Acquired esophago-respiratory fistulae in adults

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Abstract: Esophago-respiratory fistulae (ERF) are an uncommon group of abnormal connections between the esophagus and various locations in the respiratory tract. While rare, they confer significant morbidity and mortality, especially given that the majority of ERF in adults are acquired due to malignancy. As a result, management strategies are often complicated and should be undertaken with consultation between oncology, thoracic surgery, gastroenterology, and interventional pulmonary colleagues. In this review article we discuss the epidemiology, clinical presentations, etiologies, and diagnosis of ERF. We also discuss management strategies, complications related to management, and the differences in management between benign and malignant etiologies with a focus on bronchoscopic interventions.

Introduction

Esophago-respiratory fistula (ERF) is a rare disease defined as an abnormal tract between the esophagus and respiratory tract. Types of fistulous connections include tracheoesophageal (TE), broncho-esophageal or tracheo-broncho-esophageal, and esophago-pulmonary fistulas. Loss of airway wall integrity can result in airway fistulas that can be congenital but are usually acquired. Management and prognosis depend on whether they are from a benign or malignant process. Esophago-respiratory fistula is a life-threatening disease with significant pulmonary complications related to recurrent aspiration pneumonia, ongoing airway contamination, malnutrition, respiratory failure, and death (1,2). Congenital fistulas of are often diagnosed in early childhood and are usually associated with esophageal atresia at birth. Most ERF in adults are acquired and are due to esophageal and pulmonary malignancies (3).

Non-malignant causes of ERF may be iatrogenic, infectious, inflammatory, traumatic or related to caustic or foreign body ingestion (2,4). This review will focus on the etiology and endoscopic treatment modalities of acquired ERF in adults.

Prevalence, epidemiology, anatomy and risks

Congenital aerodigestive fistulas are rare, occurring in 0.04% of all live births. They arise when there are abnormalities in the formation of the laryngo-trachea tubes (which divide into the trachea and esophagus) in the fourth week of embryonic development (5). Fistulas develop when the septum between the esophagus and tracheal is incomplete or perforated. These cases are associated with other congenital abnormalities such as vertebral atresia, esophageal atresia, anal atresia, and cardiac malformations as part of the VACTERL/VATER association (6). This combination of defects may include vertebral defects, anal

Table 1 Common causes of ERF

Malignant causes
Esophageal malignancy
Pulmonary malignancy
Lymphoma
Metastatic disease
Benign causes
Postoperative[a]
Radiation induced
Intubation associated
Inflammatory disease
Esophageal diverticula
Esophageal/tracheal stents
Granulomatous disease (tuberculosis, histoplasmosis)
Caustic ingestion
Foreign body
Other
Unknown

[a], esophageal surgery, cervical spine surgery, thoracic surgery, non-esophageal gastrointestinal surgery. ERF, esophago-respiratory fistulae.

atresia, cardiac defects, tracheoesophageal fistula (TEF), renal anomalies, and limb abnormalities. Congenital TEFs and esophageal atresia are classified using the Gross-Vogt Classification Acquired ERF in adults can be related to malignant or benign diseases. It is depending on their anatomy (7).

Uncommon for patients with undiagnosed congenital ERF to reach adulthood (8). Before the 1960s, the most common causes of ERF were trauma and granulomatous infection. Depending on the series referenced, the prevalence of benign ERF and can account for up to 50% of all ERF (4,9). A recent retrospective review of 123 ERF patients from the Mayo Clinic showed 47% of patients had a benign disease. Postoperative ERF was the most common cause of benign etiology and was seen in 60%, followed by radiation-associated, intubation-associated and diverticula-associated ERF (9). Other causes of ERF include tracheal or esophageal stents, granulomatous diseases such as tuberculosis and histoplasmosis, blunt trauma to the mediastinum, and foreign body or caustic ingestion (2,10).

Over 50% of ERFs are related to locally advanced and active mediastinal malignancies and mostly esophageal cancer (1,11).

In both benign and malignant ERF, the fistula site is between the esophagus and the trachea in 52–57% of cases, between the esophagus and the left or right main bronchi in 37–40% of cases and between the esophagus and the lung parenchyma in around 3–11% of the cases (1,12). After ERF is acquired, spillage of esophageal contents into the airway results in respiratory distress, infection, pneumonia and possible obstruction of the airways. The size of the fistula correlates with the extent of airway contamination (13).

