



Management of anastomotic leak after esophagectomy – current standards of care

Leczenie nieszczelności zespolenia po resekcji przełyku – aktualne standardy postępowania

Krzysztof Walczak 

Department of Thoracic Surgery, Faculty of Medical Sciences in Zabrze, Medical University of Silesia, Katowice, Poland

ABSTRACT

Anastomotic leak (AL) is the most serious early complication after esophagectomy and significantly impacts treatment outcomes. The aim of this study is to review the current principles of diagnosis and management of AL using standardized definitions and classifications and the “step-up” approach. The key factors in diagnosis are a high index of clinical suspicion, computed tomography of the chest and abdomen with oral water contrast as the first-choice examination and early endoscopy, which combines a diagnostic role with the possibility of immediate therapy. The “step-up” approach involves rapid control of sepsis and source of infection (radiologic or surgical drainage), gastrointestinal decompression (*nil per os*), targeted antibiotic therapy and preferably enteral nutrition, with escalation to endoscopic treatment. Depending on the local findings, covered self-expanding metal stents or self-expanding plastic stents, endoscopic vacuum therapy (EVT), and – in selected situations – endoscopic internal drainage are used. In cases of extensive tissue damage, conduit necrosis, or failure of endoscopic therapy, surgical treatment may be required. Combined strategies (e.g. sequential EVT → stent) and hybrid solutions (stents with integrated vacuum systems) allow the therapy to be tailored to local conditions. Effective implementation of coordinated protocols in experienced centers, with the involvement of a multidisciplinary team, is associated with a decrease in mortality and improved short- and long-term outcomes.

KEYWORDS

esophageal cancer, esophagectomy, esophageal anastomosis, anastomotic leak, endoscopic vacuum therapy, stents, postoperative complications

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Address for correspondence: dr n. med. Krzysztof Walczak, Katedra i Klinika Chirurgii Klatki Piersiowej, SPSK Nr 1 im. prof. S. Szyszko ŚUM, ul. 3 Maja 13/15, 41-800 Zabrze, tel. +48 32 370 44 75, e-mail: krzysztof.walczak@sum.edu.pl



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STRESZCZENIE

Nieszczelność zespolenia (*anastomotic leak* – AL) jest najpoważniejszym wczesnym powikłaniem po ezofagektomii i istotnie wpływa na wyniki leczenia. Celem pracy jest przegląd aktualnych zasad rozpoznawania i postępowania w AL z wykorzystaniem ujednoliconych definicji i klasyfikacji oraz podejścia „step-up”. W diagnostyce kluczowe znaczenie mają: wysoka czułość kliniczna, tomografia komputerowa klatki piersiowej i jamy brzusznej z doustnym kontrastem wodnym jako badanie pierwszego wyboru oraz wczesna endoskopia, która łączy rolę diagnostyczną z możliwością natychmiastowej terapii. Postępowanie „step-up” obejmuje szybkie opanowanie sepsy i kontrolę źródła zakażenia (drenaż radiologiczny lub chirurgiczny), odciążenie przewodu pokarmowego (*nil per os*), antybiotykoterapię celowaną oraz preferencyjnie żywienie dojelitowe, z rozszerzeniem postępowania o leczenie endoskopowe. W zależności od obrazu miejscowego stosuje się pokryte samorozprężalne stenty metalowe lub plastikowe, endoskopową terapię podciśnieniową (*endoscopic vacuum therapy* – EVT) oraz – w wybranych sytuacjach – wewnętrzny drenaż endoskopowy. W przypadkach z rozległym uszkodzeniem tkanek, martwicą przeszczepu lub nieskutecznością leczenia endoskopowego konieczne bywa leczenie chirurgiczne. Strategie łączone (np. sekwencja EVT → stent) i rozwiązania hybrydowe (stent ze zintegrowanym podciśnieniem) pozwalają dostosować terapię do miejscowych warunków. Skuteczne wdrożenie skoordynowanych protokołów w doświadczonych ośrodkach, z udziałem wielodyscyplinarnego zespołu, wiąże się ze zmniejszeniem śmiertelności i poprawą wyników krótko- i długoterminowych.

SŁOWA KLUCZOWE

rak przełyku, ezofagektomia, zespolenie przełykowe, nieszczelność zespolenia, endoskopowa terapia podciśnieniowa, stenty, powikłania pooperacyjne

Introduction

Esophageal resection with restoration of gastrointestinal continuity remains the cornerstone of treatment for esophageal cancer. Its most serious early complication is anastomotic leak (AL), defined by the Esophagectomy Complications Consensus Group (ECCG) – as a full-thickness defect involving the esophagus, anastomosis, staple line, or graft, regardless of the method of detection [1]. The reported incidence of AL after esophagectomy ranges from about 5% to 30%, depending on factors, such as the anastomosis location and the definitions used [2,3].

