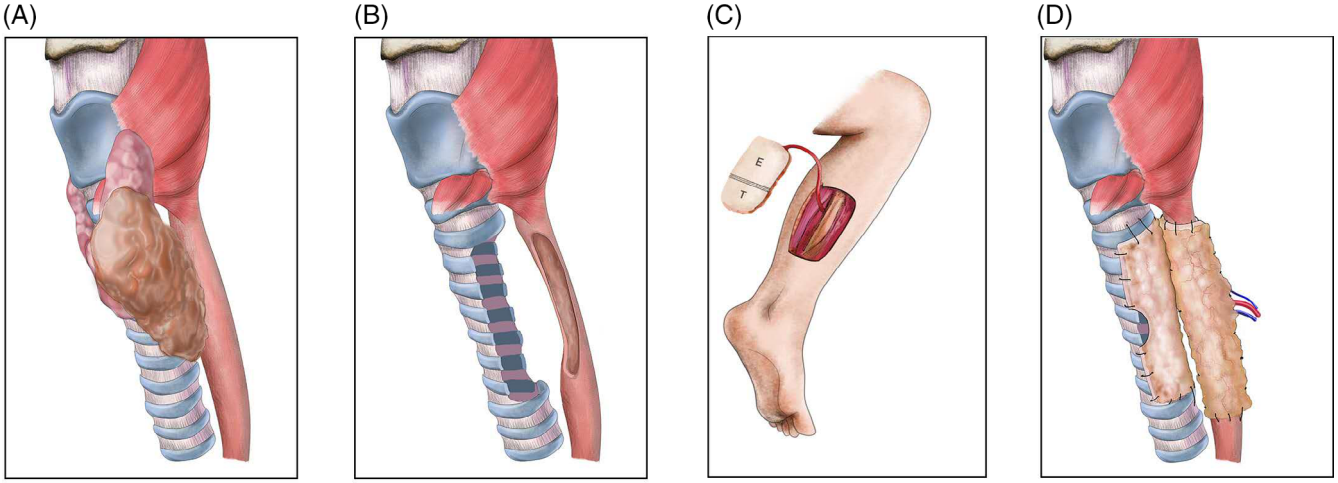

FIGURE 2 Tumor resection and simultaneous tracheal and esophageal reconstruction for thyroid cancer involving trachea and esophagus. Surgical steps: A, Thyroid cancer involving trachea and esophagus; (B) thyroid tumor resection including partial trachea and esophagus; (C) designing and harvesting of a free bipaddled posterior tibial artery perforator flap; (D) the smaller flap was initially sutured to the residual trachea and the larger smaller flap was sutured to the residual esophagus, and microvascular anastomoses were conducted [Color figure can be viewed at wileyonlinelibrary.com]

