Page 162 to 172

Volume 2 • Issue 3 • 2018

Review Article

Chronicle of Medicine and Surgery

ISSN: 2576-8298

Cervical and Intrathoracic Leaks Following Oesophageal Reconstruction

Abdelkader Boukerrouche*

Department of Digestive Surgery, Hospital of Beni-Messous, University of Algiers, Algiers, Algeria

***Corresponding Author:** Abdelkader Boukerrouche, Department of Digestive Surgery, Hospital of Beni-Messous, University of Algiers, 16002 Algiers, Algeria.

Received: April 04, 2018; **Published:** June 30, 2018

Abstract

The commonly used conduits for oesophageal reconstruction are stomach, colon and jejunum. Gastric and colon grafts are the most frequently used to reconstruct diseased esophagus. Oesophageal anastomotic leaks are a feared and devastating postoperative complication. The severity of leaks depends in part on the anastomotic site and intrathoracic leaks are morbid and potentially fatal. The clinical presentation of leak varies depending on the anastomosis location and dehiscence. The diagnosis of cervical leak is easier and it becomes obvious when there is saliva or air in cervical drain. The intrathoracic leak diagnosis can be difficult and investigations including contrast study, chest scan and endoscopy are necessary to accurate the diagnosis. Early diagnosis and adapted therapeutic option lead to successful resolution of leak. Multiple therapeutic options are available and tailored to clinical form of leak and patient conditions. The introduction of anastomotic stenting and radiologic or mini-invasive drainage of collections has decreased the need for re-surgery. The cause of leak is multifactorial and several factors predispose i to the development of anastomotic leaks following esophageal reconstruction. The prevention is the best way and optimizing modifiable risk factors prior to surgery and applying a careful surgical technique are the key to successful esophageal reconstruction with decreased risk of esophageal anastomotic leaks.

Keywords: *Oesophagectomy; Oesophageal reconstruction; Anastigmatic leaks; Management; Prevention*

Volume 2 Issue 3 June 2018

Introduction

The reconstruction of gut continuity following Oesophagectomy needs the pull up through different routes an abdominal digestive organ to achieve intrathoracic or cervical anastomosis. The commonly used conduits for esophageal reconstruction are stomach, colon and jejunum. Gastric and colon grafts are the most frequently used to reconstruct diseased esophagus. Oesophageal anastomotic leak after esophageal reconstruction is a feared and potentially devastating postoperative complication. The severity of leaks depends in part on the anastomotic site and intrathoracic leak is a major concern for surgeons because leak is dreaded, morbid and potentially mortal. The cervical leak is likely to be more frequent but benign without risk of fatality. The intrathoracic leakage is often associated with septic meadiastinitis, pneumonia, respiratory failure and the need to surgical revision leading to prolonged hospital stay and increased risk of

postoperative death [1,2]. Cervical leak is only associated with wound sepsis and increased hospital stay, and the leak heals spontaneously without need to reoperation [3]. The incidence of anastigmatic leak varied between reported studies depending on the diagnosis vigor and definition of leak [4]. Recent reports do not reveal a sharp decrease in leak rates and cervical anastomosis is associated with higher incidence of leak (10%–25%) than intrathoracic anastomosis (< 12.3%) [5-11]. Although intrathoracic leaks remain a fatal complication with high rate of related-mortality (> 20%). A slight decrease in mortality rate was recently reported in relation with improvement in surgical technique (stabled anastomosis, use of adjunctive measures), anesthetic progress, early diagnosis and management (stent) [12,13]. In additionally healing of anastomotic leak may result in further subsequent stricture causing dysphagia with need to endoscopic dilations or surgical revision. Regarding the frequency and morbidity and related-death of esophageal anastomotic leaks, understanding their cause, identifying the predisposing factors, applying preventive measures and knowledge of management strategies are fundamental for the surgical team to minimize the risk and to optimize management of leaks.

Diagnosis

The clinical presentation of leak varies depending on the location of anastomotic site and the importance of anastomotic dehiscence. The first evocative elements of leaks are postoperative fever and leukocytosis. Importantly, the presence of septic signs in the early postoperative period is a high index of suspicion of anastomotic leak. The diagnosis of leak is easier when anastomosis is located in the neck. Erythema, induration and fluctance development along the cervical incision often announces an underlying leak of cervical anatomosis. The presence of saliva or air in the cervical drain signifies a likely anastomotic leak and the diagnosis becomes obvious. In case of intrathoracic anastomosis, the development of pleural effusion in immediate postoperative days, particularly in the vicinity of the anastomosis should be considered as a leak until proved otherwise. The diagnosis of leak may be obvious and certain if presence of bile or saliva in the thoracic drainage. However the differential diagnosis arises with the chylothorax in the presence of pleural effusion and further investigations are necessary to accurate the diagnosis. Contrast study has been commonly used to detect anastomotic leak following esophageal reconstruction. It provides an assessment of anastomotic integrity and additional informations on the contour, straightness and emptying of the transposed graft. The contrast study is often performed between 5 and 8 postoperative days which correspond to time period of the development of most leaks.