AL significantly worsens the postoperative course, prolongs hospitalization, and increases morbidity and mortality (including negatively affecting long-term outcomes even after minimally invasive esophagectomy) [4]. In the international Oesophago-Gastric Anastomosis Audit (OGAA), the incidence of AL was 14.2%, and this complication was associated with significantly worse short-term outcomes [2]. Data from the TENTACLE-Esophagus study were used to develop a mortality risk model for the 90 days post-AL, emphasizing the importance of early diagnosis and coordinated management in experienced centers [5]. The aim of this article is to review the current principles of diagnosis and treatment of AL after esophagectomy in light of the latest literature and guidelines.

Definition and classification

The standard classification of AL severity is based on the invasiveness of the required treatment; this stratification was adopted by the ECCG consensus. Three grades are distinguished: I – a minor AL requiring conservative management, II – AL requiring

a non-surgical intervention (endoscopic or radiological), III – AL requiring surgical treatment. The ECCG's uniform definition and classification have enabled comparison of outcomes and quality of reporting in AL management [1,3].

In recent years, high-volume centers with extensive endoscopic experience have proposed approaches that supplement the ECCG classification with an endoscopic morphological assessment of the anastomosis. One example is the classification of the Surgical Working Group on Endoscopy and Ultrasound (Chirurgische Arbeitsgemeinschaft für Endoskopie und Sonographie – CAES), in which the endoscopic assessment of AL (defect size, local conditions, necrosis) is directly linked to the choice of therapy [6]. The latest consensus of the Austrian Society of Surgical Oncology (ACO-ASSO) in 2025 takes endoscopic assessment into account in its treatment algorithm – each grade and endoscopic image is assigned a recommended treatment (for example, endoscopic techniques as first-line for most grade II leaks, reserving surgery for severe cases with necrosis/extensive dehiscence) [7].

In practice, a useful solution is to combine the ECCG grading with dynamic endoscopic assessment (e.g. CAES) and implement a staged “step-up” approach, in which escalation from conservative to endoscopic and – only if necessary – surgical therapy occurs in accordance with the severity and local AL results [1,6,7].

Diagnosis

The symptoms of AL are often nonspecific; early warning signs include tachycardia, fever, leukocytosis, dyspnea, or chest pain. Given the nonspecific clinical presentation, a high level of vigilance is necessary –



any abnormality in the postoperative course should raise suspicion of AL until it is ruled out. Data from the OGAA and TENTACLE-Esophagus studies emphasize the impact of rapid diagnosis and coordinated management on treatment outcomes (which is also significant for long-term results) [2,4,5].

The standard for confirming a leak is contrast-enhanced computed tomography (CT) of the chest and abdomen using an oral water-soluble contrast agent. CT can reveal extravasation of contrast outside the lumen, the presence of fluid or gas collections, and delineate the extent of infection in the mediastinum and pleural cavity. Current recommendations emphasize CT as the first-line modality [7]. Contrast esophagography using water-soluble (iodinated) contrast may be useful as a complementary examination – especially for evaluating small, clinically subtle leaks and monitoring healing. However, it should be remembered that it is less sensitive than CT and may miss AL; a negative esophagram does not exclude a leak, if clinical suspicion persists [7].

Early endoscopy (preferably within 24–48 hours of symptom onset) serves both diagnostic and therapeutic purposes: it allows direct visualization of the leak site (defect size, local conditions, necrosis) and immediate treatment in the same session (e.g. placement of a covered stent or initiation of endoscopic vacuum therapy [EVT]). This approach is in line with current guidelines and the modern “step-up” algorithm [7,8].

Principles of the “step-up” approach

The goal of the “step-up” approach is to bring sepsis under control quickly and to contain the infection spread [4]. The top priorities are to ensure effective drainage (radiological or surgical), keeping the patient *nil per os* (NPO; nothing by mouth), providing targeted antibiotic therapy, and nutritional support (preferably enteral nutrition) [7,8,9]. Treatment decisions are made dynamically based on the clinical picture and the morphology of the leak (ECCG/CAES classification) [1,3,6,7]. After a short period of clinical observation (24–48 hours, up to 72 hours maximum), if AL symptoms persist, treatment is then further escalated: first-line escalation is with endoscopic techniques (self-expanding metal stents – SEMS / self-expanding plastic stents – SEPS or EVT) [7,8,10,11,12,13], and in cases with necrosis, extensive anastomotic dehiscence, or uncontrolled sepsis – surgical treatment is indicated [1,7]. This algorithm is consistent with the latest ACO-ASSO consensus and the European Society of Gastrointestinal Endoscopy (ESGE) guidelines [7,8,14].