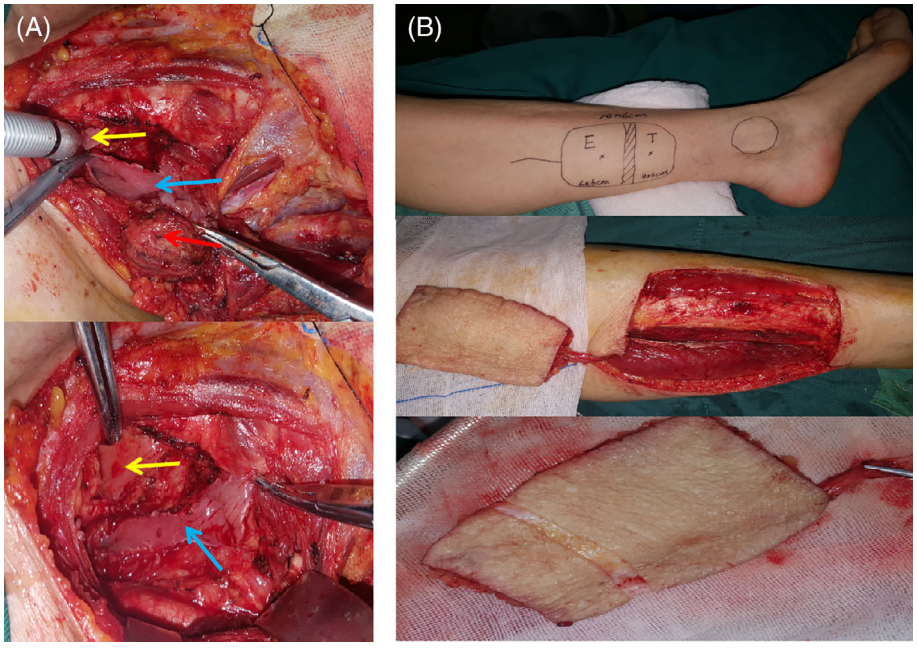

FIGURE 3 A, The radical surgical resection of tumor. B, Designing and harvesting of a free bipaddled posterior tibial artery perforator flap. Note: Red arrow indicates tumor, yellow arrow indicates trachea, blue arrow indicates esophagus [Color figure can be viewed at wileyonlinelibrary.com]

underwent postoperative adjuvant radioactive iodine-131 afterward to complete the therapy strategy.

2.3 | Long-term follow-up and functional outcome

An excellent function of the reconstructed esophagus was shown by esophagography (Figure 5A) at postoperative month 2. Postoperative recovery of the swallowing function was satisfactory, without swallowing difficulties or aspiration. Contrast-enhanced CT scan (Figure 5B) at postoperative month 6 indicated that the constructed esophagus and trachea offered a spacious passage which could ensure unobstructed eating and breathing. The tracheotomy was then surgically closed, with no evidence of breathing difficulty as measured by tracheostomy closure tests. Tumor invasion of the left recurrent laryngeal nerve resulted in left vocal cord fixation and incomplete vocal fold closure, leading to voice hoarseness not improved. During a period of 2-year follow-up, no sign of tumor recurrence was observed (Figure 6).

3 | DISCUSSION

Locally invasive well-differentiated thyroid cancer occur in approximately 13% to 15% of patients with papillary thyroid

