Esophagectomy Perianesthetic Care from a Surgeon´s Point of View

Fernando AM Herbella¹*, Marina Zamuner¹ and Marco G Patti²

¹Department of surgery, Escola Paulista de Medicina, Federal University of Sao Paulo, Brazil
²Department of surgery, Pritzker School of Medicine, University of Chicago, USA

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*Corresponding author: Fernando AM Herbella, Department of surgery, Escola Paulista de Medicina, Federal University of Sao Paulo, Sao Paulo - SP - 04037-003 Brazil, Tel/Fax: 55-11-39267610; E-mail: herbella.dcir@epm.br

Abstract

Esophagectomy is a distinctive and technically demanding operation. Perioperative care in patients to be submitted to esophagectomy should be individualized since intraoperative course may influence morbidity and mortality. We reviewed esophagectomy-related concepts of interest to the anesthesiologist. Surgical technique, Perianesthetic monitoring, intubation, ventilation, aspiration prevention and extubation, fluid management, pain control, and intraoperative complications are discussed from a surgeon’s perspective. Important Esophagectomy-related concepts of interest to the anesthesiologist from a surgeon’s perspective are: (a) close communication between surgeons and anesthesiologists, especially during the mediastinal dissection, (b) fluid restriction, (c) thoracic epidural analgesia, and (d) extubation in the operating room.

Keywords: Esophagectomy; Perioperative care; Anesthesia; Outcomes

Introduction

The esophagus has a peculiar and unique surgical anatomy [1]. It crosses the neck, thorax and abdomen and lies in close contact with vital organs. This peculiarity and uniqueness makes esophagectomy a distinctive and technically demanding operation. It cannot be compared to any other procedure. Even other complex operations, such as Whipple procedure and hepatectomy, do not violate two body cavities and disrupt body homeostasis as much as an esophagectomy.

Esophageal cancer incidence is growing fast worldwide [2], thus an increase in the number of esophagectomies is expected. Esophageal cancer has a dismal prognosis and esophagectomy for carcinoma has the highest operative mortality among the elective surgical procedures [3]. Further patients cannot be lost in consequence of their treatment. It also must be remembered that benign diseases with an expected normal life expectancy are also treated by esophagectomy.

Perioperative care in patients to be submitted to esophagectomy should probably be individualized since intraoperative course may influence morbidity and mortality. Also, the relationship between intraoperative anesthetic management and postoperative results has been clearly established [4,5].

We reviewed the literature and personal experience on esophagectomy-related concepts of interest to the anesthesiologist from a surgeon’s perspective.

Surgical Technique

There are 3 different basic approaches for esophagectomy: (1) transhiatal, (2) transthoracic and (3) en bloc or radical (Figure 1).

In a few words, transhiatal esophagectomy is accomplished through a cervicotomy and a laparotomy. The esophagus is bluntly dissected with the surgeon’s hands through the neck and abdomen [6]. Transthoracic esophagectomy is performed through a laparotomy and a thoracotomy. A cervicotomy may be added or not depending on the level of the anastomosis: mediastinum or neck. Dissection of the esophagus is accomplished under direct vision. However, there is the need to mobilize the patient during the operation [7]. Radical esophagectomy is employed for the treatment of esophageal cancer by some groups, especially from Asia. This technique tries to apply classic oncologic principles by extending the margins of resection to include non-vital organs, such as the thoracic duct, azygos vein, etc. and performing a formal lymphadenectomy in 2 fields (mediastinum + abdomen) or 3 fields (mediastinum + abdomen + neck) [8]. In all techniques, alimentary tract is reconstructed with a gastric tube or less commonly with the colon. Exceptionally, reconstruction may be delayed. Recently, laparotomy and/or thoracotomy may be replaced by minimally invasive approaches (laparoscopy and/or thoracoscopy). Early and late results seem to be similar to the open route [9,10].

There are 3 main indications for an esophagectomy: esophageal cancer, perforation and end-stage motor disorders [11].

Esophagectomy for the treatment of esophageal perforations is done if primary repair is not possible at the time of surgery due to severe mediastinitis or underlying esophageal pathologic findings [12,13]. It must be remembered that these patients may present to the operation with significant clinical deterioration.
Achalasia is the main motor disorder treated by esophagectomy, although esophagectomy is an alternative for selected cases only [14]. Massive esophageal dilation may be expected since these patients comprise end-stage disease. Thus, precautions to prevent aspiration must be increased. It also must be emphasized that esophagectomy for achalasia may be more technically challenging compared to operation for cancer due to the larger diameter of the esophagus and inflammatory adhesions to mediastinal structures [14].