A water-soluble contrast agent such as Gastrografin is the most used to check the anastomosis integrity in the postoperative phase because of fear of exacerbating mediastinal or pleural sepsis with leaked barium. This exam is more easier to be realized, it can be performed at the bedside, in patients with difficulty swallowing or mechanical ventilator support. However, care must be taken to prevent aspiration because if aspirated, Gastrografin May cause chemical pneumonia. Chest scan with oral water-soluble contrast provides more information on magnitude of anastomotic dehiscence and extent of the abscess and it is helpful for placement of the chest flush and drainage tube [14-16]. Endoscopy has been introduced as a diagnosis option for anastomotic leak especially intrathoracic leak [16,17]. It allows assessing the anastomotic integrity by diagnosing disruption not discernible on imaging studies .in addition; endoscopy provides more information on graft viability by identifying graft is chemical and necrosis that can be helpful to guide therapeutic strategy. Despite the concerns about the risk of anastomotic trauma, performing flexible endoscopy has been demonstrated to be safe even in early postoperative period. However, air insufflation during the endoscopic procedure can predispose to tension pneumothorax in presence of anastomotic disruption, so in order to prevent this problem, an appropriate chest drainage should be in place, or immediately available. Determination of amylase levels in the drain fluid and measurement of serum C-reactive protein are helpful to diagnose anastomotic leaks.

Management Strategy

The management of leak depends on the anastomosis location; the extent of anastomotic dehiscence; the adequacy of graft perfusion; the involvement of adjacent organs such as the airway and lung; the severity of sepsis and the hemodynamic stability of patient.

Cervical leak

The cervical anastomotic leak is generally confined to the cervical soft tissue with less risk of intrathoracic or mediastinal extension. However leak of anastomosis located in the lower area of the neck immediately obvious to the sternal manubrium can extend to the mediastinum resulting in extensive mediastinitis. The cervical leak is often treated conservatively and in the presence of abscess, wound opening, packing and drainage become more necessary to avoid intrathoracic or mediastinal diffusion. The spontaneous closure is often obtained after introduction of nutritional support and suspension of oral intake. Enteral feeding is the first choice because of its efficiency and safety [18-21].

Intrathoracic leak

The intrathoracic leak is less common than the cervical leak. However leak in the chest can result in severe sepsis and mediastinitis. The treatment of intrathoracic leak is not standardized and there is a controversy about the most effective treatment method. Therefore the strategy of management is guided by the severity of clinical signs, magnitude of leak, patient conditions and experience of surgeon.

The non-operative approach or conservative management more indicated in case of occult anastomotic leak (grade I) detected during routine postoperative endoscopy or imaging studies in asymptomatic patients and in subclinical or contained leaks [22]. Conservative strategy consists of delaying the oral intake, continuing enteral nutrition via jejunostomy or nasogastric/nasoduodenal feeding tube and administration of broad-spectrum antibiotics. Spilled saliva or gastric secretions are controlled with previously placed surgical drains, or the introduction of percutaneous drains into the involved areas Surgery is required in intrathoracic leak associated with sepsis and mediastinitis. The surgical management options are guided by the circumference of disruption, the extent of graft necrosis and sepsis severity. Small disruptions with minor sepsis can be managed with delayed oral intake, enteral or parenteral nutritional support, drainage of adjacent fluid collections, antibiotics. The anastomosis repair should be reinforced by buttressing the suture line with viable tissue, such as omentum, pericardial fat, or muscle flap. Surgical reparation is more risked and hazardous in moderate and large disruption because the factors resulting in leak are still present such as anastomotic tension and compromised blood flow of graft or of remnant esophagus. Additionally, contamination of surgical field, hemodynamic instability, respiratory infection and effects of systemic sepsis complicate re-operation. Therefore, in such conditions, repair of anastomosis is not recommended and management options include wide local drainage, placement of a large, exteriorized T-tube across the defect, or takedown of the anastomosis and cervical esophageal diversion (esophagostomy) with or without resection of the remaining intrathoracic graft (stomach or colon) and esophagus. If the conduit necrosis is extensive and anastomotic disruption is complete, partial or complete conduit excision and performing cervical esophagostomy are required. The remnant gastric graft can be used as a feeding –gastrostomy in immediate postoperative period and latter in the combined subsequent foregut reconstruction.

