Carcinogenesis and treatment of adenocarcinoma of the oesophagus and gastric cardia
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Chapter 8

Vocal fold paralysis after subtotal oesophagectomy

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Abstract

Background. Although vocal fold paralysis is a well-known complication of subtotal oesophagectomy, precise data concerning origin, incidence, and associated morbidity are lacking.

Patients and Methods. A retrospective study was performed of 241 patients who underwent transhiatal oesophagectomy for carcinoma of the mid/distal oesophagus between 1994 and 1998. Pre- and postoperative laryngoscopy results were available for 140 of these patients.

Results. There were 109 men and 31 women, of mean age 63 years. Thirty-one patients (22 per cent) with recurrent laryngeal nerve paralysis were identified, three with bilateral, 28 with unilateral dysfunction. Paralysis occurred ipsilateral to the side of the cervical incision in 22 of 28 patients. It was permanent in six patients. The associated morbidity was substantial: pulmonary complications were more common in patients with vocal cord paralysis (12 of 31 versus 26 (24 per cent) of 109), leading to significantly more reintubations, and a significantly prolonged ventilation time and stay in the intensive care.

Conclusion. Although mostly transient, vocal fold paralysis is a frequent complication with significant associated morbidity. It occurs preferentially at the ipsilateral side of the cervical incision. This implies that in an extended transthoracic resection (including a lymphadenectomy in the aortapulmonary window where the left laryngeal nerve is at risk) the cervical anastomosis should be made at the left side, to minimize the risk of bilateral vocal cord paralysis.

Introduction

Vocal fold paralysis is a frequent complication of subtotal oesophagectomy. An incidence up to 20 per cent has been reported.1-4 Paralysis may be unilateral or bilateral and is the result of damage to the recurrent laryngeal nerve(s), leading to disorders of speech (almost all patients suffer from hoarseness), coughing, swallowing, and breathing. Most paralysis is transient. Although (transient) hoarseness is not itself very troublesome, vocal cord paralysis may be associated with significant morbidity due to secondary pulmonary complications.

In a subtotal oesophagectomy, the oesophagus can be transected in the neck after which a cervical anastomosis is performed. This is done in some three-stage operations and during all transhiatal procedures. The oesophagus is dissected circumferentially, which puts the recurrent nerves both on the ipsilateral and contralateral sides of the incision at risk. The thoracic part of the left recurrent nerve may also be injured during the thoracic phase of an extended transthoracic resection, especially
while dissecting the lymph nodes in the aortapulmonary window and/or the left paratracheal lymph nodes.

In this institution the cervical anastomosis is performed on the right side in case of a transhiatal oesophagectomy due to the positioning of the patient. A left-sided anastomosis is preferred when an extended transthoracic approach is used, to minimise the risk of bilateral vocal fold paralysis. This strategy rests on the assumption that the ipsilateral recurrent nerve is more frequently damaged than the contralateral nerve in the cervical phase. To test this hypothesis and to analyse the morbidity associated with vocal fold paralysis after transhiatal oesophagectomy a retrospective study was performed.

Patients and methods

Between 1994 and 1998 241 patients underwent a subtotal transhiatal oesophagectomy for carcinoma of the mid/distal oesophagus. One hundred and forty of these patients had results available of indirect laryngoscopy performed both before and within two weeks after the operation. There were 109 men and 31 women with a mean age of 63.4 years (range 37-84). An otolaryngologist performed the follow-up when vocal fold paralysis was diagnosed after operation. No distinction was made between paralysis and paresis, as this is hardly possible by indirect laryngoscopy. Vocal fold paralysis was therefore defined as an absence of movement or a decreased mobility (on indirect laryngoscopy) of one or both vocal folds on phonation compared with the pre-operative examination. Permanent paralysis was defined as paralysis lasting more than six months.

Operative procedure. For a transhiatal procedure the patient is positioned in such a way that an urgent thoracotomy is possible without repositioning and redraping. This includes positioning of the patient in the dorsal decubitus position on a vacuum mattress molded in such a way that the table can be tilted 45° to the left without the patient sliding off. The right arm is draped and positioned along the side of the body and can be brought up when needed. The patient’s head is turned toward the left, denying access to the left side of the neck. This position allows an anterior thoracotomy to be done in the supine position. This technique has been described elsewhere. In all but one patient the cervical incision was therefore made on the right side of the neck.