Malignant and non-malignant

Table 1 summarizes causes of ERFs.

Malignant ERF

Esophago-respiratory fistula can occur in 5–15% of all patients with esophageal cancer, but less common in patients with lung cancer (1,3,14). In patients with malignant ERF, 92% have esophageal cancer, 7% have bronchogenic carcinoma and the rest are related to other mediastinal malignancies such as lymphoma, malignant mediastinal node disease, thyroid or laryngeal carcinomas (1,2,4,14). Most occur spontaneously due to tumor invasion or as a complication of cancer therapies including surgery, radiation, chemotherapy, laser treatment, instrumentation, or pressure necrosis caused by a previous stent (15-17). The use of antiangiogenic therapy such as bevacizumab combined with chemotherapy and/or radiation has been described in ERF (18-20).

The trachea and proximal left main stem bronchus are anterior to the esophagus. Esophageal tumors can invade the thin membranous tracheal wall and the tracheal mucosa. As tumor growth continues, so does necrosis in the tumor, which forms the ERF. Esophageal tumors may also adhere to the membranous part of the trachea causing an ulcer into the tracheal lumen. As necrosis occurs in the tumor, a fistula form (21).

For lung cancer to cause ERF, it must arise on the membranous part of the trachea adjacent to the esophagus. The tumor will grow and undergo necrosis to cause the fistula.

Compared to cancer patients without ERF, these patients present with more advanced stage disease with a longer segment of tumor frequently involving the upper and mid-thoracic esophagus. The median time from diagnosis

of esophageal cancer is 8 months but can be the initial presentation in 6% of cases. The median survival time from diagnosis of ERF is 8 weeks (1). Most patients die from respiratory infections and poor nutrition if not treated (21).

Esophageal and mediastinal procedures can be complicated by ERF. Esophageal dilation or resection in patients with esophageal malignancy are at risk for developing ERF (2,11). During mediastinoscopy for sampling of mediastinal nodes, esophageal injuries can occur, particularly when sampling station 4L (left lower para-tracheal) and 7 (sub-carinal) nodes. These injuries can cause mediastinitis and ERF (22).

ERF can complicate esophageal stents placed for prior strictures in about 4% of cases where pressure necrosis and fistula can occur at the level of previously treated tumor or at the ends of the stent (22). The risk may be increased in patients with prior radiation therapy and high Charlson comorbidity index scores (23). Esophageal stents when coupled with tracheal stents or endotracheal tube/tracheostomy balloons can exert outward pressure on the tracheal wall that can stretch and thin the trachea and esophageal walls which are already compromised with malignancy. These forces over time may cause ERF (24). Dual stenting, a stent in the trachea and the esophagus may compress the tracheal and esophageal tissue between these two stents, compressing its blood capillaries and cause ischemic damage to the tissue which may also contribute to the TEF formation. It has been shown that esophageal stenting, when used as a secondary treatment following endoluminal tumor debulking, carries an increased risk of stent-induced esophageal rupture than stenting without local treatment (24,25).

Non-malignant ERF

Less than 50% of all ERFs are benign (4,26). In the last 50 years, less have been infectious in etiology and more related to tracheal or esophageal instrumentation and mediastinal inflammation. Iatrogenic causes make up 75% of benign cases with the most common being postoperative (2,9). Esophageal stents placed for benign stricture can cause ERF. In 1967, Flege was the first to report ERF caused by cuff related injury in patients mechanically ventilated.

The increased use of cuff tubes for intubation has led to increased tracheal and potentially esophageal damage from hyperinflated endotracheal tube cuffs (27). This now occurs less frequently with the use of high-volume and low-pressure cuffs. A fistula can result from a hyper-inflated

endotracheal tube cuff. Secondary erosion of tracheal and esophageal walls occurs with an incidence of 0.3% to 3% in mechanically ventilated patients (26). Traumatic intubations or tracheostomies may also injure the posterior tracheal membrane causing ERF formation (28-30).

