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TECHNICAL NOTE

An unusual salvage technique for posterior tracheal membranous laceration associated with transhiatal esophagectomy: A transcervical–transsternal approach

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Summary Various surgical approaches may be employed for esophageal resection. Major airway injuries due to transhiatal esophagectomy include vertical tears in the membranous trachea. Tracheal injury is an uncommon but potentially fatal complication. This article describes the technique to repair the posterior membranous tracheal tear, extended just over the carina through a transcervical–transsternal approach, thereby avoiding a second thoracotomy. Six patients with posterior membranous tracheal injury underwent this procedure. The laceration ranged from 3 cm to 5 cm in length. Four patients had received neoadjuvant chemoradiation. The management of tracheal laceration added approximately 60 minutes to the total operation time. There was no mortality related to tracheal injury. Patients were followed up for 6 months after surgery, and both posterior tracheal wall and transverse tracheotomy remained intact without stenosis. The transcervical–transsternal approach decreases the need of thoracotomy and its complications in patients with tracheal laceration in any stage, even in cases of an extended tear down to the carina.

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1. Introduction

Transhiatal esophagectomy (THE) is a widely used approach with low rates of morbidity and mortality. However, the proximity of the esophagus to vital organs within the chest increases the possibility of inadvertent injury during blunt dissection.^{1,2} Membranous tracheal and bronchial injuries are potentially lethal complications of blunt transhiatal mobilization of the esophagus due to the close vicinity of the esophagus to these structures.³ With due attention to the prevalence of THE among surgeons, the incidence of tracheal injuries has been reduced to less than 10%, and even to less than 2% in some reports from experienced centers.^{3,4}

Major airway injuries due to THE are usually vertical tears in the posterior membrane of the trachea. Various strategies in the management of tracheal lacerations have been reported. Although thoracotomy is the main part in many of these procedures, a variety of technical modifications have been reported to repair tracheal laceration in THE procedures without thoracotomy. We aimed to describe a transcervical–transsternal method for repair of membranous tracheal lacerations following THE.^{2–5}

2. Technique

A retrospective study was performed on all patients who underwent THE in our general tertiary hospital over a period of 11 years (2000–2012). Of the 782 patients, six sustained an iatrogenic injury in the posterior membrane of the trachea. All tears were recognized intraoperatively. The study group included four women and two men, with a mean age of 59 years (range, 52–70 years).

In five cases, the squamous cell carcinoma was located in the middle third of the esophagus, and one patient had carcinoma distal to the carina. All cases had complaints of dysphagia and retrosternal pain, lasting between 3 months and 8 months. The TNM staging was II in four patients and III in two patients. Four patients had a history of neoadjuvant chemoradiation prior to surgery (Table 1).

Bronchoscopy was performed in patients with cancer of the middle third of the esophagus; the posterior wall of the tracheas was not implicated/infiltrated by the tumor.

During cervical dissection, tears were recognized in the posterior membranous of the trachea near the thoracic inlet. The laceration ranged from 3 cm to 5 cm in length. Tracheal rupture was manifested immediately with a fall in airway resistance and ventilator air leakage through the incision site. In order to prevent progressive pressure drop, the tube cuff deflated immediately, and the tube was advanced to the level of the carina. Despite the tracheal tube advancement, O₂ saturation dropped. Therefore, we performed an anterior transverse tracheotomy between

two cartilaginous rings above the laceration site (Figure 1). The orotracheal tube was withdrawn, and a 6-mm (ID) sterile, low-pressure cuffed, flexible armored endotracheal tube was inserted distal to laceration through the tracheal incision. O₂ saturation and respiratory rate returned to normal ranges. Owing to inadequate exposure to the whole mediastinal trachea through the classic anterior sternocleidomastoid incision, we extended the incision and performed a partial sternal split to the third intercostal space with manubrial retraction. All patients underwent esophagectomy prior to repair of the tracheal rupture. The lateral tracheal blood supply and both recurrent laryngeal nerves were preserved, and the laceration was repaired from distal to proximal with absorbable interrupted sutures outside of the tracheal lumen. While completing the repair of posterior laceration, the endotracheal tube was removed intermittently, and subsequently, the transverse

Table 1 Demographic data with diagnostic features and intraoperative characteristics of the patients.

	Frequency (%)	Mean ± SD	Range
Age (y)		59 ± 7.8	50–70
Sex			
Male	2 (33)		
Female	4 (66)		
Pathology			
SCC	6 (100)		
Adenocarcinoma	0		
TNM staging			
I	0		
II	4 (66)		
III	2 (33)		
IV	0		
Tumor location			
Upper 1/3	0		
Middle 1/3	5 (83)		
Lower 1/3	1 (17)		
Operative time (min)		198 ± 25	165–240
Distance to tumor proximal end (cm)		11 ± 2	8–16
Tracheal injury length (mm)		25 ± 5	17–34
Rupture repair duration (min)		49 ± 5	42–58
Treatment			
Surgery	3 (50)		
Chemoradiotherapy	0		
Surgery and chemoradiotherapy	3 (50)		

SCC = squamous cell carcinoma; SD = standard deviation.