Surgery has been considered an essential part of the treatment of patients with esophageal carcinoma. Adenocarcinoma is the most frequent tumor in the Western developed countries, it is related to Barrett’s esophagus and surveillance programs allow treatment of most patients in a non-advanced stage [15]. Squamous cell carcinoma is the histologic type most commonly treated in the East and in non-developed countries. It is usually diagnosed in late stages making sometimes the operation more challenging due to the presence of bulky tumors.

**Perianesthetic Monitoring**

Watchful monitoring of cardiac rhythm is extremely important during the mediastinal phase of the esophagectomy, especially during a transhiatal esophagectomy. The surgeon’s hand may displace the heart anteriorly angulating the inferior vena cava (Figure 2). In this stage, arrhythmias are frequent and may be observed in up to 65% of the cases [16]. The most common findings are supraventricular and ventricular ectopics [16]. They are generally transient and stop almost immediately if the surgeon removes his/her hand from the chest. Vagal reflex may also be contributory to intraoperative arrhythmias. Heart disease, poor pulmonary function tests, cervical anastomosis, elevated central venous pressure, and higher ephedrine doses showed to be independent predictors of the development of an intraoperative arrhythmia [17].

Postoperative arrhythmias, especially atrial fibrillation, are very common, with an incidence of up to 30% [18] and associated with worse morbidity and survival [19]. Very interestingly, an intraoperative arrhythmia has a recurrence rate of almost 40% during the first 3 postoperative days [17]. Although risk factors for atrial fibrillation have been described, they are linked to clinical status and thus not manageable in the perioperative period. Prophylaxis is a controversial point [20]. If the team opted for prophylaxis, it must be started immediately before the operation and thus of interest to the anesthesiologist.

Similarly to arrhythmias and for the same reasons, hypotension is quite common during mediastinal dissection. Malhotra et al.
[16] reported hypotension in 75% of the patients, defined as a 20% decrease in systolic blood pressure from the baseline, taken just before the start of mediastinal manipulation. They suggest an increase of oxygen concentration to 50% during the mediastinal phase to minimize the adverse effects of arrhythmias and potential hypotension. Again, intraoperative hypotension is generally transient and stops almost immediately if the surgeon removes his/her hand from the chest. Anesthesiologists must be fully aware of this complication to avoid inadvertent hyper hydration during this period in an attempt to fix hypotension.

It must be remembered that the esophagus cannot be used for monitoring purposes. We accidentally cut an intraesophageal thermometer passed by the anesthesiologist without informing the surgical team during transection of the cervical esophagus.

**Intubation, Ventilation, Aspiration Prevention and Extubation**

One-lung ventilation is rarely needed for a transhiatal esophagectomy but seldom necessary during a transthoracic esophagectomy, especially with thoracoscopy. It frequently requires high fractional FIO2, which causes absorption atelectasis, acute tracheobronchitis as a result of decreasing mucociliary clearance, and diffuse alveolar damage [21]. More modernly, some surgeons adopted the prone position for the thoracic part of the esophagectomy. This position may avoid lung deflation and seems to bring better pulmonary parameters [22]. It must be reemphasized that the patients will be mobilized between the abdominal and thoracic part of the esophagectomy, thus, the tracheal tube should be carefully secured and retested.

Esophagectomy patients are at high risk for aspiration due to:

a. Esophageal obstruction, since the most common causes for esophagectomy (cancer, achalasia, and strictures) course with some degree of mechanical or physiologic esophageal obstruction.

b. Patients with Adenocarcinoma of the esophagus have gastro esophageal reflux disease.

c. The esophagus and stomach are constantly mobilized during the procedure.

d. The tracheal tube may be displaced during manipulation or change of position.

Aspiration prevention involves prophylactic pharmacologic management of gastroesophageal reflux, rapid-sequence induction, securing the airway with a cuffed endotracheal tube, continuous aspiration of the nasogastric tube and proximal trachea, and gel lubrication on the tracheal cuff to reduce pulmonary aspiration by blocking channels formed by folds in the cuff [4].

