REVIEW ARTICLE

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Esophagojejunal anastomotic leakage following gastrectomy for gastric cancer

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Abstract

Esophagojejunal anastomotic leakage (EJAL) is a serious complication of total or proximal gastrectomy for gastric cancer, with a reported incidence of 2.1–14.6% and mortality of up to 50%. EJAL is an independent prognostic factor for the poor survival of gastric cancer patients. Meticulous surgical techniques, experience with anastomotic devices, and a thorough understanding of various risk factors and preventive measures are essential and early diagnosis is critical for preventing EJAL-related death. Patients with suspected EJAL must be evaluated promptly, but contrast swallow is not recommended. There is no standard treatment strategy for EJAL, although conservative treatment with drainage and nutritional support is the most common approach. Effective endoscopic treatments have been reported but need further validation. Surgical treatment is associated with high mortality but should be considered to prevent death from suboptimal EJAL management, for patients with severe sepsis or when conservative treatment has failed.

Keywords Gastric cancer · Anastomotic leakage · Esophagojejunostomy · Postoperative complication · Review

Introduction

Gastrectomy with lymphadenectomy is a standard treatment for gastric cancer, while total or proximal gastrectomy followed by esophagojejunal (EJ) anastomosis is a standard treatment for gastric cancer invading the upper third of the stomach and for adenocarcinoma of the esophagogastric junction [1]. Despite advances in surgical techniques and perioperative management, EJ anastomotic leakage (EJAL) remains a serious and potentially fatal complication of total or proximal gastrectomy, with incidences ranging from 2.1 to 14.6% [2–15]. EJAL has a negative impact on other postoperative outcomes, by increasing pulmonary complications, median length of hospital stay, delay before oral feeding, risk of anastomotic stricture, and the need for re-operation by up to 61% [15]. EJAL following gastrectomy has a reported mortality of up to 50% and is the leading cause of mortality-related death after this procedure [3–12, 15–17].

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Furthermore, EJAL is an independent prognostic factor for poor survival after gastric cancer surgery [14, 15, 18].

Surgeons have tried various strategies to prevent EJAL. There is no doubt that advances in surgical techniques, better anatomical knowledge, and increased awareness of the risk factors and treatment options have contributed greatly to decreasing the incidence and mortality of EJAL. We reviewed the literature on EJAL following gastrectomy for gastric cancer to summarize the prevalence, risk factors, prevention strategies, and treatment of EJAL.

Prevalence

The prevalence of EJAL following open gastrectomy for gastric cancer has been reported to range from 2.1 to 14.6% [2–15], with mortality associated with EJAL ranging from 0 to 50% [3–12, 15–17]. The variations in the literature may be explained by differences in study cohort size, study design, country, and study periods (Table 1). The EJAL incidence and mortality tend to be lower in Asian countries (including Japan) than in Western countries. The incidence of EJAL following open total gastrectomy was 4.4% in a prospective cohort study including patients selected from a Japanese nationwide registry [13], whereas the incidence ranged from