After opening of the hiatus the diaphragm is incised to facilitate intrathoracic mobilisation of the oesophagus including the tumour and the peri-oesophageal tissue up to the carina. No formal lymph node dissection is done. When the oesophagus has been mobilised a gastric tube is constructed. In the cervical phase of the operation the oesophagus is mobilised circumferentially and transsected low in the neck. The ipsilateral recurrent laryngeal nerve is identified when possible. At the contralateral
side the dissection is performed closely over the oesophagus and with the contralateral border in view whenever possible to minimise the risk of injury to the contralateral nerve. A vein stripper is then inserted from the proximal end and the normal oesophagus proximal of the tumour is extracted "blindly" from the mediastinum. Both vagal nerves are transsected at the level of the carina. An anastomosis is made either with a running suture or with a stapling device, according to the preference of the surgeon. All operations were performed by, or under the direct supervision of, two senior surgeons experienced in oesophageal cancer surgery. (JJBvL/HO)

Postoperative pulmonary complications included pneumonia (an infiltrate seen on the chest-film or the isolation of a pathogen from sputum culture for which antimicrobial therapy was given), atelectasis (lobar collapse on chest radiography), pleural effusion (a collection of fluid between the visceral and parietal pleural surfaces requiring drainage) and pulmonary embolus (ventilation-perfusion mismatch on lung scintigraphy). Pneumothorax is considered mainly as an intra-operative complication and is therefore not included.

Statistical analysis. Statistical analysis was performed with the aid of the SPSS-statistical package (SPSS, Chicago, Illinois, USA). Differences between the groups were calculated using analysis of variance, Student's t-test, χ² or Fisher's exact test when appropriate. P<0.05 was considered significant.

Results

None of the patients had vocal fold dysfunction before the operation. There was no visible tumour infiltration of the recurrent laryngeal nerve; it was not sacrificed deliberately in any patient. Thirty-one (22 per cent) of the 140 patients suffered from vocal fold paralysis post-operatively. There were three bilateral and 28 unilateral paralyses. Of the unilateral paralyses, twenty-one were on the right side, and seven were on the left. Most of the patients with unilateral paralysis presented with hoarseness, two patients with unilateral paralysis also suffered from inspiratory stridor. Four patients showed no symptoms at all. In 22 of the 28 patients with a unilateral paralysis the vocal fold dysfunction occurred on the same side as the cervical incision. Two of the three patients with bilateral paralysis developed a severe stridor after extubation and had to be reintubated, one of them aspirated before reintubation. The other patient was asymptomatic. Six paralyses were permanent (4%). In the other patients most symptoms disappeared within two to three months. Three patients were lost to follow up: one of them died within six months, the other two were transferred to another hospital from where no follow up laryngoscopy results were available.
Vocal fold paralysis was associated with significant morbidity. Twenty-six (24 per cent) of the 109 patients without vocal fold dysfunction suffered from pulmonary complications. In the 28 patients with unilateral vocal fold paralysis nine had one or more pulmonary complications, compared with all three patients with bilateral paralysis (Table 1). Patients with vocal fold dysfunction were significantly more likely to require reinsertion of an endotracheal tube after operation. Reintubation or tracheotomy for respiratory failure was necessary in six of 28 patients with unilateral and two of three with bilateral vocal cord paralysis, compared with only four (4 per cent) of the 109 patients with normal vocal cord function (P=0.001). Of the two patients with bilateral palsy requiring reintubation, one died as the result of a massive pulmonary embolus and the other underwent a formal tracheotomy; the cannula could be removed without complications two months later. Duration of ventilation and intensive care unit (ICU) stay were significantly prolonged when vocal fold paralysis occurred. (Table II) This finding was attributed to the reintubations; when only patients without the need for reintubation were considered, there was no difference in duration of ventilation or ICU-stay. Hospital stay was also prolonged in patients with vocal fold paralysis, but this did not reach statistical significance.

