Anastomotic Complications after Esophagectomy

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Key Words

Esophagectomy · Esophageal reconstruction ·
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techniques

Abstract

Anastomotic complications after esophagectomy continue to be a burden jeopardizing the quality of life and of swallowing. However, incidence, mortality and morbidity of anastomotic complications have substantially decreased in recent years. It seems that this is not so much related to the use of a particular conduit, approach or route for reconstruction, but rather related to refinement in anastomotic techniques and perhaps even more to progress in modern perioperative management. Knowledge of surgical anatomy and meticulous technique are of paramount importance and obviously related to individual expertise. As to the management, most leaks can be treated by conservative measures and reintervention surgery today is rather exceptional. Early endoscopy and dilatation seem to decrease the incidence and severity of anastomotic stenosis.

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Esophagectomy is increasingly performed for a wide spectrum of conditions but mostly for carcinoma. Improvement of perioperative management and surgical techniques has resulted in a steady decrease in postoperative mortality. Today, postoperative hospital mortality in centers with experience is well below 5%. Overall 5-year survival rates as high as 30–40% have been reported after resection with curative intent [1]. As a result, an increasing number of patients is now surviving on a long-term basis. Their quality of life may be very much influenced by the quality of their esophageal anastomosis. Furthermore, despite all efforts, in a majority of the patients surgery remains palliative mainly because of the unexpected advanced stage of the disease at the time of surgery. In such patients, quality of palliation is of paramount importance. It is widely accepted that surgery offers the best form of palliation but the quality of palliation may still be jeopardized by anastomotic complications, i.e. anastomotic leak or even worse, catastrophic complications such as the necrosis of the proximal part of the conduit used for reconstruction or in a late stage anastomotic stricture formation.

This review article focuses on different aspects of definition, etiology and management of anastomotic complications with special emphasis on anastomotic leakage.

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Table 1. Definition of leak as adapted from the Surgical Infection Study Group [4]

Leak	Definition	Treatment
Radiological	No clinical signs	No change in management
Clinical minor	Local inflammation cervical wound X-ray contained leak (thoracic anastomosis) Fever, ↑ WBC, ↑ CRP	Drain wound Delay oral intake Antibiotics
Clinical major	Severe disruption on endoscopy Sepsis	Change management: CT-guided drainage (Reintervention)
Conduit necrosis	Endoscopic confirmation	Reintervention

Definition

The incidence of anastomotic leaks varies widely and has been reported up to 53% [2]. The main reason for this wide variation is the lack of an accurate definition of an anastomotic leak. In a recent systematic literature review of all articles dealing with anastomotic leak after esophagectomy, Bruce et al. [3] only found 13 out of 33 publications that included a definition of anastomotic leak. The clinical features used to define anastomotic leakage included evidence of hematoma or seroma at the neck wound, septicemia, peritonitis, perianastomotic collection, leak, local inflammation, evacuation of air or saliva, mediastinitis, abscess, empyema and pneumothorax.

The majority of these studies reported the routine post-operative use of radiographic water-soluble contrast studies, but the timing of the contrast study ranged from 3 to 14 days after the operation. It is thus clear from this literature survey that there is a lack of consensus on the definition and seriousness of an anastomotic leak.

Bruce et al. [3] in their review article proposed to use the definition as suggested by the Surgical Infection Study Group, a UK Multidisciplinary Group [4] (table 1). Obviously even in this classification the definition and thus the incidence of a leak, especially a clinically occult leak, is very much dependent on the use of routine contrast studies. In practice, many centers today rely exclusively on the clinical parameters since a radiological detection of a minute otherwise occult leak has little or no consequence on the further therapeutic strategy.

Etiology

Many factors, local and systemic, are influencing the process of wound healing and hence influencing the incidence of anastomotic complications. In addition, a number of intrinsic aspects specific for esophageal surgery may also contribute to the occurrence of complications, in particular leakage. Such intrinsic aspects are the absence of a serosa and the longitudinal orientation of the muscle fibers resulting in a more fragile environment holding sutures poorly as compared to e.g. the gastric wall. Moreover, esophagectomy followed by reconstruction requires extensive dissection as well as an extensive mobilization bringing a viscus from a distant remote position to perform an anastomosis outside of the protective peritoneal cavity [5].

