Case Report

Use of the extended pectoralis major myocutaneous flap as a wrap-around for mediastinal tracheal repair

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**Abstract**  
Persistent tracheoesophageal fistulas requiring flap repair of the trachea in the mediastinum are uncommon. A 44-year-old man developed a 5 cm x 2 cm persistent posterior tracheal defect after failed tracheo-esophageal fistula repair. The defect was patch repaired using the de-epithelialized skin paddle of an extended pectoralis major flap tunneled into the mediastinum. The use of cross-field ventilation, second rib removal and an anterior tracheostomy slit were crucial for posterior tracheal repair. No major complication occurred. The patch repair with the de-epithelialized skin paddle of pectoralis major flap mucosalized in 2 weeks and the patient was discharged one month postoperatively. The extended skin paddle of the pectoralis major flap was a useful method for tracheal wrap-around reconstruction.

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Introduction

Mediastinal tracheoesophageal fistulas are rare complications that are difficult to manage. Options for its management include primary resection and anastomosis, stents\(^1\) and flap coverage. To treat persistent defects, the common flaps used include pedicled latissimus dorsi, pectoralis major,\(^2,3\) intercostal muscle,\(^4\) rectus abdominis, omental flaps and free flaps. Posterior tracheal defects are even harder to repair due to poor access. In this report, we describe our technique of using an extended pectoralis major myocutaneous flap for posterior tracheal repair.

Materials/Patient

A 44-year-old man presented with spontaneous esophageal perforation (Boerhaave's syndrome), which resulted in a posterior trachea-esophageal fistula above the carina [Fig. 1]. He had underlying co-morbidities of diabetes mellitus and chronic hepatitis B. Stenting of the esophagus and trachea was initially performed but the fistula persisted for several months. However, he continued to have a persistent leak around the fistula resulting in osteomyelitis and discitis of the T2–T4 vertebrae; therefore, he was counselled for definitive surgical repair to prevent further progression. He underwent esophagectomy and gastric pull-up through a right lateral thoracotomy and upper midline laparotomy, and the remaining esophageal wall that was surrounding the fistula was used as a patch to repair the defect.\(^5\) He had an uneventful recovery but unfortunately re-presented a month later with bilateral aspiration pneumonia as the esophageal patch had dehisced. Bronchoscopy revealed a 5 cm x 2 cm posterior tracheal defect with persistent flow of secretions into his airway [Fig. 1]. Due to mediastinitis and pneumonia that did not resolve with conservative management, a decision was made to repair the tracheal defect with an extended pectoralis major myocutaneous flap.

![Figure 1. Bronchoscope view of the 5 x 2 cm posterior tracheal defect (arrows) located just above the carina.](image-url)
Figure 2. A pectoralis major musculocutaneous flap with an extended vertical skin paddle measuring 23 × 6 cm was raised based on the pectoral branch of the thoracoacromial artery.

Figure 3. The flap was passed into the mediastinum through a thoracic window created by removal of the second rib. The entire skin paddle was de-epithelialised and used to cover the tracheal segment circumferentially. Patch repair of the posterior tracheal defect was accomplished with 4-O PDS sutures through an anterior tracheal slit, which was then closed directly.

Methods

The mediastinal trachea was approached through a median sternotomy. The previous esophageal patch was excised completely. Surgical access to the posterior tracheal defect was accomplished through a 5-cm vertical anterior tracheal slit, and intermittent cross-field ventilation was performed through an armored endotracheal tube advanced into the left main bronchus. An extended pectoralis major musculocutaneous flap was raised as shown in Figure 2. The skin paddle was entirely de-epithelialized to ensure its adherence to the trachea. Furthermore, removing the skin reduces the risk of hair growth and keratin deposits in the lumen. The flap was passed into the mediastinum through a second rib thoracic window. Patch repair of the posterior trachea with the de-epithelized skin flap was performed with 4-O polydioxanone mattress stitches. The anterior tracheal slit was then closed with interrupted sutures and reinforced with the “wrap-around” flap [Fig. 3]. Supplementary stitches were placed to secure the pectoralis major muscle to the surrounding fascia to prevent flap retraction. The median sternotomy was closed rigidly with 3 Biomet titanium plates (Zimmer, Warsaw, Indiana, USA). This ensured that his respiratory efforts were not compromised given his underlying lung condi-
tion, coupled with the sacrifice of the right pectoralis major muscle and removal of rib for the creation of a thoracic window.

