Carcinogenesis and treatment of adenocarcinoma of the oesophagus and gastric cardia

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Chapter 9

Injury to the major airways during subtotal oesophagectomy: incidence, management, and sequellae

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Abstract

Background. To gain insight in the incidence and sequellae of injury to the major airways during subtotal oesophagectomy.

Patients and Methods. We performed an analysis of 383 consecutive patients undergoing this procedure between 1993–1999. Indications were adenocarcinoma (220), squamous-cell carcinoma (121), and other (42). 269 patients (70%) underwent transhiatal oesophagectomy (THO), 114 (30%) transthoracic oesophagectomy (TTO).

Results. There were 4 men and 2 women (median age 57 (45-68)) with injury to the major airways, recognised during surgery in 5 patients and the first post-operative day in the other. Five lesions occurred during THE (5/269 = 1.8%), 1 during TTE (1/114 = 0.8%; p=0.67). The injury occurred proximal to the carina in 5 patients, in the left main bronchus in the other. All could be closed primarily. The defect was covered with pericardium in one patient, with pleura in two patients. In all cases the gastric tube was placed over the defect.

Four patients developed pulmonary complications. Patients with tracheal injury spent more time on artificial ventilation (median 6 days vs 1 day, p=0.02) and in the ICU (median 11 vs 3 days, p<0.01) than patients without such injury, although hospital time was not significantly prolonged (median 23 vs 16 days, p=0.09). There was no associated mortality.

Conclusions. Tracheo-bronchial injury is a rare complication of subtotal oesophagectomy. It can be managed effectively by primary closure and apposition of vital tissue (gastric tube) to the defect. It is associated with pulmonary complications, leading to prolonged ventilation-time and ICU-stay, but mortality is rare.

Introduction

Oesophagectomy can be divided into the transthoracic approach and the transhiatal approach. The former is a combined abdomino-thoraco (-cervical) approach through which the oesophagus and adjacent tissues are resected and lymphadenectomy can be performed. The latter is an abdomino-cervical resection (without thoracotomy), in which the oesophagus is mobilised through the surgically widened hiatus of the diaphragm and resected (stripped) distalwards. Often no formal lymphadenectomy is done.

Opponents of the transhiatal resection suggest that it is not only oncologically unwarranted, but can also be potentially dangerous, especially when the tumour is situated proximal to the carina. The oesophagus lies in close relation with trachea and mainstem bronchi at one side, and the vertebral
column and the aorta at the other. Blunt resection of the oesophagus could result in damage to these vital structures, with devastating results.

However, although these complications are feared, their incidence is low. The incidence of tracheal tears during transhiatal resection is around 1%, in experienced hands this number might even be lower. There are almost no data regarding the incidence of injury to the trachea or mainstem bronchi during transthoracic resections and its sequellae.

We analysed the incidence of injury to the major airways during both transhiatal and transthoracic oesophageal resections. The associated morbidity and mortality will also be reported.

Patients and Methods

An analysis was performed of the 383 consecutive patients who underwent subtotal oesophagectomy between July 93 and August 99. The analysis was based on prospectively collected data from a database. Transhiatal resections were carried out in 269 (70%) patients, the other 114 (30%) patients underwent transthoracic resection. Indications were high-grade dysplasia (12), adenocarcinoma (220) and squamous cell carcinoma (121), other, including non-malignant causes, (30). For tumours located distal to the carina the transhiatal approach was used preferably, just as for non-malignant causes and high-grade dysplasia. There were 100 patients with tumours located at or proximal to the carina, 52 of whom underwent transthoracic resection. Sixty-two patients with distal adenocarcinoma participating in a randomised trial were allocated to a transthoracic resection with two-field lymph node dissection. Statistical analysis was performed with the aid of the SPSS package. The Chi² and Mann-Whitney U tests were applied as appropriate for categorical and continuous data resp.