When the graft is positioned in the posterior mediastinum, the anastomosis is closely situated to the lung parenchyma and membranous airway and if a leak occurs, there is a risk for development of an aero digestive fistula. Such fossilization is associated with aspiration of saliva and gastric secretions into the lungs leading to pulmonary infection and respiratory compromise. In such circumstances, an emergency intervention is required to temporarily close the aero digestive communication and controlling contamination by placing a stent through the esophageal anastomosis. However stenting is a court-term solution and surgical management is required including primary repair of esophageal anastomosis and closure of the wall airway defect. Pericardium or aortic homograft have been as a buttress or patch when repairing airway defect. Interposing vascularized soft tissues such as omentum or muscle flap between repaired esophageal anastomosis and airway sutures lines is highly recommended to prevent refistulization. However if the graft necrosis is enough extensive, graft resection and cervical esophageal diversion is required after airway repair. Recently a non-surgical treatment option of anastomotic esophageal leaks have been introduced and consisted of stent placement to avoid issues associated with re-operation [23-29]. The goal of anastomotic stenting is to obtain an anastomotic defect closure; however, image-guided percutaneous or surgical drainage may be required in the presence of associated fluid collections. Properly placed, stent can seal the defect area allowing healing .The appropriate indication for stent placement is leak involving less than 30% of anastomosis circumference. In the presence of significant graft ischemia revealed by endoscopy, the indication of stenting is not appropriate and the excision of necrosis is required.

After anastomotic healing, the stent must be removed and so the fully covered self-expanding metal, plastic, or hybrid stent of a large diameter is the appropriate choice. The later removal of uncovered or partially covered stent may pose difficulties and so its use is not appropriate. Adherence of covered stent to mucosa is further compromised however uncovered or partially covered stent permits tissue growth and adherence. Stent migration is a common problem after stent placed across an anastomosis and endoscopic clipping or suturing have been advocated as adjuncts to prevent migration. Other complications can occur after stent placement including inadequate coverage of the leak; plugging; and erosion into surrounding structures, such as the airway or major blood vessels, particularly if the stent is left in place for a prolonged time [24-27]. The reported results revealed a successful control of leaks with stent placement [27,30].

If patient survives, the re-establishment of digestive continuity can be considered usually months later after full recovery and condition improvement of patient. The colon (right or left), jejunal or gastric (if available) graft can be used and substernally interposed to establish digestive continuity. In such circumstances, re-dissecting the posterior mediastinum is difficult and highly risked exposing to operative complications, so the substernal is highly recommended [31-33].

Risk factors and prevention

Several factors can impact the anastomotic healing including patient or systemic factors and technical or surgical factors (Table 1). Preoperative identification of predisposing factors to anastomotic leak, optimization of the modifiable patient risk factors and meticulous surgical technique are highly recommended to reduce the risk of leak.

Patient factors
_ Severe malnutrition
_ Hypovolemia/hypotension
_Chemotherapy
_ Diabetes
_ Smoking
_ Renal insufficiency
_ Heart failure
_ Hypertension
_ Coronary disease
_ Vascular disease
Surgical factors
_ Graft ischemia and necrosis
_ Venous compromise
_ Extrinsic compression
_ Graft distention
_ Infection
_ Radiation therapy
_ Anastomotic tension
_ Anastomotic location
_ Anastomotic technique
_ Route of reconstruction

Table 1: *Risk factors of esophageal anastomosis leak.*

Patient factors (Systemic Factors)

Healing process of esophageal anastomosis can be impaired by well-known multiple patient factors [8,34]. These risk factors include:

Poor nutritional status

Severe malnutrition is associated with high rate of anastomotic leak and sepsis. The definition of severe malnutrition varied, however a weight loss greater than 20% of usual body weight or a serum albumin less than 3.0 g/dL are commonly accepted criteria to determine a severe nutritional depletion [35], and studies demonstrated that low serum albumin (< 3.5 g/dL) has been found to be an independent predictor of anastomotic leak [36]. Esophageal surgical patients are often nutritionally depleted because they have a poor oral intake related to dysphagia or anorexia from an underlying esophageal malignant conditions and effects of chemo radiation therapy. Therefore the preoperative nutritional status evaluation is highly recommended in these patients to detect malnutrition. Correction of severe malnutrition prior to surgery is highly recommended by authors and acceptable nutritional patient conditions is primordial to improve surgical outcomes particularly surgical site infections, infectious complications [37-41]. The introduction of preoperative nutritional supports were greatly debated and their use is supported by most published studies only in patients with severe malnutrition [19, 38-40].

Both enteral and parenteral can be used to optimize patient nutritional status. However enteral nutrition via feeding tube is preferred over parenteral nutrition (PN) if the gastrointestinal tract is functional [42]. The feeding jejunostomy is now placed during the staging laparoscopy in many centers and it is used for nutrition supplementation during neo adjuvant therapies and in post-esophagectomy setting [43]. As demonstrated by meta-analyses, preoperative enteral nutrition intervention in malnourished patients had decreased major morbidity including anastomotic keak [42,44]. Parenteral nutrition is used when enteral nutrition is not feasible. The duration of preoperative nutritional therapy is variable and the goal of nutrition is to optimize the nutritional status of patient allowing to perform surgery in acceptable nutritional conditions. Hyper metabolism induced by major surgery entails a significant protein loss of lean body mass, primarily from muscle in the postoperative period. Therefore introducing a Postoperative nutrition has become a necessity to provide caloric and nitrogenous support to optimize wound and anastomosis healing, to avoid excessive loss of lean body mass and to attenuate the hyper metabolic response to surgery, and thus optimizing healing and recovery.