Results

No major complication occurred. The patch repair with the pectoralis major de-epithelialised skin paddle “mucosalized” in 2 weeks [Fig. 4] and the patient was discharged stable on post-op day 30.

Discussion

Use of the pectoralis major myocutaneous flap based on the thoracoacromial artery has been described for mediastinal tracheal repair.\textsuperscript{2,3} In this article, we describe the extended version of the flap, which included an extended skin paddle allowing circumferential cover of the tracheal segment. Based on Taylor’s angiosome concept,\textsuperscript{5} the thoracoacromial artery could supply skin extending beyond the lower border of the pectoralis major muscle provided the upper abdominal wall fascia is included.\textsuperscript{7} In this patient, the tip of the vertically designed skin paddle reached the costal margin. The long flap measuring $23 \times 6$ cm was sufficient to cover both the posterior defect and the anterior incision.

The mediastinal trachea receives segmental blood supply originating from the inferior thyroid and internal mammary arteries anastomosing with the bronchial arteries. This blood supply would have
been disrupted by the previous esophageal surgery, resulting in a relatively ischemic segment that was non-healing. We believe the wrap-around flap provided new blood supply to the trachea.

Creative airway management with intermittent cross-field ventilation using an armored endotracheal tube was key during the repair. With sufficient pre-oxygenation, the tube could be withdrawn to expose the surgical field for approximately 3 minutes. This could be repeated until the repair was complete. Alternatively, extracorporeal membrane oxygenation could have been used to circumvent these difficulties, but it would entail heparinizing the patient with risks of bleeding.

Postoperatively, a UniPerc adjustable flange extended-length tracheostomy tube (Smiths Medical, Dublin, Ohio, USA) was used to stent the repair site while avoiding single-lung intubation. It was inserted through a transverse inter-cartilagenous tracheal incision in the neck and secured with sutures to prevent dislodgement.

**Conflict of interest statement**

None.

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**Ethical Approval**

N/A.

**References**

1. Chaaban S, Simoff M, Ray C, Diaz-Mendoza J. Posterior Tracheal Laceration Treated with a Stent. *Ann Am Thorac Soc*. 2017;14(7):1224–1226. doi: 10.1513/AnnalsATS.201611-937CC.
2. He J, Xu X, Chen M, et al. Novel method to repair tracheal defect by pectoralis major myocutaneous flap. *Ann Thorac Surg*. 2009;88(1):288–291. doi: 10.1016/j.athoracsur.2008.11.030.
3. Xie B, He W, Xie D, Jiang G. A novel technique to increase the length of tracheal resection by adding an autologous pedicled pectoralis major myocutaneous flap transposition. *Ann Thorac Surg*. 2014;98(6):2236–2238. doi: 10.1016/j.athoracsur.2014.05.096.
4. Lin J, Rajdev P, Mulligan MS. Reconstruction of a complex tracheal injury using an intercostal muscle flap. *Ann Thorac Surg*. 2014;97(2):679–681. doi: 10.1016/j.athoracsur.2013.05.115.
5. Yang G, Li WM, Zhao JB, et al. A novel surgical method for acquired non-malignant complicated tracheoesophageal and bronchial-gastric stump fistula: the “double patch” technique. *J Thorac Dis*. 2016;8(11):3225–3231. doi: 10.21037/jtd.2016.11.80.
6. Taylor GI, Palmer JH. The vascular territories (angiosomes) of the body: experimental study and clinical applications. *Br J Plast Surg*. 1987;40(2):113–141. doi: 10.1016/0007-1226(87)90185-8.
7. Russell RC, Feller AM, Elliott LF, Kucan JO, Zook EG. The extended pectoralis major myocutaneous flap: uses and indications. *Plast Reconstr Surg*. 1991;88(5):814–823. doi: 10.1097/00006534-199111000-00012.