Following iatrogenic causes of benign ERF are causes related to mediastinal inflammation. A review from Lenz and colleagues from 2001 to 2012 revealed 5 of the 58 patients with benign ERF to be from radiation, 3 from esophageal diverticula, 1 each related to caustic ingestion, broncholithiasis, tracheal stenosis and actinomyces (9). Mediastinal infections, usually granulomatous infections from tuberculosis or histoplasmosis, can lead to benign ERF. In contrast to the study from Lenz and colleagues, granulomatous infections accounted for 14% of the 35 patients with benign ERF reviewed by Shen and colleagues from 1978 to 2007 (2). This discrepancy in etiologies of the ERFs across the two studies can be explained by decrease in granulomatous diseases and better treatments for them in USA in the recent years compared to the 1970s.

An emerging and difficult to treat cause of benign ERF is seen in patients with a history of malignancy that were presumed to be cured at the time of their fistula presentation. In these patients, fistulas arise as a consequence of prior oncologic treatment including surgery, esophageal or airway stent placement, chemotherapy, radiation or a combination of these (11). Among patients with a prior malignancy that had been irradiated, Balazs and colleagues noted fistula formation an average of 4 months post radiation with only 4 patients developing fistula within 4 weeks of irradiation (1). This was suggested to be related to longer survival post-treatment rather than irradiation itself. This has been suggested by Martini and colleagues reporting on 111 cases of malignant ERF where fistulas where seen in 74% of cases following radiation as well as in 26% of cases prior to radiation with the authors concluding that radiation did not increase the incidence of fistula formation (31). Radiation may be associated with fistula formation from chronic inflammation and subsequent scarring in the radiation field in the setting of an already compromised esophageal wall with prior tracheal wall impingement and indentation by tumor.

Motor vehicle accidents with blunt trauma to the chest from the steering wheel can rarely cause direct rupture of the trachea and esophagus. Most are delayed and resulting from compression of the trachea and esophagus between the sternum and vertebral bodies which can impede blood supply to the esophagus and leading to necrosis and fistula

Table 2 Clinical symptoms and signs of ERF

Clinical symptoms
Cough
Fever
Dysphagia
Chest pain
Hemoptysis
Dyspnea
Stridor
Clinical signs/syndromes
Recurrent aspiration
Recurrent pneumonia
Sepsis
Malnutrition
Mediastinitis

ERF, esophago-respiratory fistulae.

formation. Immediate esophageal and tracheal rupture can lead to early fistula formation (32).

Clinical presentation

Most patients present with recurrent and difficult to treat pneumonias and sepsis with aspiration pneumonia seen in 95% of the 264 subjects studied by Balazs and colleagues (1). *Table 2* displays clinical signs and symptom.

Intractable cough, especially after swallowing, is the most common symptom and dysphagia and Ono's sign or cough soon after eating can be reported (4,17,24). Cough and recurrent pneumonia can be non-specific and seen with chemoradiation and the diagnosis of ERF is often delayed by 1–18 months from initial symptoms (1). Patients can have mild hemoptysis, dyspnea and stridor if the primary site is the trachea (22). Some may cough up food particles that are sometimes bile stained (33). Patients may report weight loss and often have low functional status related to chronic aspiration, malnutrition and chronic inflammation. Symptoms related to the primary disease-causing ERF such as cachexia due to malignancy are also present. Ninety percent of patients with malignant ERF have advanced or metastatic disease with high Eastern Cooperative Oncology Group (ECOG) scores (1,34).

Patients may have a recent history of esophageal cancer, chest trauma, esophageal or tracheal instrumentation while presenting with fevers and chest pain related to mediastinitis. Intubated patients may have choking, coughing with feedings, aspiration of food contents, positive cuff leak, unexplained gastric distension caused by inflation of the gastrointestinal tract through the fistula under positive pressure ventilation and incongruence of inhaled and exhaled tidal volumes from loss of gas into fistula (4,28).