Graft hypo perfusion

Blood supply to the graft is an important paramount in esophageal reconstruction. Preventing perioperative hypotension and hypovolemia is primordial to maintain a good graft perfusion [35, 45-47]. Although the definition of hypotension and the assessment of hypovolemia are not precise, perioperative hypotension and use of inotropes have been shown to be an independent predictive factors of anastomotic leak and patients who required inotropic support or developed hypotension in the postoperative period had a risk of leak four and three times greater respectively [36].

Other predictive factors of anastomotic leak in esophageal surgery had been found such as anemia (hemoglobin < 8 g/dL), blood transfusion, blood loss, heart failure, coronary disease, vascular disease, diabetes, hypertension, renal insufficiency, smoking, neodjuvant chemotherapy, procedure duration greater than 5 hours, and type of procedure [2,11,36,48].

Surgical factors (technical factors)

Several factors contribute to the development of anastomotic leak but surgical technique and in adequacy of graft blood supply are the major contributing factors esophageal leaks.

Graft ischemia and necrosis

Adequacy perfusion of digestive graft and esophageal remnant is the most important factors impacting the esophago-digestive anastomotic integrity. However graft ischemia or necrosis remain the most important causes of leaks and graft blood supply insufficiency is the major cause of ischemia and necros is. The blood supply of the esophageal segment remaining after resection of diseased

esophagus is not usually a concern for surgeon. However, the vasculature of esophageal extremity to be anastomosed with graft may be impaired and thus predisposing to anastomotic leak, if a long portion of esophagus has been mobilized during esophageal dissection. Ischemia of the proximal part of graft is a major risk factor for poor anastomotic healing.

When the stomach is used, the creation of an optimal graft is the most important factor. So it is important to create a gastric tube of an adequate shape, diameter and length. The fundal tip is the most common site of esophago gastric anastomosis. Blood supply to the tip of the gastric tube has been identified as a main issue in esophageal reconstruction. Therefore maintaining an adequate blood supply to the future graft particularly the cranial part (fundal tip) is an important factor to reduce risk of ischemia and necrosis. The gastric graft blood supply is derived mainly from the right gastroepiploic vessels and the left gastroepiploic vessels and left gastric artery are ligated during the graft creation procedure. A too narrow gastric tube results clearly in fundal tip ischemia or necrosis, so the ideal width of gastric graft is 4 to 5 cm of transverse diameter.

Compared to cervical leak, intrathoracic leak is associated with high rate of mortality and complications. In fact, various adjunctive measures have been proposed to prevent or control intrathoracic leaks. Improving blood perfusion of the esophagogastric anastomosis site (fundal tip) may reduce increasingly the rate of anastomotic leaks. Various techniques and modalities that potentially increase the blood perfusion of the gastric graft have been proposed including ischemic preconditioning of stomach and delayed cervical esophagogastric anastomosis.

Ischemic preconditioning of stomach consists of partially fundus devascularization prior to esophageal reconstructive surgery by dividing the left gastric and short gastric vessels to improve gastric microcirculation (the "delay phenomenon") [49]. Ischemic preconditioning can be induced by several approaches: partial devascularization of stomach by dividing left gastric and shorts gastric vessels by laparoscopy or laparotomy or angio embolization. The animal studies showed an increase in gastric neovascularization after 4 weeks [50], and relative preservation of gastric blood flow to the fundal tip [51]. The impact of gastric ischemic preconditioning on the severity of leaks has not been studied thoroughly and the recent published reports concluded that the current and available evidence remains insufficient to draw a conclusion and support its widespread use outside of a clinical research protocol [52,53]. So further comprehensive investigation on the real impact of gastric ischemic preconditioning prior to esophageal reconstruction on the esophagogastric anastomosis leaks is more warranted [52].

Delayed cervical esophagogastric anastomosis consists of pulling up the gastric graft to the neck through the posterior mediastinum with delaying cervical anastomosis and performing a cervical esophagostomy. The esophagogastric anastomosis is performed 3 months later. This procedure has the same physiologic principles as preoperative partial gastric devascularization aiming to improve the gastric graft blood flow [54]. The reported results showed no anastomotic leaks occurred with using the method in high-risk patients [54].

Colon interposition for esophageal reconstruction is associated with relatively a high risk of graft ischemia and necrosis. The causes of graft ischemia are arterial insufficiency or venous stasis and intraoperative injury to the arterial supply or venous drainage of the graft. Optimized colon graft is consisted of the selection of colon segment with good blood supply and adequate length. Vascular graft supercharge has been used to optimize arterial and venous blood flow to the graft reducing thus the risk of ischemia and necrosis. Vascular augmentation techniques have been used to optimize colon graft perfusion during colon interposirion for esophageal reconstruction. The micro vessel anastomosis is mostly performed between the graft mesenteric vessels and the left internal mammary artery; however transverse cervical artery, branches of the external carotid artery, and the internal or external jugular vein can be used. The vascular augmentation is mostly performed on the right colon graft. The reported results showed the clear advantage of microvascular reinforcement of colon graft in preventing ischemia and anastomotic leaks. A significant reduction of leaks was observed in patients who received a colon interposition with additional microvascular anastomosis of graft [55-57].