Endoscopic treatment

Covered esophageal stents (SEMS or SEPS) are one of the fundamental methods for treating AL after

esophagectomy [8,10]. Their mechanism of action is based on sealing the defect – a membrane-covered stent prevents further leakage of enteral contents into the mediastinum, effectively creating an internal “patch” over the leak site [8]. An additional benefit is the possibility of early resumption of oral or enteral feeding despite the presence of a leak, since the stent isolates the leak site from the enteric stream [15]. The clinical efficacy of stenting, defined as the rate of complete leak closure with this method, reaches approximately 70–80% in the latest studies [10]. Particularly high success rates are reported when periesophageal collections are simultaneously drained – which underscores the importance of combined therapy (stent + drainage) for the AL healing [16].

One of the main limitations of stent therapy is stent migration [8]. Self-expanding stents, especially plastic stents, tends to shift from the implantation site once tissue edema subsides – this occurs in approximately 20–40% of cases, and in up to 60% for cervical anastomoses [17]. The risk of migration is greater for cervical leaks (short esophageal segment above the stent) and when there is no stricture at the leak site. To prevent migration, additional measures are sometimes used (e.g. percutaneous “anchoring” of the stent ends to the neck skin, endoscopic clips to fix the stent to the esophageal wall, or special anchoring systems) [18,19,20]. The second significant limitation is the lack of active drainage – while the stent closes the lumen of the defect, it does not remove infected contents from any already formed perianastomotic cavities (abscesses) [8,16]. Retention of the infected fluid beneath a stent creates a risk of infection progression or sepsis; therefore, when treating with a stent, parallel drainage must be ensured – either percutaneously under radiologic guidance or endoscopically (for example, leaving a transnasal drain into the perianastomotic cavity). Covered stents are typically left in place for about 6–8 weeks [8], then removed endoscopically. This dwell time minimizes the risk of stent ingrowth into the esophageal wall and later stricture at the leak site. Removing a stent before 6–8 weeks is associated with a higher rate of leak recurrence, whereas leaving a stent in longer increases the risk of complications such as difficult-to-treat anastomotic stricture. After AL healing, any anastomotic strictures that occur are usually managed with balloon dilations under fluoroscopic guidance, with high effectiveness over multiple sessions [21].

EVT involves placing a specialized sponge connected to a suction catheter into the perianastomotic cavity or within the anastomotic defect and attaching it to a continuous vacuum source [10,11,12,13]. Small polyurethane sponges are typically used; these are positioned endoscopically at the site of the leak or within the leak cavity, and continuous negative pressure of -100 to -125 mmHg is applied via



a vacuum pump [11,12,13,22]. This system acts as an internal suction drain: it provides continuous drainage of infected fluid, reduces the bacterial load in the wound, and stimulates granulation and healing by mechanically debriding the tissues (the so-called vacuum effect) [11,12,13]. The sponge is changed every 3–5 days during repeat endoscopies – with each exchange a new, usually smaller sponge is placed – until the defect is completely closed. The average duration of therapy is about 2–3 weeks, though it depends on the extent of the leak and the healing dynamics [11,12,13,23]. Over the past decade, EVT has gained great popularity in the treatment of esophageal anastomotic leaks, especially those accompanied by a perianastomotic abscess cavity [11,12,13]. Available meta-analyses and larger studies report complete healing rates of 85–95%, and comparisons with temporary covered stents show at least comparable and often superior efficacy of EVT [10,11,12,13,24]. For example, a meta-analysis by Scognamiglio et al. [10] demonstrated a 93% vs 71% success rate in favor of EVT. Consistent conclusions were also reported in a comparative study by Berlth et al. [24].

It should be noted that most data come from observational studies, and the choice of method often depended on the characteristics of the leak (larger, more contaminated cavities were more often managed with EVT) [10,11,12,13]. Overall, EVT is highly effective and safe, provided the necessary endoscopic therapy expertise is available [11,12,13].