Diagnosis

While diagnosis can be suspected from medical history and symptoms, thin-cut computed tomography (CT) of the chest with oral and intravenous contrast or a contrast esophagogram are useful for diagnosis and for localization of fistula (34). While there is little data to support routine CT scan in acquired ERF in adults, the pediatric literature does not support routine use of CT imaging (35). Bronchoscopy and esophageal endoscopy are the procedures of choice to diagnose ERF and also important for treatment planning. A flexible bronchoscope should be inserted and the endotracheal tube or tracheostomy cuff deflated and withdrawn to visualize a tracheal defect. Direct visualization of large open connections, and the lumen of the other organ or an intraesophageal nasogastric tube may be visible. For malignant ERF, Balazs and colleagues showed 70% of patients to have tumors in the middle third of the esophagus. Tumors were large with a mean size of 7.6 cm. Tumors in the lower third corresponded with longer tumor life and local recurrence. On the airway side, 45% of fistulas were in the right main bronchus, 32% in the trachea, 13% at the bifurcation, 8% in the left main bronchus and 1.5% in the lung parenchyma. Sixty-eight percent caused bronchial stenosis and a necrotizing cavity was seen in 13% (1).

Very small fistulas can be hard to detect and may be seen when material is coming from the esophagus into the trachea. Granulation tissue may be seen around the defect with a pin-point fistulous connection. Oral ingestion of methylene blue prior to bronchoscopy or instillation in esophagus with endoscope during bronchoscopy can assist in diagnosis of small fistulas (36,37).

Collaboration between the pulmonology and the gastroenterology teams is required to diagnose these cases.

The diagnosis of ERF can be made with a barium or gastrografin made by McKesson (diatrizoate meglumine and diatrizoate sodium) swallow study. Ingestion of barium contrast or gastrografin followed by posterior-anterior and lateral view radiographs of the chest and neck will show

contrast in the airways, confirming a diagnosis. However, large volume barium aspiration can cause pneumonitis. Iodinated contrast mediums should be avoided as they can cause severe lung injury. Most radiology departments will choose the appropriate amount and type of contrast once they know there is a concern for ERF.

Treatment modalities

The goal of treatment is to improve nutritional status and prevent aspiration and pneumonia. Most pediatric cases are treated surgically with good outcomes. In adults, most acquired ERFs are treated non-surgically, especially in patients with malignancies. Lenz and colleagues reviewed 123 patients with acquired ERF and initial treatment strategy was nonsurgical in 72% of patients with benign disease. Patients with a lower Charlson comorbidity scores were more likely to undergo surgical repair. Operative closure maybe the treatment of choice in select patients with larger fistulas, better prognosis and clinical stability (9). Surgical options include esophageal bypass, resection, direct closure of fistula, collar esophagostomy with gastrostomy or jejunostomy (4,38).

Surgical technique and outcomes are not the scope of this article, thus we will focus on endoscopic treatments.

Prior to repair, supportive care includes optimizing nutrition and treating pulmonary infections. To rest the esophagus, nutrition is provided through gastrostomy or jejunostomy tubes, naso-jejunal feeding tubes or parenterally.

Endoscopic management

Airway and esophageal stenting can be used as a bridge to surgery or when patients are not surgical candidates. It has been shown to have high technical success with low morbidity (11). The goal is to create a seal between the lumen of the esophagus and the airway to enable enteral feeding and prevent bronchial contamination.

Esophageal stenting

Esophageal stenting is the most frequently employed initial treatment modality in ERF (9,11). Covered self-expanding metallic stents (SEMSs) are typically chosen to avoid tumor invasion and to cover the fistula (11,38). These are chosen over plastic prosthesis because of lower migration rates and improved seal (39,40). Partially covered SEMS can be used for palliation in patients with unresectable esophageal cancer invading into the trachea. Partially covered stents may have a higher rate of tumor ingrowth but less migration from embedding into esophageal wall. Fully covered stents may be more likely to migrate (41). The length of the esophagus allows for the extent to safely extend 20 millimeters (mm) from both the proximal and distal extent of the fistula with sizes of stents ranging from 18 mm in diameter by 90 mm in length to 25 mm in diameter by 150 mm in length. Placement under general anesthesia with fluoroscopic guidance is usual (11). The middle third of the esophagus is the most common location of ERF (1,21). Technical difficulty of stent placement is increased by proximal strictures, where the fistula is located in the cervical esophagus close to the upper esophageal sphincter (UES) (42).