Venous obstruction constitutes an obstacle to venous drainage and may cause graft ischemia and adversely impact the anastomotic integrity. The causes include extrinsic compression, twisting, or kinking, excessive traction or inadequate exposure of the vascular feeding pedicle, and distension of graft. These technical mismanagement are often happened during the pull up of graft through the route of reconstruction. When the substernal route is used, it is highly recommended to widen the thoracic inlet to ensure there is no risk of graft compression [58].

Graft distension in postoperative period may impair blood supply resulting in anastomotic healing impairment. So in order to prevent graft distension (colon or stomach) and aspiration of gastric contents, the graft is intubated by a tube left in place for several days after reconstruction.

Anastomotic reconstruction factors

Careful surgical technique reconstruction of anastomosis is an important technical paramount when reconstructing a gastrointestinal anastomosis.

Anastomotic tension

Anastomotic tension is a detrimental factor for anastomotic healing and integrity of anastomosis. Anastomotic tension results in impairment of tissue healing and increasing risk of ischemia of fundal tip and proximal extremity of colon graft. Therefore the creation of a gastric graft or the selection of colon graft with adequate length in order to easily reach the neck is important paramount to perform a free tension cervical anastomosis. An appropriately created gastric tube has a sufficient length to reach cervical level without excessive tension. However, the reconstruction distance must be measured intra operatively to select a colon graft with appropriate length.

Anastomotic technique

A variety of methods to construct the anastomosis between esophagus and digestive graft exists and includes hand-sewn (continuous or interrupted, single- or double-layer), stapled (circular or linear), and hybrid approaches combining sutures and staples. In addition, the anastomosis can be performed in an end-to-end, end-to-side, or side-to-side fashion. Regardless of the used technique, meticulous and careful reconstruction of anastomosis includes the incorporation of all layers of the esophagus and digestive graft walls, avoiding excessive tissue strangulation and creating a watertight closure with free tension. Choosing an anastomotic technique depends on the surgeon preference and operative conditions and surgeon is able to apply the best one in any specific situation. Multiple studies have investigated anastomotic leak by comparing various anastomotic techniques. The recent reported meta-analysis comparing completely hand-sewn and linear stapled techniques found lower leak rates with linear stapled anastomosis [59]. However no difference in leak rates between linear and circular stapled anastomoses was found in reported meta-analysis [60]. Independently of the used technique to reconstruct anastomosis, the leak incidence of cervical anastomosis is higher than that of intrathoracic anastomosis [61,62].

Wrapping of the esophageal anastomosis with omentum in order to reinforce suture lines has been used to reduce the leak rate. Buttressing the anastomosis with pedicled omental flap increases neovascularization of the anastomotic site and reduces leak rate and severity. The published reports of systematic reviews showed lower leak rate with omen to plasty compared to unwrapped anastomoses [13, 63-65].

The tissue adhesives such as fibrin sealants (FS) and cyanoacrylates (CA) have been used to re-in force the anastomotic suture lines and thus preventing leaks in esophageal surgery. A recent report of a systematic review of studies assessing the role of using tissue adhesives in esophageal surgery showed a positive impact on reducing leak however quality of studies was poor due to a high degree of bias and lack of homogeneity [66]. Therefore the efficacy of tissue adhesive is a subject in need of further investigations. Further studies are needed to evaluate the combined use of the preventive measures previously described in deceasing the leak rates of esophageal anastomoses.

The route of reconstruction

The graft placement during esophageal reconstruction is an important factor in the development of anastomotic leaks. Compared to posterior mediastinum, the substernal route is associated with higher leak rate of cervical anastomosis [3,67] and some reports revealed that the substernal route was a predisposing factor for cervical leak [3,68]. The substernal route has two major disadvantages; it is the longer route with potential risk of graft compression at the level of thoracic inlet. Therefore the longer distance of reconstruction and the risk of graft compression are the major causes of the high incidence of cervical leak during substernal graft interposition [69-72]. Many authors suggested to enlarge the thoracic inlet during substernal digestive graft interposition following esophagectomy [69-73]. The posterior route or posterior mediastinum is shorter, direct without angulations and it is the preferred route for immediate reconstruction after esophagectomy. However substernal route is used in delayed reconstruction or when posterior mediastinum is technically inaccessible.

Summary

Anastomotic leak following esophageal reconstruction remains a major clinical concern for both patient and surgeon. Despite the increased understanding of the several contributive factors, advances made in perioperative optimization of modifiable risks, improvement in surgical, endoscopic, and percutaneous management techniques, leaks remain a major cause of death and morbidity in esophageal reconstructive surgery. The prevention is the best way to reduce rate leak. Therefore identifying and optimizing the risk factors, and using operative adjunctive measures are highly recommended to minimize leak occurrence. Early diagnosis of leak and best treatment strategy adapted to patient circumstances result mostly in successful resolution of leaks following esophageal reconstruction.