The literature emphasizes that EVT is no less effective than stenting, and in cases of large infected cavities it is often the first-line method [7,11,12,13]. Limitations of EVT include the need for frequent anesthesia and endoscopy for sponge changes (approximately every 3–5 days), as well as patient discomfort related to the indwelling vacuum system. Patients are usually kept strictly NPO during therapy (with enteral or parenteral nutrition) for what may be several weeks. Nevertheless, EVT is well tolerated and complications are rare; the most commonly reported are minor local bleeding or mucosal injury during sponge placement/exchange [11,12,13,23].

In selected cases with a limited perianastomotic cavity, endoscopic internal drainage (EID) can also be used. Through-the-fistula placement of 1–2 double-pigtail plastic stents from the abscess cavity into the lumen of the gastrointestinal (GI) tract allows internal drainage of the purulent collection and offloading of the anastomosis. EID is considered when there is a confined cavity with a narrow connection; the method can enable early oral feeding in some patients, but it requires careful patient selection and does not replace EVT for large, contaminated cavities [25].

Combined strategies and new technologies

An increasing number of centers report benefits from combining endoscopic methods to optimize leak management. One example is the sequential EVT → stent strategy, which involves initial vacuum therapy to clean and reduce the leak cavity, followed by placement of a covered stent for more rapid sealing of the defect [7,12]. This approach may shorten the overall healing time – EVT quickly reduces the infection and prepares the wound bed, and the stent provides definitive closure of the leak [12]. EID can also be applied in combination (e.g. a covered stent provides intraluminal separation, while EID ensures internal drainage of abscess collections) in cases of limited cavities; for extensive, contaminated cavities, EVT remains the preferred modality [25]. It has been shown that deploying a stent after initial vacuum therapy can reduce the number of sponge exchanges and shorten hospitalization time [12]. Combined methods are especially recommended in cases with a large perianastomotic cavity, where stenting alone could be insufficient due to retention of infected material under the stent [7,12,24]. Clinical reports confirm the efficacy and safety of the sequential EVT + stent strategy, though randomized comparative studies are still lacking [12].

Another interesting innovation is the vacuum-assisted closure stent (VAC-stent) – a hybrid device combining a covered stent with an integrated vacuum system [26,27]. This device consists of a self-expanding covered stent equipped with a sponge structure attached to the outside of the stent and connected to a suction drain that is brought out through the nose [26,27,28]. The VAC-stent combines the advantages of both techniques: it simultaneously seals the defect (thanks to the stent) and provides active drainage (thanks to the vacuum sponge) [26,27,29]. The first clinical applications of VAC-stents are very promising – pilot studies have shown high rates of leak closure and no significant device-related complications [26, 27,28,29]. Lange et al. [26,27] described a series of patients treated with a VAC-stent in whom AL healing was achieved without reoperation. Currently, VAC-stents are still available only within studies or at select centers [26,27,29], but it is possible that they will become an important element in AL therapy in the future. Their cost and the greater technical complexity of placement compared to a standard stent or EVT are certain limitations [29]. Nevertheless, the development of such hybrid technologies illustrates the direction of improving AL treatment – the pursuit of methods that combine effective leak closure with simultaneous infection control. A summary comparison of endoscopic techniques, their indications, advantages, limitations and outcomes is presented in Table I.

**Table I.** Management of anastomotic leak after esophagectomy – comparison of endoscopic methods

Method	When to consider	Main advantages	Limitations	Typical treatment duration	Approximate closure rate
SEMS/SEPS	Small-moderate defect, no large cavity; external drainage in place	Rapid isolation of lumen; widely available; can bridge strictures	Stent migration; no active cavity drainage; risk of ulcers or granulation overgrowth	6–8 weeks (temporary stent)	70–85%
EVT	Presence of abscess cavity, unfavorable local conditions; need for active drainage and cleaning	Active drainage and debridement; promotes granulation; usually higher closure rate than stents (SEMS)	Requires sponge changes every 2–4 days; limited availability; patient discomfort	Usually 2–3 weeks (depending on cavity)	> 80–90% (in meta-analyses)
VAC-stent	Cases needing simultaneous intraluminal isolation and local negative pressure	Combines benefits of stent and EVT; potentially shorter treatment time	Early-stage technology; limited data; availability and cost	Depends on protocol (often shorter than standard EVT)	High rate in small series
EID	Limited cavity with narrow tract; external drainage in place and sepsis controlled	Internal drainage of abscess; often allows early oral feeding; technically simple	No active cleaning like EVT; patient selection is key	4–6 weeks (several weeks)	Success depends on selection; good results in studies

SEMS – self-expanding metal stents; SEPS – self-expanding plastic stents; EVT – endoscopic vacuum therapy; VAC-stent – vacuum-assisted closure stent; EID – endoscopic internal drainage.

