Management of Intra-operative Tracheal Injuries during Trans-hiatal Esophagectomy for Carcinoma Esophagus

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Abstract

Tracheobronchial injury is a rare complication of transhiatal esophagogastrectomy, mostly seen in patients who receive neo-adjuvant therapy or have locally advanced growth with dense adhesions. Its immediate recognition and closure decreases the mortality and morbidity associated with this rare but fatal intra-operative complication. Retrospective analysis of 750 patients who underwent transhiatal esophagogastrectomy from Jan 2002 to Jan 2012 for carcinoma esophagus was performed. Out of 608 patients who underwent transhiatal esophagogastrectomy, only four patients sustained injuries to major airways. Three injuries occurred during transhiatal and one injury during transcervical part of dissection. All the injuries occurred in trachea proximal to carina. All four injuries were closed primarily, re-enforced by muscle and fascial pledgets. In two patients the trachea was repaired through right thoracotomy and in two patients the cervical incision that was utilized for mobilization of esophagus in the neck provided adequate exposure for repair of the trachea.

Introduction

The squamous cell carcinoma of esophagus is common in Asian countries of esophageal cancer belt, stretching from eastern Turkey to northern China and India, & is relatively uncommon in United States, Canada and Europe where adenocarcinoma of lower esophagus and cardia predominate. The predominant risk factors for squamous cell carcinoma are smoking and alcohol consumption and for adenocarcinoma these are gastro-esophageal reflux and Barrett’s esophagus. The most common surgical procedure performed for esophageal cancers is transhiatal esophagectomy. Other options are Ivor-Lewis, McKeown procedure & pharyngo-laryngo-esophagectomy (PLE) for hypopharyngeal and upper cervical esophageal lesions. The rationale for transhiatal esophagectomy is avoiding thoracotomy and its complications1.

Fashioning of cervical anastomosis is to minimize clinical consequences of anastomotic leak. The common complications include anastomotic leak/stricture, recurrent laryngeal nerve injury, bleeding, and chyle leak2. There is a risk of injury to azygous vein, trachea and cardiac instability. Injury to major airway is a rare but potentially fatal complication of transhiatal esophagogastrectomy which needs prompt recognition, isolation and repair

Case Report(s)

This retrospective study was conducted in the departments of Cardiovascular and Thoracic surgery, Sheri-I-Kashmir Institute of Medical Sciences, Srinagar Kashmir (India). The medical records of 750 patients operated for esophageal cancer over a period of 10 years (Jan 2002 to Jan 2012) were analyzed. Out of 750 patients, 608 underwent trans-hiatal esophago-gastrectomy and 142 trans-thoracic resection. Patients with early stages of disease did not received neo-adjuvant therapy; while as patients with advanced growth (stage IIb & III) received neo-adjuvant chemo-radiotherapy before surgery. All patients were evaluated by complete history, physical examination, complete blood count, biochemical profile, electrocardiography, endoscopic biopsy, barium esophagogram, ultrasound abdomen and computed tomography of chest and abdomen. Supra-umbilical midline laparotomy was performed, tumor resectability assessed, gastric mobilization performed and esophageal hiatus enlarged for exposure of intra-thoracic esophagus. Lymph node dissection in lower mediastinum, around esophago-gastric junction, lesser curvature of stomach and celiac axis was performed. Thoracic esophagus was mobilized by blunt finger dissection via esophageal hiatus and cervical incision such that the two hands met each other in the posterior mediastinum while mobilizing the esophagus and freeing it from surrounding structures. Gastrointestinal continuity re-established by esophago-gastric anastomosis fashioned in the neck through cervical incision. Chest drains were inserted if pleurae were breached and a feeding jejunostomy was placed.
routinely in all patients. Four patients sustained tracheal injury, three during trans-hiatal and one during trans-cervical part of dissection. The laceration ranged from 2 to 5 cm in length. The operative repair of tracheal injury was completed in 10-30 min. Two patients needed right posterolateral thoracotomy and two patients needed extended cervical incision to repair their tracheal tear. Injury recognition and immediate management-Injury to trachea occurred during mediastinal phase of esophageal dissection. The tracheal injuries were recognized immediately due to loss of airway resistance during ventilation & gush of air leaking through the incision site. The rent in the trachea was assessed by surgeon’s finger and/or direct visualization. The endo-tracheal tube was advanced into the right bronchus distal to the injury area to establish adequate ventilation & the tear area packed with moist gauze pack till patient’s ventilation was stable & acceptable for repair. Tracheal tear was repaired by trans-cervical approach in two and trans-thoracic approach in two patients. In trans-cervical approach longitudinal incision along the anterior border of sternocleidomastoid on left side was extended up to the superior border of manubrium. The neck was hyper-extended and rotated to right. The surgeon positioned on the head end, trachea was retracted medially and anteriorly, sternocleidomastoid laterally and manubrium sterni lifted anteriorly. The cervical esophageal stump was retracted cranially to widen retro-tracheal space. Repair-The tracheal rent was sutured with interrupted polypropylene (4.0) suture using long instruments from distal to proximal. The sutures were buttressed with muscle and fascial pledgets. Care was taken not to puncture the endotracheal tube. At the end of tracheal repair the endo-tracheal tube was withdrawn to ensure there was no inadvertent suturing of the airway tube. The gastric tube was advanced into the neck, anastomosed to esophageal stump and the procedure completed. Trans-thoracic approach was used in patients with longer tear (>3cm) in the trachea. Right posterolateral thoracotomy through 5th intercostals space was performed. The trachea was dissected from surrounding structures and the tear was sutured with interrupted (4-0) polypropylene sutures. The gastric tube advanced to neck for anastomosis with the proximal esophageal stump. Thoracotomy was closed after placing one intercostal tube drain (32F) in the pleural cavity. No patient needed post-operative ventilation. Breathing exercises were encouraged. One patient developed bronchopneumonia, which responded to antibiotics and supportive measures. Feeding was started on 2nd post-operative day. Integrity of esophageal anastomosis was checked on 7th post-operative day.

