Tracheal stenosis complicated with tracheoesophageal fistula

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Abstract

Objective: The aim of the present study was to evaluate the results of surgical treatment in patients with simultaneous occurrence of postintubation tracheal stenosis (TS) and tracheoesophageal fistula (TEF). Methods: In the group of 51 patients with postcannulation tracheal stenosis who underwent segmental resection, TEF was identified simultaneously in five (10%) of them. The mean age of the TS–TEF patients was 43 years (range 35–60 years). The patients underwent a single-stage operation during which TEF was sealed and resection of the stenotic tracheal segment was performed. Results: The cause of TEF and of TS was artificial pulmonary ventilation by tracheostomy tube ($n = 4$) or by endotracheal tube ($n = 1$) with a simultaneous insertion of nasogastric tube. In one of the patients with tracheostomy the fistula resulted from an injury to the pars membranacea tracheae and the esophageal wall during tracheostomy. All the patients were respiring spontaneously before the surgical treatment. The mean length of the fistula was $24.0 \text{ mm (range 15–30 mm)}$, the fistulae were located at the junction of the upper and middle third of the trachea. The mean length of the resected tracheal segment was $29.6 \text{ mm (range 26–32 mm)}$. Postoperative complications were not observed in the group of the TS–TEF patients, none of them died. Conclusions: The method of choice of the surgical treatment of TEF associated with TS is a single-stage procedure in the patient who respires spontaneously.

Keywords: Tracheoesophageal fistula; Tracheal stenosis; Surgical treatment

1. Introduction

During prolonged artificial pulmonary ventilation (APV) by tracheostomy tube or by endotracheal tube, especially with simultaneously indwelling nasogastric tube (NGT), decubital necrosis of the esophageal wall and of the tracheal pars membranacea can arise at the level of the cannula balloon, and a communication between the esophagus and the trachea, the tracheoesophageal fistula (TEF), can develop [4]. Until the 1970s TEF of non-malignant origin was known only as the result of a traumatic lesion or of inflammatory affection. In 1967, Flge [6] first described the origin of TEF as a complication arising from damage by the tracheal cannula balloon. However, during APV tracheal stenosis (TS) at the level of the balloon or above it can occur simultaneously. The incidence of both mentioned complications of APV is not very frequent, and therefore we present our experience with the treatment of them.

2. Patients and methods

Between January 1986 and January 2003, we performed tracheal resection for the postcannulation TS in 51 patients. In five (10%) of these patients TEF was diagnosed and surgically treated simultaneously with TS. The characteristics of the TS–TEF patients are indicated in Table 1. The other patients with TS and without TEF are not mentioned here. In the clinical record of all the TS–TEF patients an application of APV was found, either via a tracheostomy tube ($n = 4$) or by an endotracheal tube ($n = 1$) and simultaneously the patients required long term indwelling NGT (the mean time of AVP application was 27 days with the range of 11–40 days, the mean time of NGT application was 37.6 days with a range of 20–51 days). On the basis of the clinical symptoms the fistula was suspected and subsequently confirmed by bronchoscopy and by esophagography with a water soluble agent. Moreover, in three TS–TEF patients the fistula was also detected by computer tomography (CT) that was primarily used for the diagnosis of TS (Fig. 1). In the patients with TS and TEF, TEF was located always distally from TS and its direction was always
perpendicular to the wall of the trachea and the esophagus. The mean length of TEF was 24 mm (range 15–30 mm), the mean width of TEF was 4 mm (range 3–5 mm), and the mean distance of TEF from the cricoid cartilage was 35.6 mm (range 32–38 mm). In four patients the fistula was located at the junction of the middle and upper third of the trachea, distally from the tracheostomy site. In one patient the fistula was located exactly against the tracheostomy stoma. In this patient the fistula was caused by a late recognized iatrogenic lesion of the dorsal tracheal wall and the esophageal wall that had arisen during surgical tracheostomy.