Conflict of interest

The author has no conflict of interest to report

References

1. Conners RC., *et al*." Comparing outcomes after transthoracic and transhiatal esophagectomy: a 5-year prospective cohort of 17,395 patients". *Journal of the American Collège of Surgeons* 205.6 (2007): 735-40.
2. Tabatabai A., *et al*. "Incidence and risk factors predisposing anastomoticleak after transhiatal esophagectomy". *Annals of Thoracic Medicine* 4.4 (2009): 197-200.
3. Abdelkader Boukerrouche. Isoperistaltic left colic graft interposition via a retrosternal approach for esophageal reconstruction in patients with a caustic stricture: mortality, morbidity, and functional results. Surgery Today 44.5 (2014): 827-833.
4. Urschel JD. "Esophagogastrostomy anastomotic leaks complicating esophagectomy: a review". *The American Journal of Surgery* 169.6 (1995): 634-640.
5. Vigneswaran WT., *et al*. "Transhiatal esophagectomy for carcinoma of the esophagus". *The Annals of Thoracic Surgery* 56 (1993): 838-46.
6. Chasseray VM., et al. "Cervical or thoracic anastomosis for esophagectomy for carcinoma". *Journal of the American Collège of Surgeons* 169 (1989): 55-62.
7. Tilanus HW., *et al*. "Esophagectomy with or without thoracotomy: is there any difference?" *The Journal of Thoracic and Cardiovascular Surgery* 105.5 (1993): 898-903.
8. Patil PK., *et al*. "Cancer of the esophagus: esophagogastric anastomotic leak: a retrospective study of predisposing factors". *Journal of Surgical Oncology* 49 (1992): 163-167.
9. Shahian DM., *et al*. "Transthoracic versus extrathoracic esophagectomy: mortality, morbidity and long-term survival". *The Annals of Thoracic Surgery* 41 (1986): 237-246.
10. King RM., *et al*. "Ivor Lewis esophago gastrectomy for carcinoma of the esophagus: early and late functional results". *The Annals of Thoracic Surgery* 44 (1987): 119-122.
11. Kassis ES., *et al*. "Predictors of anastomotic leak after esophagectomy: an analysis of the Society of Thoracic Surgeons General Thoracic Data base". *The Annals of Thoracic Surgery* 96 (2013): 1919-1926.

12. Ben-David K., *et al*. "Decreasing morbidity and mortality in 100 consecutive minimally invasive esophagectomies". S*urgical Endoscopy* 26 (2012): 162-167.
13. Dai JG., *et al*. "Wrapping of the omental pedicle flap around esophagogastric anastomosis after esophagectomy for esophageal cancer". *Surgery* 149 (2011): 404-410.
14. Strauss C., *et al*. "Computed tomography versus water-suluble contraste swallow in the detection of intrathoracic anastomotic leak complicating esophagectomy: a prospective study in 97 petients". *Annals of Surgery* 251 (2010): 647-652.
15. Lantos JE., *et al*. "Comparison between esophagography and chest computed tomography for evaluation of leaks after esophagectomy and gastric pull-through". *Journal of Thoracic Imaging* 28.2 (2013): 121-128.
16. Hogan BA., *et al*. "Prospective trial comparing contrast swallow, computed tomography and endoscopy to identify anastomotic leak following oesophagogastric surgery". *Surgical Endoscopy* 22 (2008): 767-771.
17. Page RD., *et al*. " Routine endoscopy to detect anastomotic leakage after esophagectomy". *The Annals of Thoracic Surgery* 95 (2013): 292-298.
18. Manba N., *et al*. "Is early enteral nutrition initiated within 24 hours better for the postoperative course in esophageal cancer surgery?" *Journal of Clinical Medicine Research* 6.1 (2014): 53-58.
19. Llop-Talaveron JM., *et al*. "Artificial nutritional support in cancer patients after esophagectomy: 11 years of experience". *Nutrition and Cancer* 66.6 (2014):1038-1046.
20. Fujita T., *et al*. "Early enteral nutrition reduces the rate of life-threatening complications after thoracic esophagectomy in patients with esophageal cancer". European surgical research Europaische chirurgische Forschung Recherches chirurgicales europeennes 48.2 (2012):79-84.
21. Yu HM., *et al*. "Early Enteral Nutrition versus Parenteral Nutrition after Resection of Esophageal Cancer: a Retrospective Analysis". *Indian Journal of Surgery* 79.1 (2017): 13-18.
22. Crestanello JA., *et al*. "Selective management of intrathoracic anastomoti c leak after esophagectomy". *The Journal of Thoracic and Cardiovascular Surgery* 129 (2005): 254-260.
23. Freeman RK., *et al*. "Esophageal stent placement for the treatment of iatrogenic intrathoracic esophageal perforation". *The Annals of Thoracic Surgery* 83 (2007): 2003-2008.
24. Hunerbein M., *et al*. "Treatment of thoracic anastomotic leaks after esophagectomy with self-expanding plastic stents". *Annals of Surgery* 240 (2004): 801-807.
25. Chak A., *et al*. "Covered stents for the treatment of life-threatening cervical esophageal anastomotic leaks". *The Journal of Thoracic and Cardiovascular Surgery* 141 (2011): 834-844.
26. D'Cunha J., *et al*. "Esophageal stents for anastomotic leaks and perforations". *The Journal of Thoracic and Cardiovascular Surgery* 142 (2011): 39-46.
27. Freeman RK., *et al*. "Esophageal stent placement for the treatment of acute intrathoracic anastomotic leak after esophagectomy". *The Annals of Thoracic Surgery* 92 (2011): 204-208.
28. Wilson JL., *et al*. "Fully covered self-expanding metal stents are effective for benign esophagogastric disruptions and strictures". *Journal of Gastrointestinal Surgery* 17 (2013): 2045-2050.
29. Eizaguirre E., *et al*. "Treatment of anastomotic leaks with metallic stent after esophagectomies". Diseases of the Esophagus 2015.
30. Nguyen NT., *et al*. "Management of gastrointestinal leaks after minimally invasive esophagectomy: conventional treatments vs. endoscopic stenting". *Journal of Gastrointestinal Surgery* 11 (2011): 1952-1960.
31. Kesler KA., *et al*. "Supercharged isoperistaltic colon interposition for long-segment esophageal reconstruction". *The Annals of Thoracic Surgery* 95 (2013): 1162-1188.
32. Blackmon SH., *et al*. "Supercharged pedicled jejunal interposition for esophageal replacement: a 10 year experience". *The Annals of Thoracic Surgery* 94 (2012): 1104-1111.
33. Abdelkader Boukerrouche. "15-year Personal Experience of Esophageal Reconstruction by Left Colic Artery-dependent Colic Graft for Caustic Stricture: Surgical Technique and Postoperative Results". *Journal of Gastroenterology and Hepatology Research* 21.5 (2016): 1931-1937