There was no surgeon-dependent difference. Supervised surgery performed by a trainee did not carry a higher risk of injury to the recurrent nerve.

Discussion

Vocal cord paralysis due to injury to the recurrent laryngeal nerve most often occurs at the ipsilateral side of the cervical incision. Although mostly transient, it is associated with significant morbidity. Vocal cord paralysis is a well-known complication of oesophagectomy and other major surgery in the cervical region, but seldom investigated. A previous study showed that clinical assessment of vocal fold paralysis is unreliable without indirect laryngoscopy. These results are confirmed by the present study in which a significant number of patients without symptoms had vocal cord paralysis diagnosed only by laryngoscopy.

The recurrent laryngeal nerves run in the tracheo-oesophageal grooves on both sides of the neck. The right recurrent nerve turns around the subclavian artery before running cranially, the left runs into the chest, turns around the aortic arch and then runs up cranially. It is the main motor-nerve of the larynx, supplying all intrinsic muscles of the larynx except the cricothyroid muscle, which is supplied by the superior laryngeal nerve. The cricothyroid muscle tenses the plicae vocales, leading to a median position of the vocal cords when the other muscles are paralysed. The recurrent laryngeal nerve also gives off branches to the cricopharyngeus muscle, which forms the upper oesophageal sphincter and plays a pivotal role in swallowing. Swallowing, breathing, speaking and coughing all
may be impaired after damage to the recurrent laryngeal nerve. In the early postoperative period this can result in aspiration pneumonia, especially when reflux is certain to develop owing to delayed gastric emptying. When bilateral paralysis occurs, both vocal cords assume a median position, often leading to asphyxia and necessitating urgent reintubation/tracheotomy.

A cervical anastomosis can be performed during three-stage (abdomino-thoraco-cervical) subtotal oesophageal resection, although the anastomosis can also be made in the chest. A cervical anastomosis has the advantage of diminishing the risk of mediastinitis in case of anastomotic leak, but it also puts the recurrent laryngeal nerve at risk during the cervical dissection. Both the left and the right recurrent nerves may be injured in the neck, when dissecting the oesophagus circumferentially from the trachea and performing the oesophagostomy. When performing an extended transthoracic resection, including a formal lymph node dissection in the posterior mediastinum, the left recurrent nerve can be injured at the level of the aortic arch during the dissection of the lymph nodes in the aorta-pulmonary window or along the left paratracheal groove. The right recurrent nerve is not at risk, as it turns around the subclavian artery and is therefore not in the operation field.

During transhiatal resection the anastomosis is always made cervically, which may lead to local injury of the recurrent nerve. It is also possible to injure the recurrent nerves by traction during ‘stripping’ of the oesophagus. However, there is no direct surgical danger to the intrathoracic (left) recurrent nerve as is the case in extended transthoracic procedures.

Most surgeons prefer the left side for the cervical approach after three-stage oesophagectomy. In the neck the oesophagus is situated slightly to the left. The recurrent nerve runs more anteriorly than at the right side, thus facilitating dissection. However, the thoracic duct enters the jugular vein on the left side, an argument against a left-sided approach. In a transhiatal procedure in this unit, the cervical oesophagus is routinely approached from the right side.

Vocal fold dysfunction impairs coughing and thereby increases the risk for pulmonary complications such as pneumonia and atelectasis. Reintubation and/or formal tracheotomy may be necessary, leading to a prolonged stay in the ICU. This study showed that vocal fold paralysis occurred more often on the same side as the cervical incision (right), which made it likely that the injury occurred during the cervical phase and was not due to traction on the vagal nerve during stripping. This is also supported by the finding of more vocal fold dysfunctions after transhiatal than after Lewis-Tanner procedures. This has implications for the choice of the side of the cervical incision. To minimise the risk of a bilateral vocal fold paralysis the anastomosis should be made at the left side of the neck during an extended transthoracic resection. This minimises the risk of the right recurrent nerve being injured during the cervical phase, while the left recurrent nerve may already be injured during the thoracic phase. When performing a transhiatal resection the cervical incision can be either made on either side because there is no direct danger to the intrathoracic left recurrent nerve.