TS was diagnosed by bronchoscopy and by CT of the trachea. In three patients, TS was located above the tracheostomy opening. In this case, the anterior wall of the trachea above the cannula was shifted into the tracheal lumen and the subsequently formed granulation tissue closed the lumen of the trachea above the stoma. In one patient the fistula was located exactly against the tracheostomy stoma. In this patient the fistula was caused by a late recognized iatrogenic lesion of the dorsal tracheal wall and the esophageal wall that had arisen during surgical tracheostomy.

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All the patients were indicated for operation at the time when they ventilated spontaneously. The surgical treatment was accomplished through a cervical approach in all patients, sternotomy was not necessary in any of them. After isolation of the trachea and the esophagus at the level of below and above an assumed fistula, TEF was divided and the trachea was interrupted below the stenosis. The esophageal defect was closed in two layers using Vicryl (interrupted sutures) and the esophageal suture was covered by the sternohyoid muscle. Thereafter, the segmental resection of the stenotic portion of the trachea with the anastomosis end-to-end was completed. Extubation of all patients was performed in the operating room. None of the patients had a tracheostomy tube after surgical treatment. The patients had NGT for decreasing of the gastroesophageal reflux for 6–7 days (the clinical signs of the reflux were not observed due to suction of the gastric secretions) and they had also parenteral nutrition during this time. Esophagography was performed before the patients started with enteral nutrition. None of the patients had a feeding jejunostomy because of the sufficient enteral nutrition. There was no recurrence of the fistula in these patients and they healed without complications.

### 3. Discussion

The coincidence of TEF with TS is not frequent [1]. However, if TEF develops during prolonged tracheal cannulation, it is mostly associated with TS [8,12]. Some authors do not mention any case of TEF in their reports regarding the treatment of TS [2,10,13,14,20]. On the other hand, a simultaneous incidence of TEF and TS is described in the studies of other authors [5,9,19]. The data on incidence of TEF and TS are summarized in Table 2. On the basis of evaluation of these data it is possible to conclude that a simultaneous incidence of TS and TEF is relatively rare. Grillo et al. [9] described a simultaneous incidence of

### Table 1

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<tr>
<th>Characteristics of the patients with tracheal stenosis (TS) complicated with tracheoesophageal fistula (TEF)</th>
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<tr>
<td>Number of patients with TS and TEF</td>
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<td>Sex</td>
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<td>Mean age (years)</td>
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<td>Mean distance of the fistula from the cricoid (mm)</td>
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<td>Mean length of tracheal stenosis (mm)</td>
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<td>Mean distance of stenosis from the cricoid (mm)</td>
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### Table 2

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<th>The incidence of tracheoesophageal fistula together with tracheal stenosis</th>
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<td>Authors</td>
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<td>Delgado et al. (1993)</td>
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TS and TEF in 20 patients (3.8%) in the group of 521 operated patients.

Payne et al. [17] reported on the risk factors contributing to the development of TEF. They include excessive pressure of the cuff, high airway pressure during pulmonary ventilation, excessive motion of the tracheal tube, duration of cannulation, respiratory infection, esophageal infection, hypotension, corticoid administration, NGT, female sex, advanced age, and insulin-dependent diabetes. However, TEF can also develop on the basis of the injury during tracheostomy as we observed in our group of patients.

The diagnostics of TEF is clinical at the beginning and is associated with the presence of the following symptoms: (1) sudden, massive bloated abdomen due to the movement of gases from the ventilatory circuit through the fistula to the gastrointestinal tract; (2) aspiration into the lungs and the signs of unexplained pneumonia, especially in the lower lung lobes; and (3) abnormal secretions aspirated from the tracheobronchial tree. In some patients, the pseudobulbar syndrome after weaning from the ventilator can imitate the symptoms of TEF, which is of course not confirmed by examination.