34. Swanson JO., *et al*. "Usefulness of high-density barium for detection of leaks after esophago gastrectomy, total gastrectomy, and total laryngectomy". *American Journal of Roentgenology* 181 (2003): 415-420.
35. Dewar L., *et al*. "Factors affecting cervical anastomotic leak and stricture formation following esophago gastrectomy and gastric tube interposition". *The American Journal of Surgery* 163 (1992): 484-489.
36. Choudhuri AH., *et al*. "Influence of nonsurgical risk factors on anastomotic leakage after major gastrointestinal surgery: audit from a tertiary care teaching institute". *International Journal of Critical Illness and Injury Science* 3 (2013): 246-249.
37. Schiesser M., *et al*. "The correlation of nutrition risk index, nutrition risk score, and bio impedance analysis with postoperative complications in patients undergoing gastrointestinal surgery". *Surgery* 145 (2009): 519-526.
38. Dempsey DT., *et al*. "The link between nutritional status and clinical outcome: can nutritional intervention modify it?" *The American Journal of Clinical Nutrition* 47.2 (1988): 352-356.
39. Gallagher-Allred CR., *et al*. "Malnutrition and clinical outcomes: the case for medical nutrition therapy". *Journal of The American Dietetic Association* 96 (1996): 361-366.
40. Bruun LI., *et al*. "Prevalence of malnutrition in surgical patients: evaluation of nutritional support and documentation". *Clinical Nutrition* 18 (1999): 141-147.
41. Awad S and Lobo DN. "Metabolic conditioning to attenuate the adverse effects of perioperative fasting and improve patient outcomes". *Current Opinion in Clinical Nutrition & Metabolic Care* 15 (2012): 194-200.
42. Kondrup J., *et al*. "Ad Hoc ESPEN Working Group. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials". *Clinical Nutrition* 22 (2003): 321-336.
43. Ben-David K., *et al*. "Pre-therapy laparoscopic feeding jejunostomy is safe and effective in patients undergoing minimally invasive esophagectomy for cancer". *Journal of Gastrointestinal Surgery* 17 (2013): 1352-1358.
44. Daley J., *et al*. "Risk adjustment of the postoperative morbidity rate for the comparative assessment of the quality of surgical care: results of the National Veterans Affairs Surgical Risk Study". *Journal of the American College of Surgeons* 185 (1997): 328-340.
45. Perracchia A., *et al*. "Esophagovisceral anastomotic leak: a prospective statistical study of predisposing factors". *The Journal of Thoracic and Cardiovascular Surgery* 95 (1988): 685-691.
46. Buzby GP., *et al*. "Perioperative total parenteral nutrition in surgical patients". *The New England Journal of Medicine* 325 (1991): 525-532.
47. Baker JP., *et al*. "Nutritional assessment: a comparison of clinical judgment and objective measurements". *The New England Journal of Medicine* 306 (1982): 969-972.
48. Escofet X., *et al*. "Prevalence and outcome of esophagogastric anastomotic leak after esophagectomy in a UK regional cancer network". *Diseases of the Esophagus* 23 (2010): 112-116.
49. Yuan Y., *et al*. "Vascular conditioning of the stomach before esophageal reconstruction by gastric interposition". *Diseases of the Esophagus* 25 (2012): 740-749.
50. Perry KA., *et al*. "Gastric ischemic conditioning increases neovascularization and reduces inflammation and fibrosis during gastro esophageal anastomotic healing". *Surgical Endoscopy* 27 (2013): 753-760.
51. Beck SM., *et al*. "Experimental model of laparoscopic gastric ischemic preconditioning prior to transhiatal esophagectomy". *Surgical Endoscopy* 25 (2011): 2470-2477.
52. Aristotelis Kechagias., *et al*. "Ischemic Conditioning of the Stomach in the Prevention of Esophagogastric Anastomotic Leakage after Esophagectomy". *The Annals of Thoracic Surgery* 101 (2016): 1614-1623.
53. Yuan Y., *et al*. "Vascular conditioning of the stomach before esophageal reconstruction by gastric interposition". *Diseases of the Esophagus* 25 (2012): 740-749.
54. Arczu Oercelik., *et al*. "Delayed esophagogastrostomy: a safe strategy for management of patients with gastric ischemia conduit at time of esophagectomy". *Journal of the American College of Surgeons* 208.6 (2009): 1030-1034.
55. Fujita H., *et al*. "Impact on outcome of additional microvascular anastomosis - supercharge - on colon interposition for esophageal replacement: comparative and multivariate analysis". *World Journal of Surgery* 21 : 998-1003.