Amongst systemic factors influencing the healing process, a number are clearly jeopardizing the chances for an uneventful healing [6]: malnutrition, hypotension, hypoxemia, neoadjuvant therapies, other comorbidity e.g. diabetes, cardiovascular diseases, respiratory insufficiency. Often excessive smoking and drinking habits are an underlying cause of this comorbidity but also, as such, negatively interfering with the immune system of the patient. Malnutrition, if present, can be corrected by preoperative nutritional support, e.g. parenteral nutrition. But in the literature, attitudes towards preoperative nutritional substitution are conflicting [7] because of the delay in the actual cancer treatment and the potential complications such as catheter sepsis related to total parenteral nutrition [8].

During and after surgery, hypotension should be avoided because of the potential negative impact on perfusion and tissue oxygenation. In this respect the surgeon should be familiar with the vascular anatomy of the viscus

used for reconstruction. From several studies measuring gastric tissue oxygenation, it appears that tissue oxygen tension decreases after gastrolisis. After gastric pull up in the neck the tissue oxygen tension drops further down to almost half the values measured before gastrolisis. It is however not clear how far impaired tissue oxygenation in itself is responsible for anastomotic leak rather than cellular metabolic disorders or technical factors as indeed there seems to be no significant evidence of decreased tissue oxygen levels in patients with anastomotic complications [9]. In this respect a wide variety of surgery-related aspects including technical failures may interfere substantially with the occurrence of anastomotic complications.

The Conduit

Today in most centers with experience, subtotal esophagectomy with cervical anastomosis is the standard type of operation for cancer of the esophagus. Restoration of continuity is performed by using either stomach, colon or jejunum. Jejunum is rarely used because the technical difficulty to prepare a loop sufficiently long to reach the neck for anastomosis. Moreover, often this will result in excessive kinking due to the particular blood supply of the jejunum. Stomach and colon on the contrary are easily transposed to the neck.

The colon, especially the transverse and left colon, have a rather consistent vascular anatomy based on arcades connecting left, middle and right colic artery. Provided sufficient experience, results of coloplasty are very similar to gastropasty and reported short-term outcomes after esophagectomy for cancer are almost identical.

However, the majority of surgeons do prefer to use stomach to restore continuity because of the relative simplicity of the operation and the need for only one anastomosis [10]. When using the stomach as a substitute the entire vascularization depends on the right gastroepiploic artery and vein. In this respect it is important to realize that approximately 60% of the gastric tube is supplied by this vessel, approximately another 20% more cranially by the minute connections between right and left gastroepiploic vessels. Finally, the most cranial 20% is vascularized through a dense submucosal and microvascular network [11]. As the anastomosis is mostly made at the proximal 20% of the gastric fundus, it is of paramount importance to avoid trauma of the gastric tube. Too much manipulation during gastrolisis, application of suction devices, traction sutures to facilitate the gastric pull-up maneuver are all factors favoring trauma and thus jeopardizing the

esophagogastric anastomosis. For these reasons some authors advocate to resect the proximal 4–6 cm of the fundus in case of doubtful macroscopic vascularity. It is claimed that full mobilization of the stomach including Kocher's maneuver nearly always affords ample length for a tension-free anastomosis even when the proximal 4–6 cm had to be resected [11].

To improve vascularization of the gastric fundus, gastric conditioning by laparoscopic partial gastric devascularization at the time of e.g. laparoscopic cancer staging has been proposed [12]. It is however not clear whether such methods indeed result in a decreased incidence of anastomotic complications.

Whole Stomach or Gastric Tube?

Some authors argue that a better blood supply can be obtained when using the whole stomach as compared to using a gastric tube with resection of the lesser curvature. The arguments are firstly that the fundus is mainly supplied through intramural vascular anastomotic pathways along the lesser curvature rather than through the greater curvature segment and secondly a vasodilative effect of sympathectomy by skeletonizing the lesser curvature [13]. Another, more technical, argument used in favor of the whole stomach is the absence of a suture line in the vicinity of the anastomosis related to gastric tubulization. It is suggested that the narrow band of gastric tissue between this suture line and the margin of the anastomosis in its close vicinity may be poorly vascularized and cause necrosis and subsequent leak [14].

