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Ivor Lewis Minimally Invasive Esophagectomy - What Do We Choose? Literature Review

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Rezumat

Esofagectomia minim invazivă Ivor Lewis – ce alegem? Revizia literaturii

Scop: Trecerea de la esofagectomia deschisă Ivor Lewis la chirurgia minim invazivă s-a produs treptat prin intermediul abordurilor hibride. Scopul acestui studiu a fost de a prezenta comparativ variantele actuale de esofagectomie minim invazivă Ivor Lewis.
Metode: A fost efectuată o căutare sistematică a literaturii pentru a analiza varintele tehnice ale esofagectomiei minim invazive Ivor Lewis precum şi rezultatele postoperatorii ale acestora. Căutarea s-a efectuat în bazele de date Pubmed şi Medscape având ca cuvinte cheie esofagectomia minim invazivă Ivor Lewis, tubul gastric, anastomoza esogastrică, iar selecția articolelor s-a efectuat ținând cont de precizarea varientei tehnice utilizate, precum şi precizarea rezultatelor obținute.
Rezultate: Cercetarea datelor din literatură arată că actual s-a ajuns la un consens al paşilor esențiali din tehnica Ivor Lewis, însă efectuarea acestora permite utilizarea unor variante diferite, fiecare operator ținând seama în primul rând de experiența proprie, precum şi de dotările existente în fiecare spital. Deşi, de-a lungul timpului s-au produs multiple transformări ale unor paşi din tehnica de bază, actual încă există păreri contradictorii asupra anumitor aspecte din tehnica operatorie, toate aceste fiind motivate de cercetările întreprinse în vederea îmbunătățirii rezultatelor postoperatorii.
Concluzii: Esofagectomia minim invazivă Ivor Lewis ridică în continuare aspecte discutabile asupra modalității practice de efectuare a paşilor esențiali ai tehnicii, clarificarea acestora ar putea conduce la găsirea variantei optime.

Cuvinte cheie: esofagectomia minim invazivă Ivor Lewis, variante tehnice, limfodisecție abdomino-mediastinală

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Abstract

Purpose: The transition from open esophagectomy to Ivor Lewis to minimally invasive surgery has been gradual through hybrid approaches. The aim of this study was to present a comparison of the current variants of minimally invasive Ivor Lewis esophagectomy.

Methods: A systematic literature search was performed to analyze the technical features of minimally invasive Ivor Lewis esophagectomy and their postoperative results. The research was performed in the PubMed and Medscape databases with the keywords Ivor Lewis minimally invasive esophagectomy, gastric tube, esogastric anastomosis, and the selection of articles was performed taking into account the technical variance used and the results obtained.

Results: The research of the data in the literature shows that there is currently a consensus of the essential steps in the Ivor Lewis technique, but their performance allows the use of different options, each surgeon taking into account primarily their own experience and existing facilities in each hospital. Although, over time, there have been multiple transformations of some steps in the basic technique, currently there are still conflicting opinions on certain aspects of the surgical technique, all of which are motivated by research undertaken to improve postoperative results.

Conclusions: Ivor Lewis Minimally invasive esophagectomy further raises debatable issues on the practical way to perform the essential steps of the technique; their clarification could lead to finding the optimal option.

Key words: Ivor Lewis minimally invasive esophagectomy, technical variants, abdomino-mediastinal lymph nodes dissection

Introduction

In recent decades, minimally invasive surgery has become the standard of care in many surgical procedures, including esophagectomy in an attempt to reduce the increased morbidity that accompanies the open procedure. Since 1992, when the first minimal invasive esophagectomy procedure was performed, it has gained popularity (1). Luketich et al. perfected the minimally invasive techniques for esophageal cancer, initially the McKeown esophagectomy and later the minimally invasive Ivor Lewis technique was introduced, resulting in a significant decrease in the postoperative morbidity rate (2).