Discussion

Transhiatal esophagectomy has been the favored operative approach in our institution for carcinoma of esophagus below carina and type I and II tumors of esophagogastric junction. Reconstruction is usually performed by iso-peristaltic gastric tube which functions as neo-esophagus after surgery. In patients who need esophagectomy along with total gastrectomy, jejunal or colonic interposition is mandatory. Other treatment options include neoadjuvant or adjuvant chemo-radiotherapy. Advocates of trans-thoracic approach argue that it reduces rates of circumferential resection margin (CRM) involvement & neglecting mediastinal lymphadenectomy risks loco-regional recurrence. However, the mediastinal lymph node involvement reflects systemic micro metastasis and that extended resection don’t alter natural history of disease.

Regardless of the operative technique, it is often difficult to obtain circumferential clearance due to proximity of vital structures and lack of fascial boundaries. Neo-adjuvant therapies have improved surgical and oncological outcomes. It is proven that trans-hiatal esophagectomy is a safe approach with advantages in post-operative recovery and oncological outcomes have improved when combined with neo-adjuvant therapy. Tracheal injury is a rare, dreaded and potentially fatal complication of esophagectomy1-5, which should be managed immediately and meticulously to decrease intra-operative mortality and post-operative morbidity and mortality. Management of major airway injury during THE is challenging as there is no direct access to membranous trachea during the procedure. This invariably entails the performance of thoracotomy or an anterior sternal split in order to facilitate repair, which add to the morbidity. The incidence of tracheal injury was found to be similar in two large reports comparing the trans-hiatal with open thoracicapproach1,5. However, Hulscher J. B. showed that airway injury is higher in trans-hiatal than trans-thoracic esophagectomy. In our study the incidence of tracheal injury during trans-hiatal esophagectomy was 0.67%. The incidence of airway injury reported in the published literature is 0.4% & 0.67%5,9. In our experience, primary repair of airway injury with interrupted polypropylene sutures; with or without fascial / muscle pledged augmentation, resulted in optimum outcome. Primary suturing of tracheal injuries during THE has also been reported by other authors1,9.
A variety of technical modifications to avoid thoracotomy have been described to manage intra-operative tracheal injury\textsuperscript{10,11}. Use of transposed stomach to patch the laceration is suitable for small tears\textsuperscript{11}. Use of pericardial patch, reinforcement of the repair with muscle, PTFE, and cyanoacrylate glue has been reported\textsuperscript{12,13,14}. Augmentation of primary repair with gastric tube have been reported, it was associated with pulmonary complications, leading to prolonged assisted ventilation and prolonged stay in the intensive care unit, but mortality was rare\textsuperscript{5}. We used trans-cervical approach in two patients who had proximal airway tear by anterior sternal lift, with no airway injury related morbidity & mortality. The same approach has been used by Vikas Gupta\textsuperscript{4} & Gorenstein et al\textsuperscript{12} in patients with tracheal injuries during THE with good results. Harney et al described the successful use of laparoscopic instruments to repair intra-operative tracheal injury extending up to the carina\textsuperscript{10}. Two patients who sustained intra-operative airway injury had received pre-operative chemo-radiation for advanced growth. Suryanarayana SV inferred from his study that direct tumor infiltration, radiotherapy, peri-tumor malignant inflammation or infection and abscess formation, all increase the risk of injury to the peri-esophageal structures\textsuperscript{15}. Radiotherapy weakens the tracheal wall making dissection difficult and trachea vulnerable to damage during blunt dissection\textsuperscript{5}. There are many case reports of airway injuries during esophagectomy, some with a fatal outcome. In our study there was no mortality related to airway injury. In our study two patients with dense adhesions and tracheal injury >3cm needed thoracotomy to repair the airway injury. In case of suspected airway injury early conversion to trans-thoracic approach is a better option as identification of extent and repair of tracheal injury is technically easy and rapid, till then packing the leak helps to gain time for conversion. We did not use double lumen endo-tracheal tube during THE for ventilation, therefore single lumen endotracheal tube was advanced into main bronchus for ventilation in patients who sustained airway injury. Although lung isolation is not necessary in THE, yet cases with tumors in close proximity to the major airway or patients who have undergone radiotherapy may benefit from an electively positioned double lumen endotracheal tube\textsuperscript{11}.

**Conclusion**

In patients with carcinoma esophagus having dense peri-esophageal adhesions after neo-adjuvant chemo-radiation and difficult trans-hiatal esophageal dissection due to adherent growth, threshold for conversion to trans-thoracic approach (and sharp dissection under vision) should be low. Injury during trans-cervical part of esophageal dissection can be managed through the same incision and injuries as low as carina can be successfully managed without any additional morbidity.

The crux of uncomplicated repair of tracheal injuries in THE is immediate recognition, proper exposure, interrupted suture technique, suture reinforcement and proper post-operative care.
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