Others argue that there is a zone with small anastomotic sites between the various small branches of the left gastric artery and the right gastroepiploic vessels in both the anterior and posterior walls. This is a line 4–5 cm from the greater gastric curvature, a finding that supports the clinical practice to use a gastric tube rather than the whole stomach [11] since the right gastroepiploic artery is the exclusive source of blood to the gastric tube.

In fact, too little is known about the real pre- and post-operative situation, especially the direction of blood flow in the proximal part of the fundus to draw any conclusion in favor of either gastric tube or whole stomach [15].

Collard et al. [13] obtained a 1% leakage rate when using the whole stomach versus 7.9% when using a gastric tube. But when performing a semi-mechanical anastomosis in 16 cases with whole stomach, he observed one, minute, leak (6.2%) [14]. Orringer et al. [16], using a whole stomach, obtained a 2.7% leakage rate when using stapled

anastomosis versus 10–15% when using hand-sewn anastomosis.

As these figures are from retrospective studies they merely seem to indicate that experience most likely explains the observed decrease in leakage rate rather than anything else. Gastric distention, more often present when using the whole stomach, probably also plays a role in postesophagectomy anastomotic failure [17]. Indeed delayed gastric emptying is associated with a higher incidence of anastomotic leak [18]. Postoperative gastric decompression by performing a pyloroplasty or pyloromyotomy is therefore considered a mandatory procedure by many surgeons. However, such a procedure may induce duodenogastric reflux resulting itself in anastomotic ulceration, stenosis and eventually formation of Barrett metaplasia [19].

Which Approach? Which Route?

Controversy still exists as to optimal surgical approach, i.e. transthoracic (TTE) versus transhiatal (THE) esophagectomy for patients with carcinoma of the esophagus and gastroesophageal junction (GEJ) not only for oncologic reasons but also in relation to postoperative complications.

Goldminc et al. [20] performed a randomized controlled trial comparing THE versus right-sided TTE. In terms of postoperative complications in general, there was little difference between both approaches. The incidence of anastomotic leaks was 6 and 9% respectively. In another randomized controlled trial by Chu et al. [21], again no difference was found between the two approaches with no leak in either the THE (n = 20 patients) or the TTE (n = 19 patients) group.

As to the route of reconstruction it is commonly believed that the posterior mediastinal route is superior to the retrosternal route because of the shorter distance and consequently a lower incidence of anastomotic leaks.

Young et al. [22], analyzing the results after esophagectomy for benign disease, found a highly significant increase of anastomotic leaks when using the longest route but this study is a retrospective study spanning a long period of over 40 years. Blewett et al. [23] compared in a retrospective study intrathoracic and cervical anastomosis. Leaks occurred in 5% (1/19) of the cervical anastomosis and in 16% of the patients with an intrathoracic anastomosis. These figures, although indicating a trend, were not significant.

Anastomotic Technique

Numerous reports on different aspects and different variations on anastomotic techniques have been published over the last decades. Anastomosis can be hand-made, stapled or semimechanical. As to the hand-sewn anastomosis, many technical details, e.g. running versus interrupted sutures, absorbable or nonabsorbable, one- or two-layer sutures, knots within or outside the lumen, have been debated.

Bardini et al. [2] conducted a prospective randomized study comparing 21 single-layered interrupted versus 21 single-layered continuous cervical anastomoses. There was no difference as only 1 patient in the first group developed a clinically asymptomatic leak. Fok et al. [24] compared a single-layer continuous hand-sewn anastomosis with circular stapling in a prospective nonrandomized study including 580 patients. There were 5% anastomotic leaks in the hand-sewn group and 3.8% in the stapled anastomosis group ($p = 0.69$). From these studies it seems that, provided there is adequate vascularization of the stomach, little difference in anastomotic leakage rate is to be expected between hand-sewn or stapled anastomosis.