Table 1 Prevalence of esophagojejunal anastomotic leakage in previous reports

Author	Year	Country	Study design	Study periods	No. of patients	Type of gastrectomy	Prevalence of EJAL n (%)	Sub-analysis		P
Bonenkamp [19]	1995	Netherlands	RCT	1989–1993	711	TG (n=241), DG (n=467)	46 (6.5)a	D1 vs. D2 lymphadenectomy	4.2% vs. 9.1%	N/A
Cuschieri [20]	1996	UK	RCT	1986–1993	400	TG (n=218), DG (n=179)	3 (18.5)a	D1 vs. D2 lymphadenectomy	11% vs. 26%	P=0.015
Isozaki [2]	1997	Japan	Retrospective	1978–1992	404	TG	33 (8.2)			
Schardey [82]	1997	Germany	Retrospective	1991–1994	205	TG	14 (6.8)	Without vs. with decontamination	10.6% vs. 2.9%	P=0.049
Lang [4]	2000	Germany	Retrospective	1968–1998	1114	TG	83 (7.5)			
Nomura [12]	2000	Japan	Retrospective	1985–1997	1234	TG(n=1144), PG (n=90)	78 (6.3)	Stapler vs. hand sewn	4.6% vs. 18.1%	N/A
								1985 vs. 1997	20.0% vs. 0.8%	N/A
Lamb [11]	2004	UK	Prospective	1999–2001	76	TG	8 (10.5)			
Sauvanet [5]	2005	France	Retrospective	1985–2000	1192	TG (n=408), PG (n=773)	104 (8.7)b	TH vs. right thoracotomy vs. LTA vs. cervicotomy	7% vs. 9% vs. 10% vs. 13%	P=0.010
								Stapler vs. hand sewn	7% vs. 11%	P=0.021
Sasako [83]	2006	Japan	RCT	1995–2003	167	TG	12 (7.2)	TH vs. LTA	6% vs. 8%	P=0.77
Tonouchi [3]	2007	Japan	Retrospective	1992–2003	331	TG (n=140), DG (n=191)	4 (2.9)			
Portanova [84]	2010	Peru	Retrospective	2004–2008	173	TG	9 (5.2)			
Nishikawa [17]	2010	Japan	Retrospective	2005–2008	48	TG	2 (4.2)			
Sierzega [15]	2010	Poland	Retrospective	1999–2004	690	TG	41 (5.9)			
Yoo [14]	2011	Korea	Retrospective	2000–2005	478	TG (n=183), DG (n=295)	14 (7.7)			
Migita [6]	2012	Japan	Retrospective	2001–2011	327	TG (n=317), PG (n=10)	19 (5.8)			
Deguchi [8]	2012	Japan	Retrospective	1999–2008	1640	TG (n=1450)c, PG (n=190)	35 (2.1)			
Schietroma [9]	2013	Italy	Retrospective	2009–2012	171	TG	25 (14.6)	80% FiO2 vs. 30% FiO2	9.3% vs. 20%	P<0.05
Wakabayashi [13]	2014	Japan	Retrospective	2011	20,011	TG	771 (4.4)			
Sano [85]	2016	Japan	RCT	2002–2009	505	TG	19 (3.8)	Splenectomy vs. spleen preservation	4.3% vs. 3.2%	P=0.64
Kanaji [16]	2016	Japan	Retrospective	2008–2011	185	TG	9 (4.9)			
Carboni [7]	2016	Italy	Retrospective	1998–2013	199	TG	14 (7.0)			
El-Sourani [10]	2017	Germany	Retrospective	2009–2013	104	TG	15 (14.4)			

Table 1 (continued)

Author	Year	Country	Study design	Study periods	No. of patients	Type of gastrectomy	Prevalence of EJAL n (%)	Sub-analysis		P
Kodera [28]	2018	Japan	Retrospective	2012–2013	32,144	cStage I LTG (n=3947) OTG (n=7793) cStage II–IV LTG (n=1802) TG (n=18,602)	N/A	cStage I: LTG vs. OTG cStage II–IV: LTG vs. OTG	5.4% vs. 3.6% 5.7% vs. 3.6%	P<0.001 P=0.002
Eto [44]	2018	Japan	Prospective	2014–2015	2494	LTG (n=925) OTG (n=1569)	N/A	LTG vs. OTG	5.3% vs. 6.1%	P=0.59
Katai [29]	2018	Japan	Prospective	2015–2017	245	LTG (n=195) LPG (n=50)	4 (1.6)			
Hyung [30]	2018	Korea	Prospective	2012–2014	170	LTG	3 (1.9)			

EJAL Esophagojejunal anastomotic leakage, *RCT* randomized controlled trial, *TG* total gastrectomy, *PG* proximal gastrectomy, *DG* distal gastrectomy, *TH* abdominal-transhiatal approach, *LTA* left thoracoabdominal approach, *N/A* not applicable, *LTG* laparoscopic total gastrectomy, *LPG* laparoscopic proximal gastrectomy, *OTG* open total gastrectomy

a Including gastrojejunal anastomotic leakage

b Including esophagogastric anastomotic leakage

c Including completion gastrectomy

4 to 26% in phase III studies conducted in Western countries [19, 20]. This difference may be attributed to the higher incidence of cardiopulmonary comorbidities and more intra-abdominal fat tissue in patients with gastric cancer from Western countries as well as the higher incidence of gastric cancer in Asian patients [8, 21]. Pulmonary insufficiency [5, 8], cardiovascular disease [9], and increased visceral fat area (VFA) [22–24] are all risk factors for EJAL. As gastric cancer is one of the most commonly diagnosed cancers in Japan [25], Japanese surgeons have considerable experience in performing gastric cancer surgery, which may account for the relatively lower incidence of EJAL in Japan.