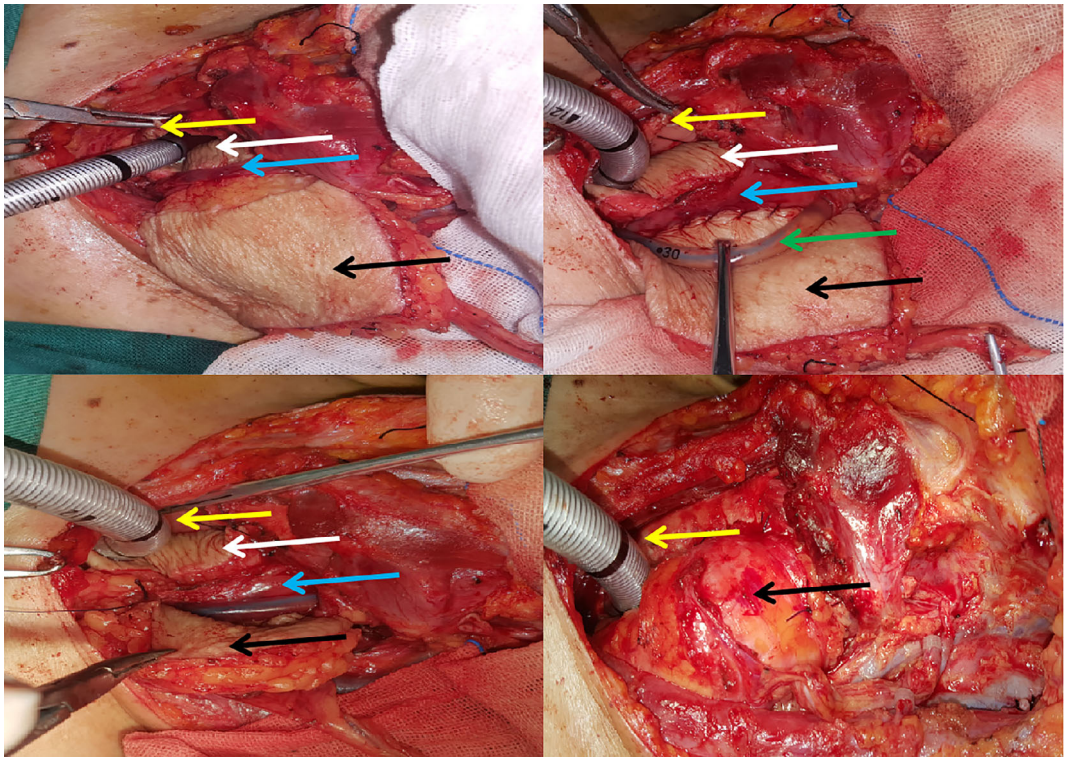

FIGURE 4 Simultaneous reconstruction of large tracheal and esophageal defects using a free bipaddled posterior tibial artery perforator flap. Note: Black arrows indicate the larger flap, white arrows indicate the smaller flap, yellow arrows indicate the residual trachea, blue arrows indicate the residual esophagus, and green arrow indicate nasogastric tube [Color figure can be viewed at wileyonlinelibrary.com]

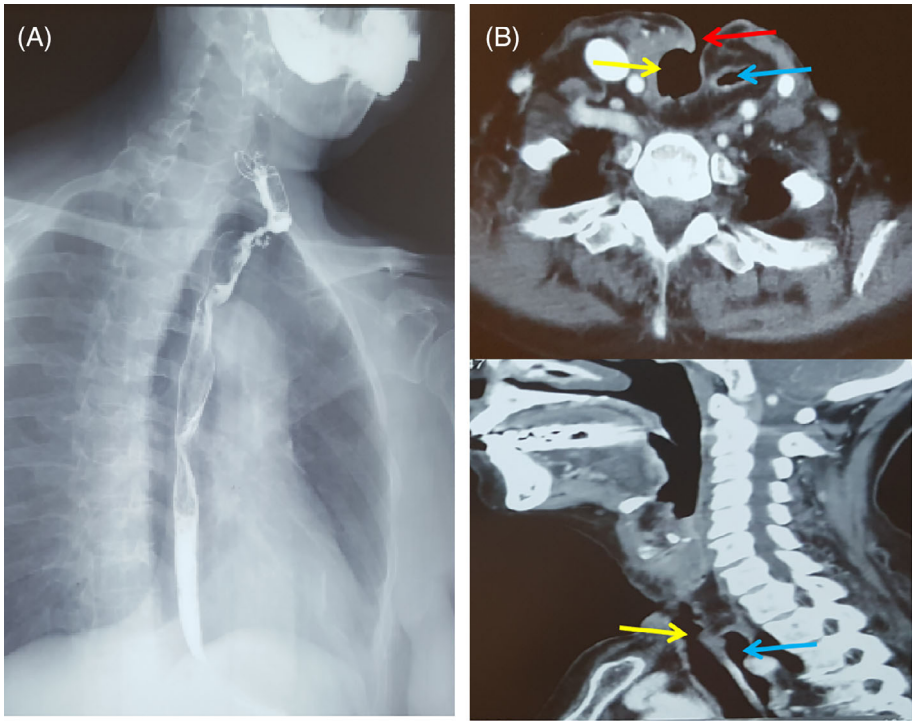

FIGURE 5 Postoperative esophagography and CT scan. A, Esophagography shows the function of reconstructed esophagus at the second month postoperatively; B, CT shows the reconstructed trachea and esophagus at the 6th month postoperatively. Note: Blue arrows indicate the reconstructed esophagus, yellow arrows indicate the reconstructed trachea, and the red arrow indicate the tracheotomy [Color figure can be viewed at wileyonlinelibrary.com]

cancer as a result of extrathyroidal spread of the primary tumor and have an important prognostic significance.[3] Extrathyroidal spread occurs more frequently in older patients and patients with larger tumors, that is, those older than 50 to 58 years of age and tumors larger than 3.7 to 4 cm.[4] Local invasions most commonly involve the strap muscles, recurrent laryngeal nerve, trachea, larynx, esophagus, and major vessels. Better survival and lower risk of recurrence are more likely to be observed only