Some authors have suggested that leakage rate is influenced by the presence or absence of a cervical drain. Choi et al. [25] performed a randomized study comparing the use of a closed suction drainage versus nondrainage in 40 patients who underwent esophagectomy for carcinoma. Anastomotic leaks did not occur in any patient. It was therefore concluded that, as in other types of visceral surgery [26], routine use of a cervical drain for esophageal anastomosis in the neck is not necessary.

More recently the so-called semi-mechanical anastomosis has been introduced. Both Collard et al. [14] and Orringer et al. [16] have published a low incidence of leakage rate of 6.2 and 2.7% respectively. It is believed that the use of endostaplers with three rows of staplers at each side of the anastomosis decreases the incidence of leaks. But whether the reported low incidence of leaks is really the result of the particular anastomotic technique is difficult to prove. In Collard's report indeed the semi-mechanical anastomosis was randomized against hand-sewn anastomosis with no leakage in the hand-sewn group. Moreover, many other groups have reported a very low incidence of anastomotic leaks below 5% with hand-sewn anastomosis [2]. In our own experience with 126 resections for carcinomas in 2001, the overall incidence of anastomotic leaks was 3.1% (4/126, one leak being subclinical and detected only on X-ray); all anastomoses were performed using a two-layer continuous hand-sewn technique.

In the past, anastomotic leakage was one of the leading causes of perioperative mortality after esophagectomy. Because of refinements in anastomotic technique as well as improvements in perioperative management, the consequences of an anastomotic leak today seem to be less dramatic. The clinical presentation and consequently the therapeutic attitude is largely determined by the site (thoracic versus cervical) and, the yes or no containment of the leak by surrounding tissues.

The management of anastomotic leaks can roughly be subdivided into four categories (table 1). In case of an asymptomatic leak only discovered at X-ray contrast study, little specific treatment is required. Usually a delay of oral intake, especially solids, for a few days will suffice. In the presence of a minor, well-contained leak, the patient will be placed on a nil-by-mouth regimen combined with total parenteral nutrition especially in the presence of malnutrition. According to infectious parameters, broad-spectrum antibiotherapy may become necessary. We very much favor the use of native somatostatin in order to diminish the volume of gastric secretion combined with proton pump inhibitors (PPI) to neutralize gastric acid secretion. Usually there is no need for a nasogastric tube in these cases. When judged necessary, e.g. in case of abscess formation in the neck, bedside opening and drainage of the cervical incision is performed.

Early postoperative esophagoscopy and dilatation have been reported by Trentino et al. [27] and Orringer et al. [28]. We do agree that dilatation of a leaking anastomosis may favorably influence healing because relative narrowing by local inflammation and spasm may contribute to obstruction distal to an esophageal leak and adversely affect spontaneous closure. Once the leak has dried up or has disappeared on X-ray contrast study, oral diet can be resumed. In the presence of a documented major clinical leak a more aggressive treatment may become necessary. When the leak is located in the neck a major disruption has to be excluded by endoscopic control. The further management then very much depends on the location of the anastomosis and the perianastomotic fluid accumulation. Indeed, some patients may develop an intrathoracic fluid collection requiring CT-guided drainage. In case of intrathoracic anastomosis, the leaks have a tendency to be poorly contained by the surrounding tissues. Nevertheless, the majority of intrathoracic leaks can be managed by conservative measures as mentioned above. However, in case of rapidly developing sepsis with diffuse leakage on contrast study a reintervention

becomes mandatory. In most of such cases there will be a substantial defect at the site of the anastomosis which together with the present mediastinitis will preclude a repair of the anastomotic dehiscence. In such a situation a take down of the anastomosis with temporary esophagostomy and feeding jejunostomy may be the only valid option. Depending on the severity of mediastinitis, a T-tube drain associated with esophageal exclusion may be another option.

Finally in case of necrosis of the proximal part of the conduit, a resection of the necrotic part, debridement of the mediastinum, esophagostomy and feeding jejunostomy is the treatment of choice [29]. In the rare case of limited mediastinitis one can consider an immediate reconstruction with another type of conduit avoiding the need for a temporary esophagostomy. Overall however it seems from our own experiences that except for the rare cases of necrosis of the gastric conduit (<1%) surgical reintervention to treat anastomotic leakage has become the exception since almost all anastomotic leaks can be cured by means of conservative treatment, including antibiotherapy and CT-guided drainage when necessary.

