

Surgical approach for iatrogenic tracheoesophageal fistula. Case report and literature review

Abordaje quirúrgico de la fístula traqueoesofágica iatrogénica. Presentación de caso y revisión de la literatura

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Abstract

Background: Post-intubation tracheoesophageal fistula is a severe complication in long-term mechanical ventilation patients with possible fatal consequences. **Objective:** To describe a case of post-intubation tracheoesophageal fistula and its surgical management. In addition, a brief literature review was effectuated. **Case report:** 45-year-old female, suffers ischemic stroke with progressive neurological damage that requires long-term mechanical ventilation. During endoscopic gastrostomy tracheoesophageal fistula is shown. **Results:** Undergoes surgery for esophageal repair and tracheal resection, through cervicosternotomy. Unfortunately died in the immediate postoperative period. **Conclusions:** This complex pathology requires structured protocols for its prevention in patients in whom long-term mechanical ventilation is expected.

Keywords: Tracheoesophageal fistula. Tracheal diseases. Median sternotomy. Mechanical ventilation.

Resumen

Antecedentes: La fístula traqueoesofágica es una complicación en pacientes con ventilación mecánica prolongada. La contaminación pulmonar permanente puede ser grave, con evolución fatal. **Objetivo:** Describir un caso de fístula traqueoesofágica posintubación y hacer una breve revisión de la literatura. **Caso clínico:** Mujer de 45 años que sufre un evento cerebrovascular isquémico que condiciona deterioro neurológico progresivo, ameritando ventilación mecánica prolongada. Durante la gastrostomía endoscópica se evidencia una fístula. **Resultados:** Intervenido quirúrgicamente para reparación esofágica y resección traqueal mediante cervicoesternotomía, lamentablemente fallece en el posoperatorio inmediato. **Conclusiones:** Esta patología es compleja. Deben implementarse protocolos enfocados en su prevención en pacientes en quienes se espera una ventilación mecánica prolongada.

Palabras clave: Fístula traqueoesofágica. Enfermedades de la tráquea. Esternotomía media. Ventilación mecánica.

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Introduction

Tracheoesophageal fistula in adults occurs as a result of trauma, malignancy, tracheal necrosis induced by overinflation of the endotracheal tube balloon in cases of prolonged mechanical ventilation, traumatic endotracheal intubation, foreign body ingestion, mediastinitis, or prolonged presence of a rigid nasogastric tube, or as a surgical complication of tracheal resection or oesophageal or mediastinal surgery¹.

Its frequency is estimated to range from 0.3% to 4% of all intubated patients undergoing mechanical ventilation^{2,3}. Its pathophysiology is variable and linked to the mechanism of injury. In cases with prolonged mechanical ventilation, the tracheoesophageal fistula is induced by ischemia of the posterior wall of the trachea caused by overinflation of the endotracheal cuff, which is in contact with a nasogastric tube used to feed or aspirate gastric contents; Wall necrosis with secondary fistula may occur when this condition lasts for more than 2 hours. Risk factors are elevated airway pressure, excessive mobility of the endotracheal tube, prolonged intubation time, steroid treatment, insulin-dependent diabetes, poor nutritional status, chronic hypoxia in cardiopulmonary diseases, prolonged episodes of hypotension, chronic anemia, sepsis, and gastroesophageal reflux^{2,4}.

Iatrogenic injury can be the result of emergency intubation, with injuries other than those that occur in traumatic injury associated with mechanical ventilation. It is characterized by a longitudinal laceration of the posterior tracheal wall. The inflammatory process is progressive, induced by the endotracheal balloon, so there are never leaks into the mediastinum, as seen in traumatic fistula. Perilesional inflammation joins the tracheal and esophageal walls, so mediastinitis never occurs^{5,6}.

Tracheoesophageal fistula can develop after 12 to 200 days of mechanical ventilation, with an average of 40 days, although the time in which it can become symptomatic varies according to the etiology, location, and size of the lesion¹. This also conditions the severity of the symptoms, the urgency, the choice of treatment and the final prognosis. Prompt resolution is important, since permanent lung contamination by food residues and digestive secretions can be very serious, with a possible fatal outcome⁴.

The objective of this paper is to describe a clinical case of post-intubation tracheoesophageal fistula and the surgical management performed.