Results

There were four men and two women, with a median age of 57 years (range 45 – 68), with injury to the major airways. In five patients injury to the major airways was noticed during the operation, in one additional patient it was noticed in the ICU on the first post-operative day after urgent reintubation for autodetubation. Three patients had a squamous cell carcinoma, two suffered from adenocarcinoma and one patient had high-grade dysplasia. In two cases the carcinoma was located proximal to the carina. There were four T3 tumours, and one T1 (sm) tumour. One patient with a squamous cell carcinoma underwent pre-operative chemotherapy, radiation therapy had not been administered once.
Five lesions occurred during transhiatal resection (5/269 = 1.8%), while one lesion occurred during transthoracic resection (1/114 = 0.8%). This difference is not statistically significant (p=0.67). Also when the tumours proximal to or at the carina are analysed separately, there is no difference between transhiatal or transthoracic approaches. In five cases the injury occurred proximal from the carina, in one it was located in the left main bronchus. There was no correlation between tumour location and location of the tear. Three patients underwent a microscopically radical R0 resection, micro- and macroscopic tumour was left behind in one patient each. There was no correlation between the occurrence of injury to the major airways and tumour stage (including T and N stage).

The air-leak was noticed immediately during surgery in five patients. In four patients undergoing transhiatal resection it was noticed by large amounts of air escaping through the hiatus and a pressure drop in the circuits of the anaesthesiologist. In two patients the leak occurred during stripping of the oesophagus, while it occurred during the transhiatal dissection previous to stripping in the other two patients. In the patient undergoing transthoracic resection the tumour was attached to the left main bronchus, which was torn accidentally during the dissection, which was noticed immediately under direct vision. After immediate insertion of a double lumen tube to gain control of the airway a conversion to a right-sided thoracotomy was performed (during transhiatal resection). In the patient undergoing transthoracic resection the double lumen tube could be replaced distal to the defect, providing adequate ventilation. In one patient the airleak was noticed after urgent reintubation for auto-extubation, with air escaping through the cervical wound.

All lesions could be closed primarily with 5.0 Vicryl stitches. The defect was subsequently covered with pericardium in one case, and with pleura in two. In all patients the gastric tube was placed against the closed defect posterior to the trachea and loosely attached with a few stitches. Care was taken that the longitudinal staple-line of the gastric tube was not in direct contact with the airway closure.

Post-operatively four of the six patients developed pulmonary complications such as pneumonia and/or atelectasis (versus 72/377 or 19.0% in the patients without injury to the major airways, p = 0.009, Chi-square). This is also reflected in a prolonged time spent on artificial ventilation and in the Intensive Care Unit (see table 1). Hospital time was also prolonged in patients with injury to the major airways, but this did not reach statistical significance.

On follow-up patients did well functionally without symptoms of stricture-formation. No routine bronchoscopy was done on follow-up. After a median follow-up of 1.2 years (2 months – 2.5 years) four patients have developed recurrent disease, three of whom have died.
Injury to the major airways is an uncommon complication of oesophagectomy (6/363 = 1.6%), which can be managed adequately by primary closure and apposition of vital tissue (gastric tube) to the defect. Although associated with significant pulmonary morbidity all patients recovered.

Opponents of transhiatal resection suggest that tracheal lesions occur more often in the transhiatal resection because of the close relation between the oesophagus and trachea. Blind stripping of the oesophagus might lead to damage to the major airways. Usually tracheal lesions are vertical tears in the membranous posterior portion of the trachea. In the largest series published on transhiatal resections, Orringer reported an incidence of 1% for tracheal lesions in patients undergoing transhiatal oesophagectomy, with an inverse relation between incidence of tracheal lesions and surgical experience. When the literature of the last decade is reviewed, the incidence of injury to the main airways is 0.6% after transhiatal resection, while it has not been mentioned after transthoracic resection. However, most authors do not mention this complication, especially when describing the results of transthoracic resection.

Careful selection of patients for transhiatal resection is mandatory to prevent injury to the tracheobronchial tree. In our institution tumours at or proximal to the carina are preferably operated transthoracically due to the position of the oesophagus between trachea, vertebral column and aorta. However, when the general health of the patient precludes thoracotomy, a transhiatal resection is performed. In patients with a proximal tumour bronchoscopy should be performed before a (transthoracic) resection takes place to exclude ingrowth in the mucosa. Although this was not administered in the present series, neo-adjuvant radiation therapy might make dissection more difficult.

Transhiatal resection of distal oesophageal cancers is not as blunt/blind a resection as has often been described by its opponents. The tumour can be mobilised through the widened hiatus of the diaphragm, with dissection under direct vision till well proximal to the tumour. Only the normal part of the oesophagus is therefore resected bluntly. However, peri-tumoural inflammatory adhesions may develop making dissection and stripping more dangerous, which might have been the cause of the airway lesion in some of our patients with distal tumours. During the procedure, the pressure of the dissecting finger should always be on the oesophagus, in order to prevent pressure on the posterior membranous trachea, especially over the bulb of the endotracheal tube.