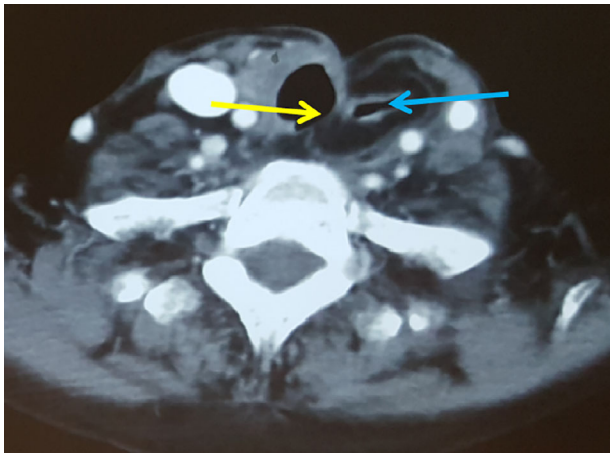

FIGURE 6 CT shows the reconstructed trachea and esophagus at the second year postoperatively. Note: Blue arrows indicate the reconstructed esophagus, yellow arrows indicate the reconstructed trachea [Color figure can be viewed at wileyonlinelibrary.com]

in patients with proper preoperative evaluation, a high index of suspicion for invasion, and surgery done by surgeons with surgical expertise for complete resection with low morbidity.[5] It is evident that radical surgical resection of the primary tumor is crucial to the initial management of patients with tracheal and esophageal invasions by well-differentiated thyroid cancer. However, the reconstruction of the tracheal and esophageal defects left by such wide-range surgeries poses a great challenge and greatly affects quality of life of patients.

Window tracheal resection and segmental tracheal resection are the main surgical methods for well-differentiated thyroid tumor that transgress the tracheal cartilage. Although complications associated with the tracheal sleeve resection include anastomotic dehiscence, laryngeal stenosis, and anastomotic site stricture, segmental tracheal resection followed by end-to-end anastomosis has been considered to have less mortality and morbidity than window segmental tracheal resection followed by flap reconstruction.[5,6] However, in our case, preoperative examination indicated extensive invasion of the thyroid tumor (Figure 1), so a radical surgical resection was mandatory. The length of the trachea defect after this radical resection was too long (about 5 cm) after radical tumor resection, and end-to-end anastomosis was no longer suitable, making a flap to be an optimal selection for tracheal reconstruction. Extensive defects of the esophagus were suggested to be reconstructed with a myofascial/myocutaneous pedicled flap or microvascular free tissue transfer of a fasciocutaneous flap or jejunum.[5] Thus, we decided to perform a flap-based reconstruction for both tracheal and reconstruction.

There have been multiple flap-based reconstruction procedures, including free bipaddled anterolateral thigh flaps and free radial forearm flaps. Free anterolateral thigh flap has been widely accepted for head and neck reconstructions[7] and used successfully for simultaneous reconstruction of large larynx and prelaryngeal skin defects.[8] However, this flap is relatively thick for the narrow space of the head and neck, and flap thinning could significantly decrease the success rate of the surgery.[9] Free radial forearm flap is one of the most popular free flaps in head and neck reconstruction with thinner and safer characteristics despite its limited soft tissue availability and donor site morbidity.[10] Free posterior tibial artery perforator flap has been successfully used for large tracheal defects reconstruction after radical head and neck surgery and demonstrated quite acceptable performance, with more unsightly scar with less noticeable surface.[11] Free bipaddled posterior tibial artery perforator flap was considered to contain advantages of both bipaddled anterolateral thigh flap (one perforator artery supplying two flaps) and free posterior tibial artery perforator flap (better tissue properties), and was chosen in this case considering the demand of simultaneous reconstruction of two large defects.

Half of cartilage rings were preserved to partially support the airway with no rigid support, as it has been reported that partial cartilage rings were enough to provide airway support when defects were not too long.[11] A second tracheal closure strategy was adopted to allow the flap to have enough time to form scar adhesions, providing a more stable and rigid flap status. Satisfactory breathing and swallowing function were obtained. The patient could perform nasal and oral breathing and enjoy normal oral diet without swallowing difficulties or aspiration. During the follow-up period, no locoregional tumor recurrence or distant metastasis was observed.

In conclusion, a free bipaddled posterior tibial artery perforator flap could be utilized for simultaneous reconstruction of large tracheal and esophageal defects. However, adequate preoperative preparation, strict inclusion criteria, a complete tumor resection, an appropriate tracheal and esophageal reconstruction strategy, and reasonable postoperative management should be considered to guarantee that the patient obtains ideal function recovery after tumor resection and reconstruction.

3.1 | Consent

Approval was obtained from the Institutional Review Board of the West China Hospital of Sichuan University, and written informed consent was obtained from the patient for presentation of the paper and accompanying images.

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