Early extubation was, in the past, feared due to the chance of respiratory problems and reintubation [23], the lack of round-the-clock experienced staff [24] and compromise of respiratory mechanics due to pain [25]. Current tendency, almost
unquestionable, is for immediate extubation in the operating room [26] since prolonged intubation is a risk factor for pneumonia and systemic inflammatory reaction. Early extubation may shorten or avoid intensive care stay [27]. It must be remembered that intraoperative fluid restriction may facilitate early extubation by avoiding excessive third spacing, thereby reducing the frequency of pulmonary edema [28].

**Fluid Management**

Fluid restriction is a key point during esophagectomy. Several studies have demonstrated the deleterious effects of intraoperative hyper hydration [29]. A systematic review of 30 series [29] showed adverse effects of hyper hydration on cardiac function, pulmonary function, tissue oxygenation and wound healing, postoperative ileus, renal function and coagulation. In the specific case of esophagectomy, deleterious effects of excessive fluid administration are expected to be even greater due to the facts that:

a. Mediastinal lymphatic vessels are disrupted during the procedure leading to interference of lymph flow and consequent lung edema.

b. The impairment of the coughing reflex as a result of injury to the bronchial branch of the vagus nerve attenuates the expectoration of sputum [21].

c. Esophagectomy is often accompanied by a severe systemic inflammatory reaction with particularly deleterious effects on the lung.

d. Pulmonary edema is frequent, which results from a lowering of osmolarity, increased water retention and injury of the vagus nerve causes accumulation of interstitial fluid as a result of increasing capillary permeability of the pulmonary vascular bed [21].

e. After esophagectomy, cardiac index and left ventricular stroke work index are decreased and pulmonary vascular resistance is increased on the day of surgery. In this cardiorespiratorily unstable period, excessive fluid administration also impairs cardiopulmonary function [21].

Anesthesiologists must be alert that anesthesia effects, reservation of fluid in the body, and internal fluid redistribution caused by heavy stress and inflammatory responses elicited by surgical trauma may be contributory to positive intraoperative balance [30,31]. Also, increased capillary permeability as a result of inflammatory mediators as well as fluid conservation effects from neuroendocrine hormones, the result of stress responses could be considered as influential factors in maintaining the positive fluid balance on early postoperative [31].

Several studies and reviews compare different fluid regimens and end points for fluid management in esophagectomy, however it has been difficult to derive guidelines regarding perioperative fluid therapy, including the amount and choice of fluids. Mathematical calculation to guide intraoperative crystalloid administration may mislead correct fluid management.Neal et al. [28] showed that patients averaged significantly less volume replacement than would be calculated yet, hemodynamic stability was not difficult to maintain. It suggests that hemodynamic stability and urinary output of 1mL/kg/h must be accepted as therapeutic endpoints [28].

It is well known that pulmonary and cardiac complications are associated to hyper hydration. They constitute the most common complications after esophagectomy and direct linked to mortality [31,32]. Also, anastomotic leakage is linked to ARDS and pulmonary complications [32,33]. Different studies reported benefits of fluid restriction in esophagectomy patients. Wei et al. [31] studied early postoperative course in 99 patients submitted to esophagectomy for cancer. Larger fluid balance on postoperative day 1 and day 2 and cumulative fluid balance from the intraoperative period to postoperative day 2 was significantly related to adverse surgical outcomes. On multivariate logistic regression analysis, cumulative fluid balance from intraoperative period to postoperative day 2 was confirmed to be independently related to adverse surgical outcomes. Pulmonary complication and heart complication both were associated with a larger cumulative fluid balance compared with no complications. In this study all patients were in a status of positive fluid balance during the operation and most of the patient's urine output began to increase after completion of surgery, which resulted in a negative fluid balance on postoperative day 0. Then the fluid balance turned to be positive again in the subsequent 2 days. Kita et al. [21] studied 112 patients from 2 different time periods before and after fluid restriction protocol were initiated. The protocol consisted in a maintenance infusion rate at about 4 to 5 ml/kg/h, a volume balance at about 1 to 2 ml/kg/h and a central venous pressure at less than 5 mmHg during surgery. Intraoperative volume balance in the early period and late period was 2.386±1,307mL and 749±697mL respectively. The need for tracheostomy, bronchoscopic suctioning and extubation failure were more frequent before fluid restriction. Also, the length of stay was short in the fluid restriction period. Tandon et al. [32] compared in a cohort of 168 patients the predictors for ARDS and found a significant correlation between the volume of fluids infused and ARDS.

The main justification of some anesthesiologists for liberal fluid administration is the fear of acute renal failure. Against this fact most series show that acute renal failure incidence after esophagectomy is deniable, some papers show absence of this complication [34], others report incidence below 2% [34], including those that adopted a fluid restriction protocol [28].