The prevalence of EJAL varies with the year of each study because of changes in the anastomotic devices that were used at the time. An analysis of a large patient series at the National Cancer Center of Japan showed that the incidence of EJAL decreased from 20.0% in 1985 to 0.8% in 1997 [12]. Over the same period, the use of stapler anastomosis increased from 8 to 100%. Because the surgical outcomes of stapler anastomosis are clearly superior to those obtained with manually sutured anastomosis, it has become the standard method. After Kitano introduced laparoscopic gastrectomy in 1991, the technique became popular throughout the world, particularly in East Asia [26]. In 1999, Uyama et al. [27] reported the first case of laparoscopic total gastrectomy, which involved esophagojejunal anastomosis using a linear stapler with functional end-to-end anastomosis (FEEA). According to a recent large-scale cohort study and multi-center phase II studies, the prevalence of post-LTG EJAL ranges from 1.7 to 5.7% [28–30].

Risk factors

Identification of the risk factors of EJAL helps to decrease its incidence. The reported risk factors include patient and tumor characteristics and intraoperative factors. Sufficient blood supply [9, 31] and adequate tension on the anastomosis site [9, 32] are essential for proper healing. Long operation time [8], invasive surgery [2, 15, 24], anastomosis procedures [5], and surgeon inexperience (<30 cases) [16] have all been reported as intraoperative risk factors. In a retrospective evaluation of a large patient cohort, Tu et al. [33] developed a nomogram to predict the individual risk of anastomotic leakage. Patient age ≥65 years, anemia (hemoglobin ≤8.0 g/dL), and malnutrition were independently associated with the risk of leakage. In a large, retrospective, cohort study using a Japanese web-based nationwide registry, age, sex, preoperative ADL, ascites, hypertension, previous percutaneous coronary intervention, steroid administration, weight loss, poor ASA score, splenectomy, Brinkman index, body mass index, elevated aspartate aminotransferase, and an elevated white blood cell count were identified as risk

factors for anastomotic leakage following total gastrectomy [34]. Sarcopenia, characterized by muscle wasting, has also been reported to increase the risk of postoperative complications following surgery for several malignancies [35–38]. A recent meta-analysis demonstrated that preoperative sarcopenia was a risk factor for postoperative complications following gastrectomy, though it was not found to be a risk factor for anastomotic leakage [39]. Elderly patients tend to have more comorbidities, poor nutritional and performance status, and poor wound healing. Anemia and malnutrition may result in insufficient blood and energy supplies to the anastomosis, which might affect the healing of the anastomosis and reduce the levels of inflammatory cells, inflammatory factors, and administered antibiotics, thereby increasing the risks of infection and of anastomotic leakage [31, 40–42]. Obesity also increases the risk of postoperative complications. Body mass index (BMI) is a standard criterion of obesity, but the visceral fat area (VFA) may be more important to predict EJAL [22–24]. The presence of a thick mesentery in patients with a high VFA tends to produce excessive tension and pressure at the anastomosis site. In addition, the deep surgical field in these patients provides a less-than-optimal surgical view that could predispose to surgical errors during anastomosis surgery. Other reported patient factors include diabetes [6], pulmonary insufficiency [5, 8], cardiovascular disease [9], and chronic renal failure [6]. Pathological stage IV [2, 9] and esophageal invasion [6] have also been reported as tumor risk factors.