Over-the-scope clips can be done in combination with esophageal stents or as a second procedure. Other interventions include endoscopic clips, esophageal stents combined with sutures, esophageal stents combined with bronchoscopic cautery or argon plasma coagulation (11).

Airway stenting

TEFs are more common than fistulas affecting the left or right main stem bronchi (1,12). The goal of airway stenting is to cover the fistula to avoid further contamination (stent length) as well as to avoid stent migration (radial expansile force). This is more difficult than in esophageal stents due to cartilaginous rings and dynamic respiratory changes (42).

Airway stents may be placed initially when there is symptomatic airway obstruction or when ERF has been caused by an esophageal stent. Esophageal stenting should follow if the fistula is still seen endoscopically or on esophagram (40,43). Concomitant stenting should be considered in fistulas larger than 20 mm to cover the defect and to avoid esophageal stent migration. Up to 24% of patients may require esophageal and airway stents as initial therapy (9,39,40). Airway stenting can be considered as monotherapy if the esophageal end of the ERF is close to the UES, esophageal stricture or necrosis is present prohibiting safe passage of a guide wire or a scope distal to the fistula. Subsequent airway stenting may be required if the esophageal stent failed to cover the fistula or resulted in airway obstruction (42,43). In a review of 39 patients with ERF and esophageal stents, Colt and colleagues reported 25% developing airway obstruction requiring silicone airway stents (39). Lenz and colleagues reported 24% of

Table 3 Complications of endoscopic stent placement (9,48,49)

Airway stents
Stent malposition
Stent migration
Granulation tissue formation
Cough
Impaction
Stent fracture
Airway rupture
ERF
Esophageal stents
Stent malposition
Stent migration
Chest pain
Gastroesophageal reflux/aspiration
Dysphagia
Procedural complications
Tracheal compression from stent
Need for prolonged intubation bleeding
Death
ERF

ERF, esophago-respiratory fistulae.

patients requiring simultaneous esophageal and airway stents as initial therapy. Another reason for monotherapy using airway stents may be when fistulas connect to the lung parenchyma and esophageal stenting does not seal the fistula. In these cases, a stent may be placed in the airway of the destroyed lung parenchyma to close off the airway.

Choice of airway stent, methods of placement, after care and follow up

Silicone Y stents are used to treat fistulas at the carina, proximal left or right main stem bronchi and tracheal stents to treat defects located in proximal, middle and distal trachea. Undersized stents will not seal the fistula and can migrate, whereas, over-sized stents may dilate the fistula by causing tension on the wall from high radial force. Silicone or plastic stents have higher expansile or radial force than SEMS (42). If the stent is mal-positioned, further

instrumentation to remove or re-position the stent may dilate the fistula. For TEF, it is recommended to use stents at least 40 mm in length, with around 20 mm of overlap on each side of the fistula. Dimensions of the trachea should be measured on imaging and endoscopically (38). A silicone Y stent can only be placed with rigid bronchoscopy. Studs on silicone stents are designed to prevent migration, however this remains a common complication. Self-expandable metal stents can be placed under fluoroscopy using guides wires either with flexible bronchoscope or under direct visualization with rigid bronchoscopy. Covered SEMS may better conform to the uneven tracheal dimensions (17,44). All airway stents should be placed under general anesthesia.

Complications

Procedural complications are reported in 0–17% of procedures and mortality from the procedures is reported to be around 2% (1). Complications include tracheal compression following esophageal stent placement in 7–10% and respiratory failure requiring transient ventilation in 6% (1,3,12,40,45-47). Adverse events are seen more commonly in malignant ERF and in patients with proximal fistula (11). Adverse events include stent migration (up to 33%), pain (27%), new stenosis or fistula, dysphagia, bleeding at fistula site, reflux (more likely in distal esophageal stents), pneumonia and stent infolding (9,11,48). Use of concomitant airway stents may not increase procedure related complications but clinical success rates were lower than monotherapy in a series reviewed by Silon and colleagues (33% *vs.* 54%) (11). Complications from airway stents include migration, obstruction and stenosis from granulation tissue, mucostasis and airway perforation (49). A summary of complications can be found in *Table 3*. Pulmonary toilet using frequent nebulized saline treatments should be maintained in patients with airway stents immediately after placement and while stents are in place to help humidify the airway and avoid obstruction (38). Surgical complications in malignant ERF repair have been reported to be as high as 40% with a mortality of 14% (50).