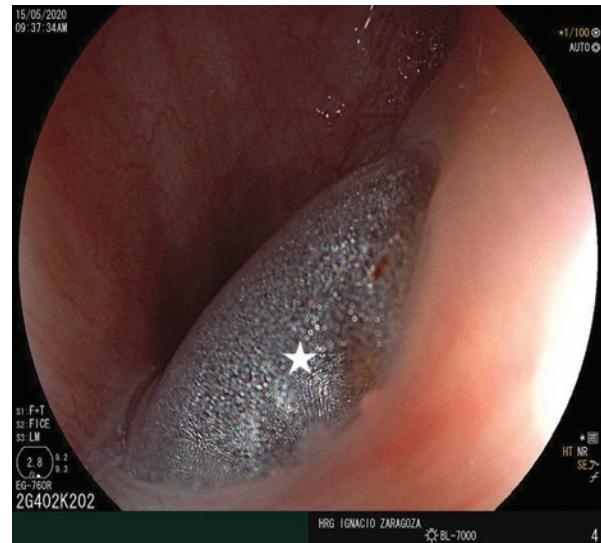


Figure 1. Endoscopic image showing the protrusion of the balloon (indicated with a star) of the endotracheal tube towards the esophageal lumen.

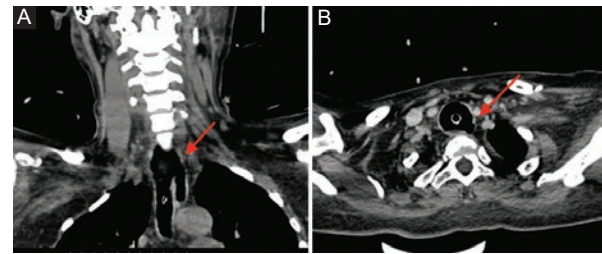


Figure 2. Computed tomography showing the fistula between the trachea and the esophagus at the level of C7-T1 (arrow) as a hypodense tract with gas density. **A:** coronal cut. **B:** sagittal cut.

Clinical case

A 45-year-old woman, with no significant medical history, was admitted to the emergency department due to sudden gait disturbance. On physical examination, he is alert, conscious, oriented, without focalization data, hemodynamically stable, with sinus bradycardia, but without low output data, with preserved ventilatory mechanics and abdomen without pathological data. On admission, a computed tomography of the skull was performed, which evidenced an ischemic-type cerebral vascular event, with edema that displaced the midline. Assessed by the neurosurgery service, it is concluded that she is not a candidate for surgical management. Two days later, presented a new acute neurological deterioration, with a score on the Glasgow Coma Scale of 6 points (O1, V1, M4): localized pain, mydriatic pupils, no response to light

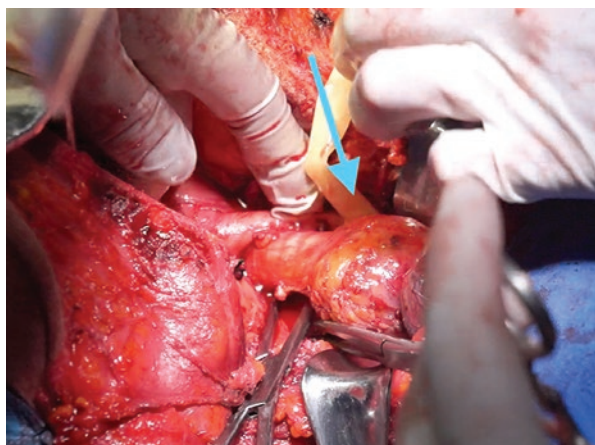


Figure 3. Intraoperative image of the tracheoesophageal fistula secondary to hyperinflation of the endotracheal cuff (arrow), with a healthy portion of the distal trachea above the brachiocephalic trunk.



Figure 4. Intraoperative image of the esophageal defect, below the pharyngeal constrictor muscle, with revitalized edges to allow primary closure.

stimuli. Advanced management of the airway with mechanical ventilatory support was carried out, progressing with torpid evolution towards deterioration with no possibility of progression for weaning from mechanical ventilation, developing pneumonia associated with mechanical ventilation and secondary septic shock. Forty-five days after intubation, a gastrostomy tube is placed endoscopically, which identifies a complex tracheoesophageal fistula (Fig. 1). Cervical computed tomography reports a 30 × 33 mm anteroposterior and laterolateral increase in diameter of the trachea at the level of C7 and T1 below the cricoid cartilage, with a 2.5 mm defect in the posterior

wall of the trachea, forming a fistulous tract. towards the anterior wall of the esophagus, recovering the interface at the level of the aortic segment of the esophagus (Fig. 2).