Several case controls have compared LTG and open total gastrectomy (OTG) mortality; however, a recent meta-analysis showed no difference in the incidence of EJAL between these procedures [43]. Two large-scale, prospective studies in Japan and Korea reported that LTG for clinical stage I gastric cancer patients is safe, with EJAL incidences of 1.6% and 1.9%, respectively [29, 30]. However, we cannot deny the possibility of publication or selection bias. A large-scale, retrospective cohort study using the NCD database and including ≥ 30,000 patients revealed that the rate of EJAL was higher for LTG than for OTG, for both clinical stage I (5.4% vs. 3.6%, $p < 0.01$) and stage II–IV patients (5.7% vs. 3.6%, $p < 0.020$) [28]. However, another prospective cohort study, using the NCD database, demonstrated no significant difference in the incidence of EJAL between LTG and OTG (5.3% vs. 6.1%, $P = 0.59$) [44]. This inconsistency could be due in part to selection bias, as the latter study included fewer institutions and the data were retrieved 2 years before the former study. Since there are no large-scale randomized controlled trials, whether laparoscopic surgery is a risk factor for EJAL remains unknown.

Various anastomosis techniques for the esophagojejunal anastomotic procedure following LTG have been described, including FEEA, overlap using a linear stapler [45], a single stapling technique [46], a double stapling technique [47], a hemi-double stapling technique using a circular stapler [48], and hand-sewn methods [49]. A meta-analysis showed that circular stapler methods were significantly associated with EJAL (4.7% vs. 1.1%, $p < 0.001$) [50]; however, there is no clear evidence based on randomized controlled trials. Therefore, the optimal procedure of EJA in LTG has not been established.

Prevention

The prevention of EJAL depends on the recognition and management of its risk factors. For example, addressing malnutrition with preoperative enteral feeding or immunonutrition therapy has been reported to reduce the incidence of anastomotic leakage [51, 52]. Precise surgical technique and good understanding of anastomotic devices are also essential. Circular staplers are the most commonly used devices to perform EJ anastomosis, but their use requires learning skills and avoiding some pitfalls. The incomplete placing of purse-string sutures, incorrect insertion of the anvil on the esophageal mucosal layer, and piercing the oral side of the jejunal limb when firing the stapler may result in serious complications, such as EJAL. The integrity of the ring of tissue retained in the circular stapler after completion of the anastomosis should be confirmed. If the mucosal or muscular layer of the ring is discontinuous, additional suturing is required to reinforce the anastomosis.

The usefulness of intraoperative air leak testing and endoscopic examination has been reported [16, 17, 53]. These methods have been shown to detect physical dehiscence and surgeons can add sutures that may prevent EJAL; however, neither method can prevent anastomotic leakage in every patient because the incidence of EJAL depends not only on intraoperative factors, but also on patient conditions. Nevertheless, intraoperative air-leak testing should be performed whenever surgeons suspect EJAL. The test can be performed easily, safely, and without additional cost, although the low sensitivity of intraoperative methods should be borne in mind.

In a prospective randomized trial of the benefit of supplemental oxygen, Schietroma et al [9] found that the risk of EJAL was 49% lower in patients who received 80% FiO2 than in those who received 30% FiO2 during and 6 h after open total gastrectomy surgery. Haverkamp et al [54] reported that the reinforcement of EJ and esophagogastric anastomoses with a fibrin patch (TachoSil; Baxter Healthcare, Deerfield, IL, USA) reduces the occurrence of EJAL. The patch, which contains human fibrinogen and thrombin, was folded into a harmonica shape and wrapped around the anastomosis. It improved the mechanical strength and may prove effective in clinical practice to prevent anastomotic leakage. Afaneh et al [55] used a degradable extracellular

matrix scaffold derived from porcine urinary bladder (MatriStem; ACell Inc., Columbia, MD, USA) to reinforce the EJ anastomosis. A total of 37 patients who underwent total gastrectomy followed by EJ anastomosis were enrolled in their study. The scaffold was wrapped around the anastomosis and EJAL developed in only one patient (2.7%). Although both studies evaluated small-scale case series, the results warrant further investigation to clarify the efficacy of these methods.