Outcomes

Technical and clinical success has been good for both surgical and endoscopic repair of ERF, but there have been no large trials to show how well esophageal and/or airway stents control symptoms or prolong survival in patients

with ERF.

If a patient is clinically stable, surgical repair should be considered in carefully selected patients. Lenz and colleagues showed surgery can be an appropriate treatment in certain patients with malignant ERF with improved survival compared with nonsurgical treatment. This was not significantly different in benign ERF. Reintervention was also more common in nonsurgical treatment in benign disease but not significant in malignant ERF. The prolonged survival related to surgical correction of ERF is likely related, in part, to better overall clinical status of the patient prior to repair (9).

For nonsurgical treatments, endoscopic treatment significantly improves dysphagia, dyspnea, and performance scores (51). Advancement of oral intake after endoscopic treatment is an important palliative outcome in patients with poor survival and can be seen in up to 75% of patients treated endoscopically (11). Technical success is high but does not always correlate with clinical success confirmed by follow up radiographic or endoscopic evaluation and/or lack of recurrent aspiration and durable ERF closure. Clinical failure of initial treatment and need for repeat procedures such as replacement of esophageal stent, over-the-scope clip or airway stents may be indicated in patients with ongoing aspiration, stent migration or persistent fistula. The literature shows 67–100% clinical success (9,12,14,24). Durable clinical success falls to 47–80% when evaluated at a follow up time of less than 3 months (9,11,14). Rates of fistula recurrence can be seen in up to 20% of patients (12,14). The funnel phenomena, or spillage of contrast medium through a gap between proximal stent margin and esophageal wall despite proper stent position is a common cause of clinical failure along with size and extent of fistula (14,46). Follow up may include an esophagram at 1 week and then every 1–2 months to evaluate for persistent fistula closure (2). Airway follow up should include repeat bronchoscopy at 4 weeks and then as needed if concern for treatment failure arises (42).

Outcomes based on fistula location have been described and show proximal ERF as being the most difficult to manage with the lowest clinical success rate, decreased survival, highest rates of adverse events and recurrent aspiration despite endoscopic therapy (11,46). This may be due to potential contamination of the left and right main stem bronchi as well as difficulty in placing stents too close to the UES (11). Alternatively, Herth and colleagues described outcomes based on tracheobronchial location

showing fistulas in the right main bronchus having lower survival than those in the trachea, carina or left main stem bronchus (40). The authors concluded that fistula in the right main bronchus reflects increased severity of disease given its increased distance from the esophagus.

Early closure of the ERF with stents has shown improved survival in small studies when compared to standard treatment with bowel rest using PEG tube feeds. This improvement in survival was seen early on in the disease process, reflecting the stents efficacy in controlling sepsis and limiting pneumonias (3). In a series of 264 patients there was a three-fold increase in mean survival in patient with stenting of the fistula from 1.1 to 3.4 months (1). The average survival reported for malignant ERF treated non-surgically is around 2–6 months (9,11,16,45,52). Benign ERF outcomes are less well described with good outcomes seen in 75–93% of patients treated surgically (2,9,53). Lenz and colleagues revealed a median survival of 74 months with no difference in surgical versus non-surgical treatment. Reintervention for recurrent fistula was necessary more often in patients undergoing non-surgical treatment with 80% of patients requiring repeat procedures (9).

Outcomes based on etiology have been reported by Silon and colleagues with lower survival in malignant fistula after endoscopic intervention when compared to benign (3.3% vs. 6.8%) as well as lower clinical success rates in malignant disease (70.4% vs. 90.1%) (11).