56. Shirakawa Y., *et al*. "Colonic interposition and super charge for esophageal reconstruction". *Archives of Surgery* 391 (2006): 19-23.
57. Boukerrouche A. "Colonic Esophageal Reconstruction by Substernal Approach for Caustic Stricture: What is the Impact of the Enlargement of the Thoracic Inlet on Cervical Anastomotic Complications?" *Journal of Surgery* 10.2 (2014): 140-145.
58. Deng XF., *et al*. "Hand-sewn vs linearly stapled esophagogastric anastomosis for esophageal cancer: a meta-analysis". *World Journal of Gastroenterology* 21 (2015): 4757-4764.
59. Zhou D., *et al*. "Comparison of two different mechanical esophagogastric anastomosis in esophageal cancer patients: a meta-analysis". *Journal of Cardiothoracic Surgery* 10 (2015): 67.
60. Hulscher JB., *et al*. "Transthoracic versus transhiatal resection for carcinoma of the esophagus: a meta-analysis". *The Annals of Thoracic Surgery* 72 (2001): 306-313.
61. Markar SR., *et al*. "Technical factors that affect anastomotic integrity following esophagectomy: systematic review and meta-analysis". *Annals of Surgical Oncology* 20 (2013): 4274-4281.
62. Yuan Y., *et al*. "Omentoplasty for oesophagogastrostomy after oesophagectomy". *The Cochrane Database of Systematic Reviews* 10 (2014): CD008446.
63. Sepesi B., *et al*. "Omental reinforcement of the thoracic esophagogastric anastomosis: an analysis of leak and re intervention rates in patients undergoing planned and salvage esophagectomy". *The Journal of Thoracic and Cardiovascular Surgery* 144 (2012): 1146-1150.
64. Yoshida N., *et al*. "Triangulation stapling technique covered with the pedicled omental flap for esophagogastric anastomosis: a safe anastomosis with fewer complications". *Journal of the American College of Surgeons* 220 (2015): e13-16.
65. Plat VD., *et al*. "The role of tissue adhesives in esophageal surgery, a systematic review of literature". *International Journal of Surgery* 40 (2017): 163-168.
66. Orringer MB., *et al*. "Transhiatal esophagectomy for treatment of benign and malignant disease". *World Journal of Surgery* 25 (2001): 196-203.
67. Urschel JD., *et al*. "A meta-analysis of randomized controlled trials of route of reconstruction after esophagectomy for cancer". *The American Journal of Surgery* 182 (2011): 470-475.
68. Dale and Sherman. "Interposition colique retrosternal". *The Journal of Thoracic and Cardiovascular Surgery 2*9 (1955): 344-356.
69. DeMeester TR., *et al*. "Indications, surgical technique, and long-term functional results of colon interposition or bypass". *Annals of Surgery* 208 (1988): 460-474.
70. Takushi Yasuda and Hitoshi Shiozaki. "Esophageal Reconstruction with Colon Tissue". *Surgery Today* 41 (2011): 745-753.
71. Abdelkader B. "Esophageal replacement for caustic stricture –A brief review". *Advanced Research in Gastroenterology and Hepatology* 3.5 (2017): 555623.
72. Cattan P., *et al*. "Surgical approach by cervicosternolaparotomyn for the treatment of extended cervical stenoses after reconstruction for caustic injury". *World Journal of Gastroenterology* 19.27 (2013): 3918-3930.