Diagnosis

The successful management of EJAL depends on early detection and prompt treatment. The presence of digestive fluids in surgical drains is unequivocal evidence of EJAL, but initial clinical signs are often nonspecific, such as pyrexia, elevation of the white blood count or C-reactive protein, and abdominal pain [6, 33], and require further evaluation to detect EJAL. While several researchers have established classifications based on the degree of EJAL, there is currently no universally accepted classification [7, 56, 57]. However, Clavien et al. introduced an innovative system for grading complications based on the type of therapy required, called the Clavien–Dindo classification [58]. This classification uses objective criteria, providing the same results regardless of the subjectivity of the observers. The Clavien–Dindo classification is used worldwide and considered to be the most reliable classification system for complications, including EJAL [30, 59, 60].

Contrast swallow

Contrast swallow is performed routinely before resuming oral intake after upper gastrointestinal surgery because it is easy and inexpensive; however, its diagnostic sensitivity for anastomotic leakage is low [10, 61]. In a prospective study [11], of 76 patients who underwent total gastrectomy and a stapled EJ anastomosis, contrast swallow was done on postoperative days 5 and 9. Eight patients suffered EJAL, which developed before postoperative day 5 in 7, and contrast swallow gave false negative results in two of five patients. In another study, Tonouchi et al [3] reported that anastomotic leakage was diagnosed by contrast swallow in only 53% of the affected patients. The majority needed two or more contrast swallow tests before diagnosis, with only 12.5% successfully diagnosed at the first examination. Although routine contrast swallow is not recommended for diagnosis, the value of this test lies in the fact that it provides information on the location and extent of leakage. It can assist in selecting appropriate treatment and is useful for the follow-up of EJAL treatment.

Endoscopy

Endoscopy can be used to diagnose EJAL in patients with clinical evidence of leakage with nearly 100% sensitivity and specificity [62]. Moreover, Endoscopy can be used to treat EJAL by the placement of self-expanding metallic stents or the insertion of a nasojejunal feeding tube distal to the dehiscence of the anastomosis or by the insertion of drainage tube into the abscess cavity through the leak hole. Despite concerns that endoscopy may worsen a pre-existent EJAL, endoscopy is well tolerated and safe when performed by experienced endoscopists or surgeons [10, 62–64]. Hogan et al [62] compared routine follow-up with contrast swallow, CT, and endoscopy in a series of 38 patients with esophagogastric resection 1 week after surgery. In the eight patients with clinically apparent leaks, contrast swallow and CT each missed one leak that was subsequently confirmed by endoscopy. Endoscopy had a sensitivity and specificity of 100%, but there were incongruous radiological findings, and only two patients underwent endoscopy. As there are concerns about whether endoscopy can detect minor leaks, additional study of the reliability of endoscopy is needed.

Computed tomography

The presence of perianastomotic air and/or fluid on CT evaluation strongly suggests EJAL [62]. An elevated white blood count or C-reactive protein level is frequently associated with EJAL [6], but they are nonspecific signs. CT can detect not only EJAL but also other morbidities, such as intra-abdominal abscesses, ileus, or pneumonia, and should be performed as soon as any suspicious symptoms appear. CT also shows the extent of abscesses and their accessibility to a percutaneous drain, both of which are important for treatment.

In summary, considering that most patients with EJAL experience clinical signs such as pyrexia, and because the contrast swallow test has low diagnostic sensitivity for leakage, routine postoperative contrast swallow is not recommended for early leakage detection. Although endoscopy is highly sensitive and specific, it is not routinely recommended because of the costs and effort. If EJAL is suspected based on clinical signs, CT should be performed first, followed by a contrast swallow and/or endoscopy if needed.