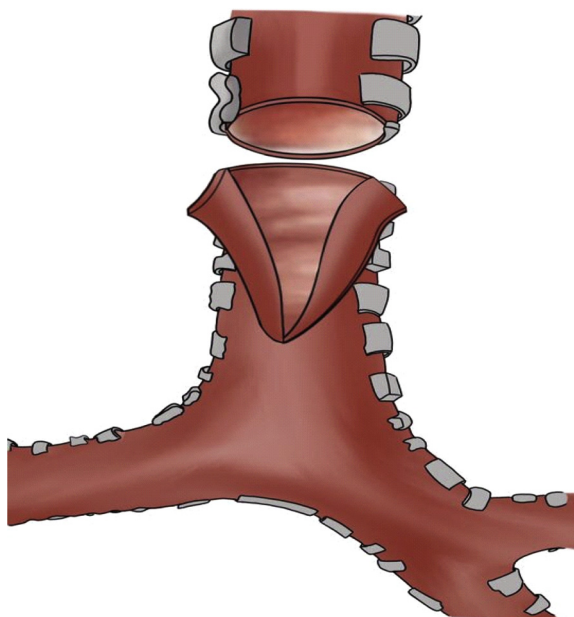


Figure 1 Transverse tracheotomy performed between two cartilaginous rings across the top of laceration site.

tracheotomy was sutured with interrupted 4-0 polyglactin sutures outside of the trachea (Figure 2). Finally, gastric pull-up and esophagogastric anastomosis were performed. The repair of tracheal injury was completed in less than 60 minutes in all patients (Table 1).

After surgery, patients were transported to the intensive care unit. On the 5th postoperative day, all patients underwent gastrografin swallow study that demonstrated no evidence of extravasation, and oral feeding was started without complication. Seven days after operation, bedside

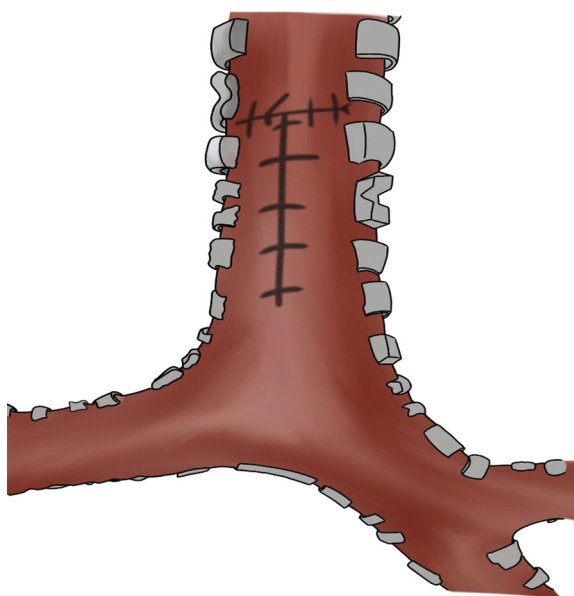


Figure 2 Posterior laceration and the transverse tracheotomy sutured.

flexible bronchoscopy revealed that posterior tear and transverse tracheotomy had healed completely in patients. Patients were discharged, on average, 2 weeks post-operatively (range 11–15 days). No mortality was reported during the 6-month follow-up in all patients. An endoscopic follow-up after 6 months revealed posterior tracheal wall healing without stenosis.

3. Discussion

The major airway injury is an uncommon complication of esophageal mobilization during THE, but is associated with significant morbidity.³ A comparison of the results of earlier studies with those of new researches reveals a dramatic decrease in the tracheal tear rate. Loss of direct access to the membranous trachea during operation causes a challenge in the management of tracheal rupture. Various surgical methods for tracheal repair are described in the literatures. Thoracotomy can be a primary consideration for repair in most circumstances, while proximal rupture may be managed through cervical incision with a partial upper sternal split.^{1,6} This article describes the technique to repair the tracheal tear, which extended just over the carina, through a transcervical–trans-sternal approach, thereby avoiding a second thoracotomy. Reinforcement of the suture line with a well-vascularized structure or synthetic tissues has been described.³ We used gastric tube transposition to reinforce the repair of the tracheal tear. Deshmane et al⁶ described that prior radiotherapy did not influence the site or severity of tracheal injury. Some authors believe that neoadjuvant chemoradiotherapy and malignancy are risk factors for tracheal ruptures.³ In our cases, preoperative chemoradiation could be a risk factor where four patients had received neoadjuvant chemotherapy with radiation. Welter⁷ described that tracheal injuries can be reduced by releasing the tracheal tube cuff during mediastinal dissection. Sung et al. suggested that aggressive blunt dissection of the mediastinum against a large tracheal tube cuff could result this complication.⁸

In conclusion, tracheal laceration is a rare but potentially life-threatening complication of esophagectomy. Surgical repairs should be individualized for each location of injury. The surgical approach has been modified to avoid thoracotomy depending on the level and extension of the tear. Injuries equivalent to the carina can be successfully repaired through the transcervical–trans-sternal approach without any risk of additional morbidity. Early diagnosis and treatment are keys to better outcomes.

Ethics committee approval

Tabriz University of Medical Sciences, Ethics Committee of Research Chancellor (approval number: 92221).

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