Scheduled for tracheostomy and esophageal reconstruction. The transverse cervical approach is started 2 cm above the jugular notch and median sternotomy with an automatic saw. Tracheoesophageal fistula (Fig. 3) and the vascular structures, supra-aortic trunks, and venous systems. The esophageal defect is identified (Fig. 4) in its cervical portion, approximately 4 cm in diameter. We proceed to perform primary closure of the defect with 2-0 Vicryl® suture in one plane and then a muscle patch is placed. A V-shaped tracheostomy is performed 5 cm above the carina, and a new sterile endotracheal cannula is placed (Fig. 5). Subsequently, the anesthesiology department deflates the cuff, removes the orotracheal cannula with secretion aspiration, and reconnects it to the ventilation circuit with the previously described endotracheal cannula. Tracheal resection and end-to-end anastomosis are performed with Prolene® 4-0 with simple sutures outside the mucosa (Fig. 6). The sternotomy was closed with a wire suture using the hemi-Robicek technique and the cervicotomy was closed by planes, after drain placement. Unfortunately, the patient died in the immediate postoperative period due to multiple organ failure.

Literature review

The trachea is a cartilaginous tubular structure that connects rostrally with the larynx and caudally with the main bronchi. The lower border of the cricoid cartilage defines the beginning of the trachea, and the carina its terminus, normally at the level of the T4 vertebral body. On average it measures 11.8 cm. It is made up of 18 to 22 rings with C-shaped cartilages and a posterior membranous wall that connects the ends. Each tracheal ring averages 4 mm in height and the wall thickness is approximately 3 mm. The right and left lobes of the thyroid gland lie anterolateral to the proximal trachea, and the isthmus crosses anteriorly at the second or third tracheal ring. The esophagus is in close relationship with the trachea. The outer limit of the pharyngoesophageal junction is the cricoid cartilage. In the esophagoscopy, this is 15 cm from the dental arch. The esophagus lacks a serosa and consists of an external longitudinal muscular layer and an internal circular muscular layer. The cervical esophagus is approximately 5-7 cm long and

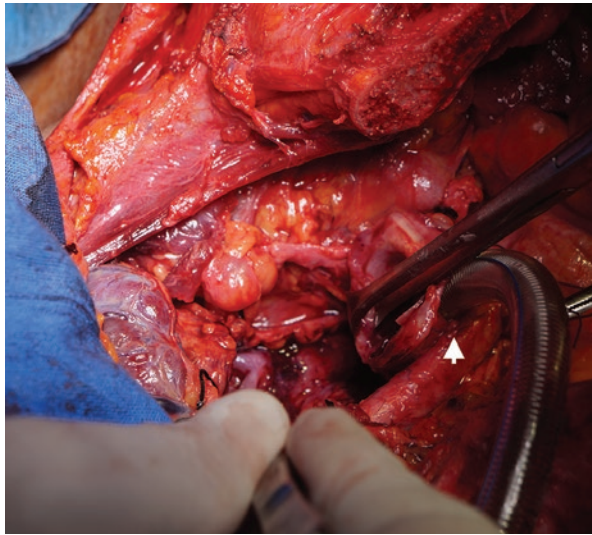


Figure 5. Intraoperative image after resection of the fistulized tracheal portion with tracheostomy in the distal end (arrow) and cannula with a steel core connected to the ventilation circuit.

contacts the posterior aspect of the cricoid cartilage and the trachea, anterior to the long neck muscle and the vertebral bodies; It descends in contact with the vertebral column to the upper part of the posterior mediastinum. It is related from behind to the cervical spine and prevertebral muscles, from which it is separated by celluloadipose tissue, which constitutes a space for surgical dissection. Anteriorly it is attached to the trachea by easily separable fibromuscular tracts (tracheoesophageal muscle). The neurovascular bundle of the neck (common carotid artery, internal jugular vein, and vagus nerve) runs lateral to and slightly anterior to the esophagus; the lateral lobe of the thyroid gland is in contact with the esophagus, which sometimes requires ligation and sectioning of one or several thyroid veins. Recurrent laryngeal nerve injury, whether by complete or partial transection, traction, contusion, thermal injury, ischemia, or tumor invasion, can cause vocal cord paresis or paralysis that results. It can lead to dysphonia, complete loss of voice, or compromised airway, depending on the extent of the lesion and the integrity of the contralateral nerve. The surgeon must be cautious about the course of these nerves during dissection of the proximal trachea⁷⁻⁹.