Stenosis

Despite the lowering of the incidence of anastomotic leaks, the incidence of anastomotic stenosis remains relatively high between 10 and 56% [16]. However, recent progress in the management of strictures, in particular the introduction of PPI and the development of better and safer dilatation techniques, e.g. Rigiflex balloon dilatation, resulted in a major decrease in morbidity caused by these strictures. As a matter of fact, in our department we have had no single reintervention for benign anastomotic strictures after esophagectomy for carcinoma in the last 1,000 cases. Chronic PPI therapy combined with Savary or pneumatic dilatation are the key factors in the treatment of anastomotic stricture.

From the available data it seems that anastomotic strictures occur more frequently after circular stapler anastomosis than after hand-sewn anastomosis. In hand-sewn anastomosis there is a higher tendency for stricture formation after two-layer anastomosis than after single-layer anastomosis. Early postoperative endoscopy, i.e. between days 3 and 5 and dilatation when necessary, seems to result in a decreased need for multiple dilatation. Trentino et al. [27] reported a 83% success rate after a mean of 3.6 dilatations when performing early endoscopy and dilatation. The presence of ulceration involving more

than 50% of the anastomotic circumference is the most important factor in predicting development of anastomotic stricture [27].

The use of the semi-mechanical anastomosis technique seems to be promising in relation to the incidence of anastomotic stricture formation. Orringer et al. [16] reported an incidence of 48% stricture formation in hand-sewn anastomosis versus 35% in the semi-mechanical anastomosis. In this group, no patients required more than three dilatations whereas in the hand-sewn group 7.5% of the patients required five or more dilatations. It is believed that this decreased incidence of strictures and the decreased need for multiple dilatations results from a significantly wider cross-sectional area of the esophagogastrotomy after the semi-mechanical anastomosis [14]. However, such an anastomosis requires a sufficiently long remnant of proximal esophagus and is therefore contraindicated for oncologic reasons in upper half esophageal carcinomas.

General Considerations

The incidence, mortality and morbidity of anastomotic complications have substantially decreased in recent years. It seems that this is not so much related to the use of a particular conduit, approach or route for reconstruction but rather related to progress in modern perioperative management. From a number of publications it becomes clear that most centers with experience have seen a constant decrease in mortality and morbidity rates over the years. A recent study by Whooly et al. [30] analyzed the reason for reduced death and complication rates after esophageal resection. Important perioperative factors

were the increased postoperative use of epidural analgesia and bronchoscopy, a decrease in history of smoking and a decrease in surgical blood loss of <1,000 ml. Undoubtedly these factors and especially the decrease in respiratory failure will positively influence tissue oxygenation, hence anastomotic healing. Amongst general factors affecting anastomotic leak and stricture formation, Dewar et al. [31] found a significant correlation with low preoperative serum albumin and high intraoperative blood loss.

Of course the refinements in technique have also contributed to the decrease of anastomotic complications and needless to stress the individual expertise of the surgeon in improving results. Atraumatic mobilization of the gastric fundus, avoiding traction sutures or suction devices, performing a watertight anastomosis without the use of excessive number of sutures, adequate mobilization of the conduit, correct orientation when transposing the conduit into the mediastinum and the neck, compression-free passage of the conduit at the narrow thoracic inlet, familiarity with the vascular anatomy of the different conduits are just a few technical points that may influence the final outcome of the anastomotic site. Obviously a majority of anastomotic complications are to be seen as the result of a technical failure related to one or more of these technical 'details'. This is endorsed by a growing body of evidence in the literature that both surgical volume and experience have a significant impact on mortality and morbidity after esophagectomy [32–34]. The key to a further decrease in death rate and postoperative morbidity is the accruing experience by a dedicated team of surgeons, anesthesiologists, intensivists, nurses, etc. in a high volume setting and working in a hospital that is fully equipped to handle such complex interventions.

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