A number of other methods to avoid recurrent laryngeal nerve injury have been described, including early transsection of the vagal nerves during ‘stripping’ to prevent traction, and avoidance of
placement of retractors in the trachea-oesophageal groove. The incidence of nerve damage decreases with growing experience, but in this and other studies, there was no disadvantage in having operations performed by a trainee. In three cases the palsy was not surprising as there were technical difficulties during the cervical dissection or early re-exploration. The recurrent laryngeal nerve was never transected consciously.

The incidence of cord paralysis in the present study (22 per cent) is in line with published values. In this study, post-operative laryngoscopy results were available in 140 of the 241 patients. A certain selection bias cannot therefore be excluded. The patients who did not undergo postoperative laryngoscopy might include those without symptoms. The presented incidence of vocal fold paralysis might therefore be an overestimation. However, this study shows, just as the report by Johnson et al., that absence of symptoms does not always rule out vocal fold paralysis. Hoarseness of voice after intubation obviously does not always imply recurrent nerve damage (but may e.g. also be due to oedema of the folds due to the intubation), just as difficulties in swallowing is not a differentiating symptom after oesophageal surgery. Indirect laryngoscopy is therefore the only reliable way to establish a correct diagnosis.

The paralysis was permanent in only six patients (4 per cent), suggesting that the injury inflicted to the recurrent nerves was probably due to traction as opposed to transsection. Persistent hoarseness of voice from recurrent nerve paralysis causes deterioration in quality of life.

With the introduction of three-field lymphadenectomy for oesophageal cancer (including an extended cervical lymph node dissection) higher incidences of vocal fold paralysis can be expected.

**Conclusion**

Although vocal fold paralysis after transhiatal oesophagectomy is transient most of the times, it is associated with significantly more reintubations and a significantly prolonged ventilation time and ICU-stay. Injury to the recurrent laryngeal nerve occurs preferentially at the side of the cervical incision. This implies that when performing a subtotal oesophagectomy with an extended intrathoracic lymphadenectomy, the cervical incision should be made on the left side, to minimise the risk of bilateral vocal fold paralysis.
References


Table 1: Incidence of pulmonary complications (pulm. compl.) in patients without vocal fold paralysis (vfp) and in patients with vocal fold paralysis. (Chi-square, no vfp versus total vfp)

<table>
<thead>
<tr>
<th></th>
<th>No vfp</th>
<th>Unilateral vfp</th>
<th>Bilateral vfp</th>
<th>Total vfp</th>
<th>P-value</th>
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<tbody>
<tr>
<td></td>
<td>(n=109)</td>
<td>(n=28)</td>
<td>(n=3)</td>
<td>(n=31)</td>
<td></td>
</tr>
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<td>nr. of pts. with pulm. compl.</td>
<td></td>
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<td></td>
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<td>pneumonia</td>
<td>26</td>
<td>9</td>
<td>3</td>
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<td>2</td>
<td>7</td>
<td>0.29</td>
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<tr>
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<td>3</td>
<td>1</td>
<td>4</td>
<td>0.26</td>
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<tr>
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<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>reintubation/ tracheotomy</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>8</td>
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Table 2: Ventilation time, ICU-stay and hospital-stay (in days; mean, range) in patients with and without vocal fold paralysis.

<table>
<thead>
<tr>
<th></th>
<th>Ventilation time</th>
<th>ICU-stay</th>
<th>Hospital-stay</th>
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<tbody>
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<td>no vocal fold paralysis</td>
<td>1.8 (1-13)*</td>
<td>3.6 (1-19)*</td>
<td>19.7 (10-155)</td>
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<td>unilateral paralysis</td>
<td>5 (1-33)*</td>
<td>7.1 (1-33)*</td>
<td>25.2 (10-67)</td>
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<tr>
<td>Bilateral paralysis</td>
<td>9 (1-3)*</td>
<td>16.7 (7-22)*</td>
<td>34.7 (21-60)</td>
</tr>
</tbody>
</table>

(\*: p<0.05, ANOVA)