**Pain Control**

Upper abdominal laparotomy and thoracotomy are associated to severe postoperative pain. It is still unclear if minimally invasive techniques lead to less postoperative pain, although epidural pain is significantly reduced with this approach [35,36].

Thoracic epidural analgesia has been shown to provide the most satisfactory analgesia and to reduce the incidence of both fatal and nonfatal respiratory complications after esophagectomy [26,37]. Experimental [38] and clinical [33] studies showed that...
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Thoracic epidural analgesia is also associated with a decrease in occurrence of anastomotic leakage. Its use has been reported to improve the graft microcirculation and to prevent anastomosis insufficiency [39]. Moreover, respiratory failure and mechanical ventilation may be associated with anastomosis disruption [33]. The use of epidural anesthesia is justified even without a thoracotomy as during a transhiatal esophagectomy [40]. The dual-epidural catheters analgesia technique used in spine surgery has been tested in a single esophagectomy series with promising results [41].

Intraoperative Complications

Intraoperative complications of interest to the anesthesiologist are bleeding and tracheal lesion. Voluptuous bleeding is a rare occurrence during esophagectomy, usually caused by lesion of a large vessel, such as the azygos vein. It has an incidence of 0.6% [11] and mortality of 0.2% [40]. The incidence of severe bleeding in transhiatal and transthoracic approaches are similar [42]. However, blood loss is significant higher in the transthoracic approach [42].

Tracheal lesion has an incidence of 0.2-2% [11,43,44] and most cases described occurred in esophagectomy for cancer [43]. Interestingly, however, the incidence in transhiatal and transthoracic approaches are similar [42,43] and the majority of case occurred in tumors below the carina, showing that direct invasion of the airway is not the main cause of major airway injury during Esophagectomy. The injury is frequently detected during the operation and it is noticed due to pressure drop in the circuits of the anesthesiologist [43]. Anesthesiologist must

Figure 3: Important esophagectomy-related concepts of interest to the anesthesiologist from a surgeon’s perspective are:

a. Close communication between surgeons and anesthesiologists, especially during the mediastinal dissection.

b. Fluid restriction.

c. Thoracic epidural analgesia.

d. Extubation in the operating room.
be watchful during the mediastinal part of the operation. If an injury is suspected, the tube must be immediately tube may be reinserted with the balloon distal to the defect [44]. Care must be taken to prevent additional injury to the airway. The surgeon may guide tube reinsertion or a bronchoscopy may be performed. Afterwards a double-lumen tube may be used. Repair is always accomplished through a thoracotomy when the injury is diagnosed and repaired. The operation must not be interrupted at this point, since the position of the graft that replaces the esophagus [stomach or colon] in the posterior mediastinum works as a buttress to the repair.

Laryngeal recurrent nerve injury may be a complication following esophagectomy with an incidence up to 20% [45] but it is uncommon in experienced teams. The nerve may be injured during the cervical or thoracic part of the procedure. Bilateral injury is infrequent. The injury is usually diagnosed in the postoperative period due to hoarseness. Although it may be linked to pulmonary morbidity due to the risk of aspiration [46] and bilateral damage may course with airway obstruction and the need for tracheostomy [47], these are rare events and rarely influence perianesthetic management. It also must be remembered that hoarseness may be present in the preoperative period as a potential sign of recurrent laryngeal nerve invasion and irresectability of the esophageal carcinoma.

Conclusion

Esophagectomy is associated to high levels of morbidity and mortality. In 1980, Earlam and Cunha-Melo [47] reviewed the literature and reported 29% mortality for esophagectomy. These numbers do not remain the truth after significant improvements in antibiotics, intensive care, surgical equipment, etc.; however, they are still far from ideal. Multiple studies showed that high-volume centers report better outcomes compared to low-volume centers [48-55]. It is questionable, though, if better results are linked only to the number of esophagectomies done by individual surgeons or the conjoined experience of a center, i.e., the multidisciplinary team experience. With this viewpoint in mind, anesthesiologist must be prepared and trained to the distinctive details that surround the perioperative care of esophagectomy patients. Important Esophagectomy-related concepts of interest to the anesthesiologist from a surgeon’s perspective are:

a. Close communication between surgeons and anesthesiologists, especially during the mediastinal dissection.

b. Fluid restriction.

c. Thoracic epidural analgesia.

d. Extubation in the operating room (Figure 3).

References


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