Surgical treatment

Despite advances in minimally invasive methods, a subset of patients with an AL will require surgical treatment. Absolute indications for reoperation are: uncontrolled sepsis despite intensive conservative therapy and drainage, extensive anastomotic dehiscence (e.g. involving > 50% of the anastomotic circumference), necrosis of the anastomosis or conduit (for example, gastric conduit necrosis), and early complete anastomotic breakdown immediately post-surgery (the so-called “blow-out”) [1,7]. Another indication is failure of endoscopic therapy – if despite stents or EVT the patient’s condition is deteriorating or the leak is not healing, escalation to salvage surgery becomes necessary [7,8]. In clinical practice, the decision to reoperate can be difficult and should be made by an experienced team, considering the patient’s overall condition (hemodynamic stability, severity of infection, comorbidities, expected quality of life) [2,7].

Possible surgical options are individualized depending on the local situation and the patient’s condition. They include:

1. Limited surgical revision and drainage – indicated for a localized mediastinal abscess without massive anastomotic dehiscence. Surgical debridement and washout via a cervical approach or thoracotomy allows evacuation of pus, removal of necrotic tissue, and placement of drains. This approach can serve as a bridge, permitting subsequent continuation of endoscopic therapy (e.g. EVT) under improved conditions [7,10,11,12,13].

2. Anastomosis repair – if technically feasible, meaning the defect is not too large and the tissues of the anastomosis and graft are sufficiently well perfused. This involves re-suturing the dehiscence (usually after freshening the edges) and reinforcing the anastomosis – often an omental flap or a muscle flap (e.g. intercostal muscle) is used to buttress the repaired site [30]. A primary repair carries a risk of failure, especially if local conditions are unfavorable (infection, edema, friable tissues).
3. Temporary gastrointestinal continuity diversion – reserved for the most severe cases. This entails disconnecting the esophageal continuity (or removing a necrotic conduit) and creating a temporary stoma: most commonly a cervical esophagostomy to divert saliva, along with a decompressing gastrostomy (and/or a feeding jejunostomy) [30]. This approach controls the infection and offloads the leak site at the expense of a temporary loss of GI continuity. After a few months, once the patient’s condition has improved, reconstruction can be performed – for example, using another conduit (such as a colonic interposition).

The choice of surgical strategy depends on the extent of the leak, the time elapsed since the initial surgery, the perfusion of the graft, and the patient’s overall condition [7]. A staged approach is often used – first a limited life-saving operation (washout, drainage, diversion stomas), followed by a delayed reconstruction in a second stage after a few months [7,30,31]. Regardless of the extent of surgery, the overriding



goal is to control sepsis and save the patient's life, even at the cost of a temporary sacrifice (such as a stoma) [7]. The mortality of reoperation for AL is high and increases with AL severity and organ failure [2,4,5,32] – therefore the decision to operate is made after considering whether there is a chance to achieve healing of the leak by less invasive means. On the other hand, waiting too long to perform surgical intervention in the face of progressing sepsis worsens the prognosis [2,4,5]. Risk models (e.g. TENTACLE) indicate that the patient's overall condition and the severity of AL determine survival; brief, closely monitored trials of minimally invasive therapy are acceptable provided there is prompt escalation if no improvement is seen [5,7].

Conclusions

Management of an AL after esophagectomy should always be tailored to the individual patient's situation and the characteristics of the leak. Thanks to appropriate care and the development of endoscopic techniques, the results of AL treatment have improved in recent years [3,6,8,10,11,12,13,33]. Currently,

a staged “step-up” strategy is preferred, in which treatment begins with conservative and endoscopic methods, with surgery reserved as a last resort [7,8]. Such approach minimizes the invasiveness of therapy and often allows control of the leak without graft resection or stoma creation [7,10,11,12,13]. However, early recognition of AL and management in specialized centers by an experienced multidisciplinary team is essential [4,6,7,14]. To ensure optimal care, close collaboration among the surgeon, endoscopic gastroenterologist, and interventional radiologist is necessary at all stages – from diagnosis to therapy [6,7]. This organized approach, supported by guidelines and protocols, has translated into a reduction of AL-associated mortality to low-teens percentages range in the best centers, which is a significant improvement over historical data [2,4,5]. Ongoing research into AL risk factors, refinement of minimally invasive treatment methods, and implementation of established standards on a wider population scale gives hope for further reduction of the adverse consequences of AL in the future [2,32].

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