The American College of Chest Physicians guidelines gives a grade C recommendation for stenting both the esophagus and airway in ERF (54). There is limited data supporting this practice and is not standard in clinical care likely from limited access to interventional pulmonologists. Zori showed lower success rate of 33.3% in dual stenting compared to a study showing 70% success (47). Combined stenting may be a marker for larger and more complex fistulas with more severe illness. Clinical success rates of dual stenting range from 33–80% (11,47,52). Combined stenting may be a marker for larger and more complex fistulas with more severe illness. Herth and colleagues prospectively studied 112 patients with malignant ERF and they did not see much of a difference in survival time in single esophageal stenting versus combined therapy, but tracheal stent monotherapy had a lower survival time when compared to esophageal stents used in single or dual therapy (219, 263, 253 days respectively). No difference was seen regarding mortality and complications (40). Similarly, in a series of 50 patients with malignant ERF, there was
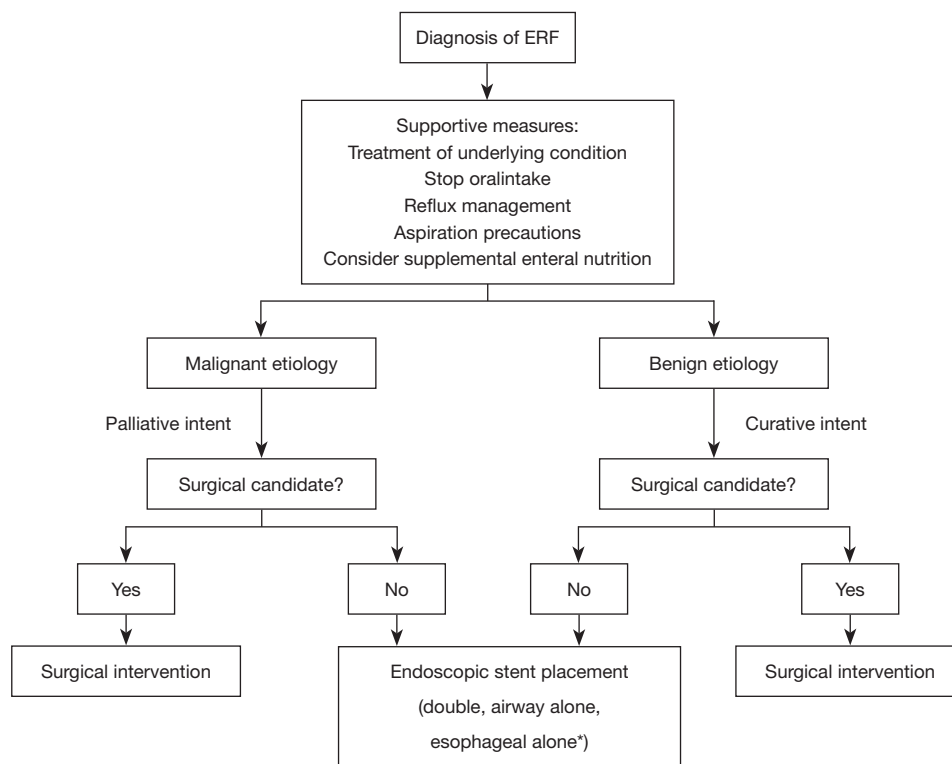
Figure 1 Treatment algorithm for malignant *vs.* benign ERF. *, the decision for placement of an airway stent will depend on the presence and/or degree of airway obstruction and location of fistula. ERF, esophago-respiratory fistulae.

no significant difference between groups in the rate of successful sealing of ERF or in survival time (52). These studies are small but support esophageal stenting as the initial endoscopic treatment of choice with airway stenting reserved for cases of airway compression.

considered first unless airway obstruction is present. Close surveillance and follow up is suggested to monitor endurance of clinical success after endoscopic management.

Sustained clinical success is still lacking, therefore, larger prospective trials involving multiple centers are needed.

Summary

Acquired ERFs in adults are uncommon but debilitating and often arise from esophageal cancer and its treatments and/or from complications following surgery. Early diagnosis and management can improve outcomes and quality of life in these patients. Therefore, early consultation with thoracic surgeons, gastroenterologist and interventional pulmonologists is essential. For patients unable to tolerate surgery, endoscopic therapy offers minimally invasive and safe interventions for palliation. No official guidelines exist and there are only a few small and mostly retrospective studies addressing management and outcomes. *Figure 1* displays a proposed algorithm regarding treatment. If surgery is not indicated, esophageal stenting should be

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