Tracheoesophageal fistula should be suspected clinically if massive distension of the abdomen, abnormal secretions, or aspiration of gastro-alimentary contents from the tracheobronchial tree occur. Confirmation of clinical suspicion can be done by upper

endoscopy, in which the endotracheal balloon is observed protruding into the esophageal lumen through the fistulous tract. Fiberoptic bronchoscopy should be performed to define the exact site and dimensions of the fistula, as well as to demonstrate concomitant laryngeal or tracheal stenosis.^{10,11}

Qureshi et al.⁶ they evaluated the etiology and classified the aerodigestive fistulas according to their anatomy, proposing a therapeutic algorithm divided into surgical and non-surgical; the latter subdivided into conservative, endoprosthetic and palliative. Repair must be anticipated with multiple essential preliminary steps, including weaning from mechanical ventilation and control of associated comorbidity. If weaning from mechanical ventilation is not possible, most authors suggest palliative measures to prevent complications, such as removal of the nasogastric tube, placement of the endotracheal tube cuff distal to the fistula, diverting gastrostomy, and enterostomy or jejunostomy for feeding in order to reduce reflux and contamination of the bronchial tree with gastric contents; the latter also makes it possible to promote nutritional status in conjunction with the administration of parenteral nutrition^{10,11}. In this way, it is possible to avoid expanding the fistula and contamination of the airway by gastroesophageal reflux, allowing to continue with mechanical ventilation and adequate nutrition¹².

Preoperative evaluation and preparation includes computed tomography of the larynx, trachea, and lungs, flexible or rigid bronchoscopy (or both), and upper gastrointestinal endoscopy in all patients. Recurrent pulmonary infections and control of aspiration are treated with physical therapy, discontinuation of oral intake, and antibiotics. Spontaneous resolution is illusory, because the edges may be epithelialized. Surgery is the only curative treatment and the main objectives it pursues are the closure of the fistula and the prevention of its recurrence^{3,5}.

The choice of surgical technique for post-intubation tracheoesophageal fistula repair remains controversial. The surgical approach can be through cervicotomy with or without median sternotomy. Most fistulas are located in the upper and middle part of the esophagus/trachea, and can be operated through a low cervical incision. If the tracheoesophageal fistula is located distally, a partial sternotomy may improve exposure of the carina. Fistulas located in the carina, or very distal in the trachea, should be approached through a right thoracotomy in the fourth intercostal space. Consequently,

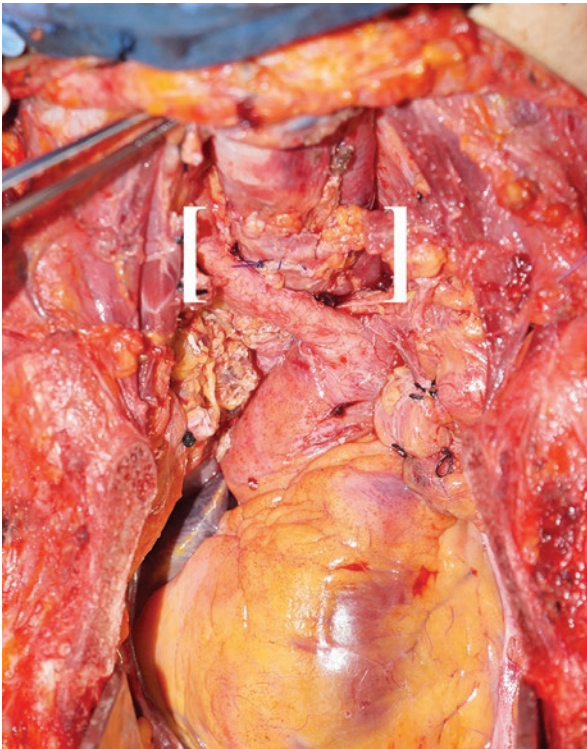


Figure 6. Intraoperative image of the end-to-end tracheal anastomosis (in brackets), above the brachiocephalic trunk. The left innominate vein was sectioned.

bronchoesophageal fistulas should be operated via a thoracotomy on the affected side⁵.

A low "collar" incision and upper sternotomy are sufficient for most repairs. The repair is performed by direct suture closure in a single surgical act, with tracheal resection and anastomosis, with primary esophageal closure and overlapping muscle flaps. If preferred, the approach can be in two stages, through esophageal bypass and primary closure of the tracheal defect to later perform an esophageal replacement by gastric lift or colonic transposition. Another option is to place *stents* self-expanding coated metal esophageal tubes. The choice of repair method depends on local conditions, dependence on mechanical ventilation, and the general condition of the patient.¹¹

Dhiwakar et al.¹³ compared different case series and described some key points in the surgical management of tracheoesophageal fistula: preoperative gastrostomy/jejunostomy, concomitant tracheal stenosis, fistula healing, mortality, and postoperative follow-up. Complications associated with tracheal resection with anastomosis include anastomotic dehiscence, emphysema, and pneumomediastinum^{14–16}.