Treatment

The treatment of EJAL following total gastrectomy includes the following: conservative treatment (with or without percutaneous drainage), endoscopic treatment, and surgery. A standard protocol for the treatment of EJAL has not been established because there is a lack of evidence
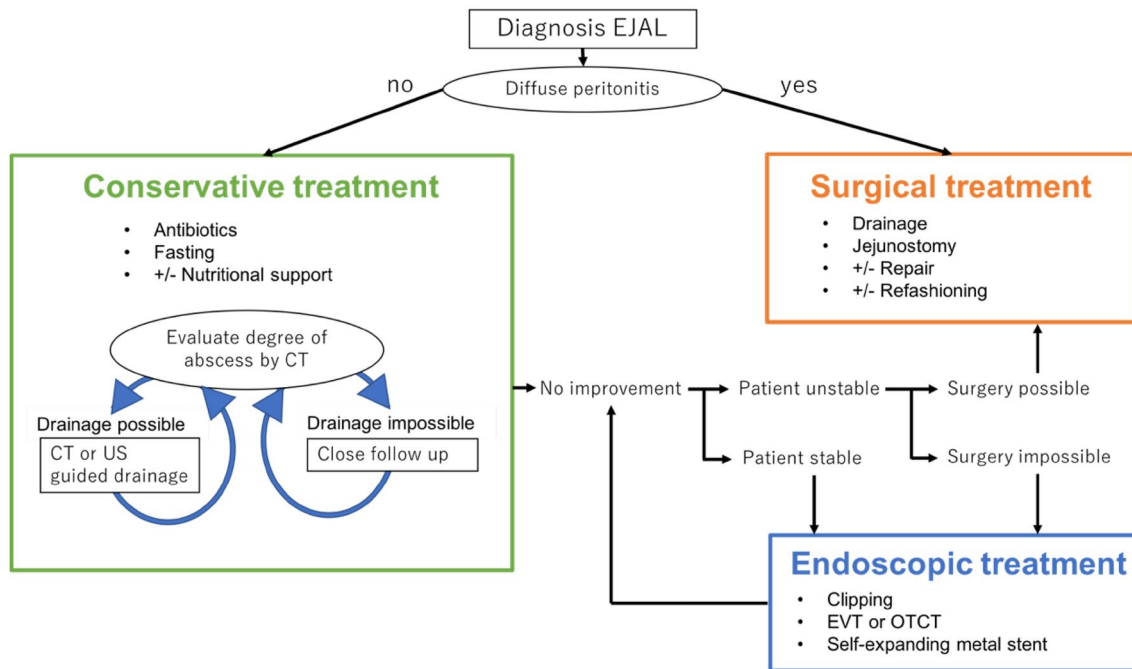
Fig. 1 Treatment algorithm for esophagojejunal anastomotic leakage. *EJAL* esophagojejunal anastomotic leakage, *CT* computed tomography, *US* ultrasonography, *EVT* endoscopic vacuum therapy, *OTSC* over-the-scope-clip system

from randomized controlled trials [7]. Proposed management algorithms [7, 65, 66] include surgical treatment if there is sepsis involving one organ or multi-organ failure, signs of diffuse peritonitis, or jejunal loop ischemia. Otherwise, conservative treatment, including fasting, antibiotics, nutritional support, and insertion of a nasojejunal tube, is recommended. If there is a perianastomotic collection, radiologically guided or endoscopic drainage with or without endoscopic management, such as glue, clips, or stents, should be considered. If conservative treatment has failed, surgery should be performed without delay. Figure 1 shows our recommended treatment algorithm.

Conservative treatment

Conservative treatment with or without percutaneous drainage is the most widely accepted treatment of EJAL, performed in 39–84.2% of patients [4–6, 15, 16, 33]. At the very least, fasting and antibiotics are necessary. Nutritional support is preferably administered via the enteral route, downstream of the leakage site, with a feeding jejunostomy or a nasojejunal feeding tube placed radiologically or endoscopically. If the enteral route is not an option, parenteral nutrition can be considered. A CT scan should be performed before initiating conservative treatment. If there is only a small volume of fluid surrounding the anastomosis, careful surveillance without percutaneous drainage is possible. If a moderate volume of fluid is detected, radiologically guided

drainage should be considered. If the fluid has collected behind other organs, such as the colon or in the mediastinal space, the successful insertion of a drain is difficult, and its success depends on the radiological and surgical techniques used. It is important to position the drainage tube near the anastomosis when the gastrectomy is performed, if there is a concern of leakage, such as suspicion of incomplete formation of the circular anastomosis.