Bronchoscopy, possibly with the application of methylene blue dye into the esophagus, or esophagography with a water soluble agent exactly define even a small fistula. Maddaus and Pearson [12] reported that esophagography with a water soluble agent is mostly not necessary, and the fistula is well identified by esophagoscopy at the inflated cuff. Analysis of the gases from the stomach during artificial ventilation can indirectly demonstrate the presence of TEF. In our experience, esophagoscopy is not of great importance because the fistula can be overlooked in the mucosal folds of the esophagus. A direct visualization through the tracheostomy opening or bronchoscopy examination through the tracheostoma after decannulation identified in our patients the communication between the trachea and the esophagus with the finding of the nasogastric tube on the base of the defect. CT was performed for the purpose of TS diagnosis but it could also confirm the occurrence of TEF. Normally, CT is not a necessary examination for the diagnosis of TEF.

Treatment of patients with this complication is very difficult because of probable pulmonary complications caused by aspiration, a catabolic phase of the patient’s metabolism and a frequent dependence of the patient on APV [1]. Therefore, it is optimal when the patient, being prepared for surgical intervention, ventilates spontaneously and the metabolic homeostasis is stabilized [11,18]. In the postoperative course, APV endangered both the tracheal anastomosis (by dehiscence or restenosis) and the esophageal closure by recurrence of the fistula. The chance for a successful surgical treatment in such cases is very small [15]. Therefore, a proper timing of the operation for the fistula is an important precondition for successful surgical intervention. The favorable postoperative course in our patients we see in the maintenance of these principles.

Grillo et al. [8] described a single-stage operation technique during which the esophageal fistula is closed with two layers and the segmental resection of tracheal stenosis follows. This technique is used also by other authors [11,15,16]. The controversial view whether to perform a single-stage operation or a second-stage operation is reported by Wolf et al. [21]. We consider a well-timed and single-stage operation to be beneficial for a patient.

In some cases when TEF and TS are excessive in length and resection of TS cannot be performed because of its length, it is possible to use a surgical approach during which the esophageal fistula is isolated, corrected with suture, the esophageal suture line is covered with a strap muscle and the tracheal stenosis is maintained by a tracheal T-tube. This technique allows for oral nutrition and removal of nasogastric tube [15], Galan et al. [7] reported on the patient with TEF and TS of a length of 6.5 cm. In this patient, the authors carried out tracheoplasty of the pars membranacea tracheae with help of the esophageal wall, they excluded esophagus and performed esophagocolic bypass and stenting of the trachea by a self-expanding stent. A simultaneous stenting of the esophagus and the trachea in TEF is dangerous, since it may be complicated by necrosis of the walls of both organs and by exsanguination [3].

If the tracheal stoma is not located at the level of stenosis and fistula, and is not resected during the operation, it may be left in place, and closed later on [4].

When the patient’s condition requires long-term APV, Mathisen et al. [15] recommended the following therapeutic method: (1) to remove the nasogastric tube; (2) to place the balloon of a tracheostomy tube below the site of the fistula; and (3) to perform feeding jejunostomy and gastrostomy as the prevention of esophageal reflux. Radical surgical treatment is appropriate after the stabilization of the patient, as mentioned above. Payne et al. [17] described a successful use of the high-frequency jet ventilation in the treatment of the patients with TEF, as a possibility of prevention of respiratory complications, which allows us to postpone a definite solution to the fistula and to gain time for a radical procedure.

Recurrence of TEF after operation ranges from 3 to 8.3% [4,11,15]. Macchiarini et al. [11] observed paresis of nervus laryngeus recurrent in two patients (6.3%) and delayed tracheal stenosis of the trachea after its resection with a simultaneous closure of TEF in two patients (14.2%). In our group of patients, there was no recurrence of TEF, tracheal restenosis or paresis of nervus laryngeus recurrences.

4. Conclusion

Tracheoesophageal fistula associated with tracheal stenosis is a serious but not frequent complication of artificial pulmonary ventilation. In our experience,
the proper timing of a surgical procedure, and if technically possible, the realization of a single-stage operation are essential for the successful treatment of this complication.

Acknowledgements

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References