Tracheal lesion is a very uncommon complication, which is thought to result in an immediate inability to ventilate the patient. In addition, life-threatening respiratory complications might ensue in the postoperative course. In this series four out of six patients developed respiratory complications, probably due to initial hypoventilation in combination with the aspiration of blood through the defect, especially during the expiration phase in which airway-pressures are low, leading to atelectasis and
pneumonia. Although most patients in this series developed respiratory complications and spent significantly more time on artificial ventilation and in the Intensive Care Unit, there was no associated mortality. All patients were able to leave the hospital in relatively good condition.

Treatment of these injuries should be straightforward. When an airleak is suspected per-operatively, either by the surgeon noticing large amounts of air escaping through the operative field or by the anaesthetist noticing a sharp decrease in pressure in his circuits or large changes in the capnography readings, immediate control of the airway is mandatory. After insertion of a double-lumen tube conversion to a thoracotomy can take place in case of a transhiatal resection. Care has to be taken not to enlarge the defect during the insertion of the double lumen tube. During a transhiatal resection the defect may be covered by the surgeons finger, thus guiding the ventilation tube. In case of a transhiatal resection we position the patient in the dorsal decubitus position with the aid of a beanbag, so immediate conversion can take place without having to reposition and/or to redrape the patient.\(^3\) After conversion to a thoracotomy primary repair can be carried out. When possible, a regular tube may be (re-) inserted with the balloon distal to the defect. Airway pressures should be kept as low as possible and early extubation should be strived for. When prolonged ventilation is necessary, the double lumen tube may be changed for a regular tube, which should be inserted under bronchoscopic guidance.

Post-operatively tracheal injury might be suggested by persistent airleak through the chest-tubes or subcutaneous emphysema developing over the face and neck. Bronchoscopy will subsequently reveal the lesion. When the airleak is noticed post-operatively, as occurred once in this series, the patient should undergo re-operation, unless the lung is fully expanded, the patient remains well oxygenated and the gastric tube already abuts the lesion completely. Negative suction might be applied to the chest-tubes to try and expand the lung, but when this is not successful operative repair should take place.\(^4\) Intensive lung-physiotherapy and bronchial toileting are mandatory, and (broad-spectrum) antibiotics are to be considered.

The defect can be closed primarily followed by the apposition of vital tissue to the defect. Primary repair is said to carry a high risk of subsequent stricture formation, but this did not occur in the present series. Stricture formation might occur when primary repair narrows the lumen or can only be performed under tension. In those cases, patches from pleura or pericardium may be used, but these patches are relatively poorly vascularised, and sometimes not available due to tumour ingrowth. Also, post-operative radiation might cause damage to the graft site.\(^5\) The use of Goretex or Marlex grafts has also been described, but this is less attractive as it leads to the presence of a foreign body in a possibly infected area.\(^4,\(^6\) The gastric tube is a relatively well vascularised structure which can be positioned over the defect without adding substantial tension. Placement of the gastric tube with its attached omentum
adds vital tissue to the defect, improving vascularisation and thereby increasing local resistance to infection. The use of pedunculated muscle flaps (intercostal or pectoral) is probably not indicated in the acute treatment of these injuries, but might be an important treatment option for long-standing tracheal injuries associated with mediastinitis, filling the dead space with well vascularised and highly resistant tissue.

**Conclusion**

Injury to the major airways is a rare complication of both transhiatal and transthoracic oesophagectomy. Careful patient selection and meticulous surgical technique should prevent many of these injuries. When they occur, primary repair followed by apposition of the gastric tube to the defect is usually sufficient. Pulmonary morbidity is high, but mediastinitis and mortality are rare.

**References**

Table 1: Time spent on artificial ventilation, in the ICU and in the hospital (days; median, range) of patients with and without injury to the tracheo-bronchial tree after subtotal oesophagectomy

<table>
<thead>
<tr>
<th></th>
<th>No injury</th>
<th>Injury</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilation time</td>
<td>1 (0-33)</td>
<td>6 (1-40)</td>
<td>0.02</td>
</tr>
<tr>
<td>Time in ICU</td>
<td>3 (1-71)</td>
<td>13 (3-47)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Hospital time</td>
<td>16 (9-155)</td>
<td>23 (14-58)</td>
<td>0.11</td>
</tr>
</tbody>
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*Mann Whitney U-test