Endoscopic therapy

Several EJAL case series of patients treated with endoscopy and the placement of self-expanding metal stents originally developed for the palliative treatment of advanced gastrointestinal cancer have been reported [67–71]. Feith et al [71] reported that complete healing was achieved by stent implantation in 70% of 115 patients with anastomotic leakage following esophagogastrectomy or gastrectomy. The most frequent drawback was stent migration, which occurred in up to 61% of patients. If this occurs, a second procedure is needed to remove the stent, which may cause additional complications [72]. Repeated stent placement, stent-related pain, and symptomatic stricture after stent removal have all been reported [71, 73]. Non-stent endoscopic treatments, including endoscopic clipping, glue injection, and detachable snares, have been reported in some case series [74–76]. A comparison of non-stent treatment and self-expanding metallic stents by Shim et al [77] found no complications

associated with the non-stent treatment, but successful sealing on the first attempt was significantly lower than that achieved with stent treatment (28.6% vs. 80.0%, *P* = 0.036).

The indications for endoscopic treatment are limited by the size of the dehiscence (< 2 cm or < 70% of the circumference) and the interval from perforation to intervention [68, 70, 77, 78]. The over-the-scope-clip system (OTSC), an innovative non-stent endoscopic therapy, can be used to close large gastric or colonic perforations following endoscopic mucosal resection or anastomotic leakage [79–82]. Openings up to 30 mm can be repaired with a closing force of 8–9 N, which is far stronger than that achieved with hemostatic clips [81]. A systematic review by Weiland et al. [80] reported successful procedures in 80–100% of patients, with durable clinical success in 57–100%; however, the success rate of OTSC is inversely associated with the time from the clinical diagnosis of the leakage to the application of the clip, ranging from 100% at 1 week to < 60% with time [81, 82]. Endoscopic vacuum therapy (EVT) was recently introduced in Europe as a treatment for upper gastrointestinal perforation and anastomotic leakage. In EVT, continuous negative pressure decreases bacterial contamination, secretion, and local edema, and promotes perfusion and the formation of granulation tissue. Briefly, following endoscopic rinsing, a sponge containing a drain is placed in the cavity of the leak, which removes the exudate and maintains negative pressure. The sponge is changed every 3 days until the leakage resolves. Small-case series of patients treated with EVT [83–87] include a comparison by Hwang et al. of EVT and endoscopic stenting in 18 patients with postsurgical gastroesophageal leakage [88]. They reported a better clinical success rate of 100% in the EVT group vs. 64% in the stent group, although the difference did not reach significance. Complications occurred in none of the EVT patients vs. 54.5% of the stent patients. Thus, EVT was more effective and safer than stenting for treating gastroesophageal leakage.

In summary, several endoscopic treatment methods have been reported. The self-expanding metal stent is the most common procedure, but it has several drawbacks, and can cause irreversible complications. Therefore, it should only be used when conservative treatment fails and the patient's poor condition contraindicates surgery. Other new methods have been reported as safe and effective; however, as only small-scale case series are available, the optimal strategy for endoscopic treatment is still unclear.

Surgical treatment

Surgical treatment involves drainage and repair or refashioning of the anastomosis and has been reported as necessary following gastrectomy in 10–61% of patients [4–8, 15, 16, 33, 89]. In a recent systematic review, surgical treatment for EJAL was performed in 23.7% of patients [55]. Mortality

following surgery for EJAL was much higher than that after other treatments: 62.96% after surgery, 28.6% after endoscopic treatment, and 18.2% with conservative treatment. It must be considered that surgery is generally performed on patients who are likely to be in a critical condition, as surgery is not recommended as the first choice, but rather for patients who are gravely ill, if radiologically guided insertion of a drainage tube is not possible, or when conservative treatment has failed.

Conclusions

EJAL is a serious and often life-threatening complication of total and proximal gastrectomy. Meticulous surgical techniques and experience with anastomotic devices are the key to its prevention. Surgeons must be familiar with the risk factors, and early diagnosis is essential to prevent EJAL-related death. Careful monitoring and appropriate evaluation of patients with suspicious symptoms are essential. Conservative treatment with appropriate drainage and nutritional support is currently the treatment of choice. Endoscopic treatment appears to be safe and effective but needs further investigation. Surgical treatment is associated with high mortality, but is appropriate for patients with severe sepsis and if conservative treatment fails to prevent death from suboptimal EJAL management.

Compliance with ethical standards

Conflict of interest Rie Makuuchi and the co-authors have no conflicts of interest to declare.

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