A Novel Technique to Increase the Length of Tracheal Resection by Adding an Autologous Pedicled Pectoralis Major Myocutaneous Flap Transposition

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Resection of the trachea is usually limited by the length of involvement. We present a case of long segment tracheal resection performed by adding an autologous pedicled pectoralis major myocutaneous flap transposition. By applying this technique, a segment of trachea as long as 7.5 cm was safely resected without complications.

Adenoid cystic carcinoma is a common type of tracheal cancer. Surgical resection, which offers the best treatment option, was limited by the length of involvement. Despite progress in the field of tracheal surgery, extensive tracheal resection remains challenging, and a reliable tracheal substitute has yet to be discovered [1, 2]. We report a case of extensive primary tracheal adenoid cystic carcinoma treated successfully by adding an autologous pedicled pectoralis major myocutaneous flap to increase the length of safe resection.

Technique
This study was approved by the Ethics Committee of Shanghai Pulmonary Hospital. A 46-year-old woman was referred with a history of dyspnea for 4 months. Computed tomographic scan (Fig 1) and bronchoscopy revealed a tracheal tumor 6.5 cm long, 2.0 cm below the vocal cords, and 3.2 cm above the carina. The tumor extended for 4.5 cm on the cartilaginous wall and 6.5 cm over the membranous wall. Because severe airway obstruction (approximately 80%), laser ablation had been performed to maintain airway patency to relieve her respiratory distress.

The tracheal resection was performed with general anesthesia and endotracheal intubation, through a T-shaped combination sternotomy and collar incision. Video-assisted thoracoscopic bilateral hilar release and release of the inferior pulmonary ligaments and pericardium was used; 5.5 cm (approximately 47.0% of the total length of the trachea) of the cartilaginous wall, and 7.5 cm (approximately 64.1% of the total length of the trachea) of the membranous wall was resected with negative margins on frozen sections. The tracheal membranous defect was 2 cm in length and involved 45% of the circumference after reapproximation. Next, the patient was intubated and the tracheal defect was repaired with a pedicled pectoralis major myocutaneous flap as a free flap.

Fig 1. A tracheal mass approximately 6.5 cm long (arrow) was observed at the mid-trachea on computed tomography.
through the operation field to distal trachea. A left autologous pedicled pectoralis major myocutaneous flap (20 × 30 mm, maintaining blood supply from the thoracoacromial artery) was harvested to cover the tracheal membranous defect. The flap was brought into the chest cavity through the left second intercostal space (Fig 2). The superior and inferior margins of the myocutaneous flap were stitched to the distal and proximal borders of the posterior tracheal wall defect, using 4-0 Vicryl sutures, respectively. The cartilaginous wall of the trachea was anastomosed using 4-0 Vicryl sutures in a figure-eight fashion (Fig 3). The anastomosis sutures were not tied until in-field intubation was switched to oral intubation. Finally, thymus and pericardial fat were used for reinforcement of the anastomosis. The incision was closed after a Penrose drainage was placed inside. Bilateral chest-to-chin guardian sutures were used to prevent neck extension.

Postoperative pathology showed adenoid cystic carcinoma, with clear margins on both sides. The patient’s symptom was alleviated right after surgery. Bronchoscopy performed 2 weeks postoperatively revealed a widely patent lumen, and the anastomosis was healing well. Two months after surgery, bronchoscopy showed minimal granulation at the anastomosis and an otherwise widely patent airway. Bronchoscopy at 6 months postoperatively showed good anastomotic healing (Fig 4).

Comment
Surgical resection of no more than 6 cm or 50% of the trachea is generally considered the optimal treatment for tracheal tumors [3, 4]. For tumors involving more than that portion of trachea, surgery will be challenging or impossible. In this patient, 7.5 cm of the membranous wall needed to be resected, and the involvement of the cartilaginous wall was relatively short. Using an autologous pedicled pectoralis major myocutaneous flap allowed closure of the extra 2 cm membranous wall defect. This method reduced anastomotic tension by preserving more cartilaginous wall without compromising principles of oncological surgery.

There are advantages of using vascularized autologous pedicled pectoralis major myocutaneous flap to help bridge long-segment tracheal defects [5]. Pedicled myocutaneous flaps have been used in a wide range of...
tracheal surgeries because of favorable mechanical strength and versatility. In particular, pedicled myocutaneous flaps have been shown to provide more rigidity, flexibility, air-tightness, and reliable healing.

Caliceti [6] reported that the latissimus dorsi muscle flap, forearm free flap, lateral thigh flap could be used to repair the trachea. However, these muscle flaps are less desirable because of their remote location and the need for vascular anastomosis. On the contrary, autologous pedicled pectoralis major myocutaneous flap is a simple and effective graft to support the membranous wall. The pedicled pectoralis major myocutaneous flap is close to the trachea and sufficient blood supply can be preserved. Furthermore, compared with the muscle flap, the myocutaneous flap is superior for its rigidity and the similarity between the skin and internal lining of the trachea.

Myocutaneous flap lacks the elasticity that can be compensated by preserving the cartilaginous wall. Meyer and Ris [7, 8] described principles of tracheal wall defect repair. When the defect was less than 30% of the circumference, it could be reconstructed with a muscle flap alone. When the defect was more than 30% but less than 50% of the circumference, mechanical reinforcement of the reconstruction could be obtained by embedding a rib segment into the muscle flap. If the defect is greater than 50% of the airway circumference, it is difficult to reconstruct with a muscle flap. In our case, although the defect of tracheal wall accounted for about 45% of the circumference, it was mainly located in the membranous wall, which made the reconstruction much easier.

The disadvantage of this approach is the formation of postoperative anastomotic granulation. We found anastomotic granulations 2 months after surgery, which were removed by electrical cautery.

In short, tracheal segmental excision combined with autologous pedicled pectoralis major myocutaneous flap transposition is a safe and reliable method of radical resection for extensive tracheal tumors with a curative intent. This procedure can be applied to extensive tracheal tumors when more tracheal membranous wall is involved. Compared with the traditional surgery, this method can effectively increase the length of the trachea excised.

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References