Mortality rates range from 0.5% to 10.5%; however, they are not comparable according to the etiology of the fistula, whether it is malignant or not. Mortality related to infectious complications due to fistula recurrence or poor patient conditions is significantly increased in relation to patients undergoing surgery who are still dependent on mechanical ventilation and with associated pneumonia¹¹.

Discussion

Surgical treatment for tracheoesophageal fistula is described in the literature as a complex procedure with high morbidity and mortality. Despite the fact that weaning from mechanical ventilation is recommended before repair, some cases have been reported in which definitive treatment is considered despite the critical situation of the patient.^{3,17}

When definitive surgical treatment cannot be carried out, some strategies are planned to allow the resolution of pulmonary sepsis. Such strategies include esophageal bypass and tracheal stents in conjunction with temporary esophageal closure with muscle patches. Mechanical ventilatory support in the immediate postoperative period implies poor healing, fistula recurrence, and risk of mediastinitis^{11,18}.

Cougar, et al.¹² described two patients who underwent surgical treatment, despite the unsatisfactory results of prolonged preoperative preparation, considering the following: 1) increase in the size of the fistula and multiple recurrent episodes of pneumonia, repeatedly requiring the restart of mechanical ventilation, previously withdrawn; and 2) a distal defect that made it difficult to place the endotracheal cuff below the fistula, in a patient with a complicated weaning process due to neurological damage.

Surgery should be considered very cautiously in patients dependent on mechanical ventilation, but in the opinion of the authors this should not be considered an absolute contraindication for surgical closure of the tracheoesophageal fistula. Each case must be evaluated individually.

Mortality in these patients reaches 18.9% despite adequate surgical treatment. Bayrak et al.¹⁹ describe their experience with a 50-year-old male patient who suffered a traffic accident and became a quadriplegic, with home mechanical ventilatory support, underwent surgery and was discharged on postoperative day 14, with a 3-year survival after surgery.

On the other hand, Cream, et al.²⁰ describe a case of a 27-year-old male patient who ingested caustic, who

presented dysphagia, odynophagia, and retrosternal pain 14 days later. An endoscopy was performed that revealed a wide fistula between the esophagus and the right bronchus, and surgical treatment was carried out in two stages, first performing terminal cervical esophagostomy and gastrostomy, with restitution of intestinal transit 8 months later by means of pharyngocoloplasty.

Laryngotracheal surgery is associated with an increased risk of airway-related complications, making anesthetic management challenging. Therefore, open and continuous multidisciplinary communication optimizes results. Anesthetic planning is relevant. It has been documented that adverse events occur in up to 70% of surgical procedures, including intraoperative and recovery.²¹

When faced with a patient with a tracheoesophageal fistula, the anesthesiologist should begin with a thorough pre-anesthetic assessment, with emphasis on comorbidity and the type of fistula. You must pay attention to ventilation and oxygenation preoperatively and postoperatively as you are dealing with a critically compromised airway. Close monitoring of respiratory and hemodynamic parameters is required to achieve adequate oxygenation and elimination of carbon dioxide, emphasizing pharmacological management, in order to improve surgical conditions and maintain intraoperative hemodynamic stability. For this, an arterial line must be channeled, preferably the left radial artery, since the right receives its perfusion from the brachiocephalic trunk, which crosses the trachea and can be compressed during the intervention^{22,23}.

In extubated patients, not dependent on respiratory support, the success rate of surgical repair is close to 90%. Operative mortality is approximately 13% and the recurrence rate is 6.6%.³ Abstaining from treatment may be appropriate in situations with no prospects for the future, but in a young, working-active patient with no comorbidity prior to the cerebrovascular event that conditioned her hospitalization, there are countless doubts, and any treatment option is subject to controversy.

In conclusion, structured protocols for the prevention of tracheoesophageal fistula should be implemented, including the appropriate selection of the endotracheal tube, the periodic review of the pressure of the endotracheal cuffs (if possible every 8 hours) with emphasis on maintaining pressures less than 25 mmHg, and consider early tracheostomy (within the first 2 weeks)^{24,25}. In cases in which, despite these measures, a tracheoesophageal fistula occurs, adequate preparation, selection of the surgical approach, and postoperative monitoring improve the prognosis of patients.

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Conflicts of interest

The authors declare they have no conflicts of interest.

Ethical disclosures

Protection of people and animals. The authors declare that no experiments were carried out on humans or animals for this research.

Data confidentiality. The authors declare that they have followed the protocols of their work center regarding the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

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