A recent international study of esophageal cancer and gastroesophageal junction surgery found that in 2014, the preferred approach in 43% of respondents was minimally invasive transthoracic esophagectomy, compared with only 14% in 2007. In addition, the preferred site of anastomosis changed. In 2007, 87% of respondents preferred cervical anastomosis (McKeown procedure), down to 54% in 2014 (3).

In England and Wales, over 50% of Ivor Lewis esophagectomy between 2014 and 2016 were open procedures (8), in addition, 75% of the minimally invasive Ivor Lewis procedure was a hybrid procedure. In 2018, in the UK, a minimally invasive approach was still controversial, while in Asia, continental Europe and the United States, the procedure is much more accepted as a cancer operation (4).

A randomized French study comparing the results of the open approach with the hybrid approach (laparoscopic mobilization and open thoracic esophagectomy) shows that the major postoperative morbidity rate was 64.4% in patients with open esophagectomy compared to 35.9% in the hybrid group, the difference being explained mainly by the significant reduction of pulmonary complications (5).

A 2018 study of 420 patients with minimally invasive esophagectomy for distal esophageal cancer or esogastric junction showed that the rate of cervical anastomotic fistula was 23.3% compared to 12.4% intrathoracic fistulas. In addition, the minimally invasive Ivor Lewis approach was associated with a significantly

reduced incidence of pulmonary complications, recurrent laryngeal nerve palsy, and number of reoperations, 90-day mortality, and shorter average hospitalization (6). A recently study noted that a consensus had been reached among European experts on the essential surgical steps for minimally invasive Ivor Lewis esophagectomy (7).

The aim of the study is to present the current possibilities of minimally invasive Ivor Lewis esophagectomy, in different variants with specific indications, with the advantages and disadvantages of each variant, as well as the immediate postoperative results, in order to select the optimal procedure for each patient:

- Totally minimally invasive/hybrid operation;
- The current role of preoperative ischemic conditioning;
- Position of the patient on the operating table;
- Abdominal-mediastinal lymph dissection;
- Extra/intracorporeal gastric tube type, narrow/flexible;
- Intraoperative evaluation of gastric tube vascularisation;
- Pyloroplasty?
- Type of manual / mechanical esogastric anastomosis.

Hybrid / Total Minimally Invasive Ivor Lewis total esophagectomy

In high-volume centres for the treatment of patients with esophageal cancer, hybrid Ivor Lewis esophagectomy - laparoscopic gastric dissection and open thoracic approach paved the way for the minimally invasive approach and has been the standard of surgical care since the beginning of the minimally invasive procedure (8).

Some authors have proposed a two-stage hybrid Ivor Lewis esophagectomy. The first stage is complete laparoscopic gastric mobilization with abdominal lymphadenectomy. After 3-5 days, open transthoracic esophagectomy is performed. This management is indicated in patients who are at increased risk of poor vascularisation of the gastric tube or in patients with multiple concomitant comorbidities associated with old age (9).

From the open thoracic approach, the surgery switched to video-assisted thoracoscopy with anterolateral mini-thoracotomy (VATS) and laparoscopic gastric dissection and lymphadenectomy as a hybrid method, which led to a significant reduction in postoperative mortality and the possibility of extensive mediastinal lymphadenectomy (10).

Hybrid techniques, with minilaparotomy used to extract the specimen and to make the extracorporeal gastric tube, or to mount the circular stapler extracorporeal, have been described (11).

Gastric Ischemic Conditioning

Gastric tube ischemia is the main contributing factor to dehiscence and anastomotic fistula. Ischemic conditioning was proposed by Urschel (12).

The concept of gastric ischemic preconditioning is based on the principle of deliberately inducing an ischemic lesion in the gastric fundus and cardia, 1-2 weeks before esophagectomy for the development of vascular anastomosis in the gastric wall which would lead to a decrease in the rate of anastomotic fistulas. This concept was first applied clinically by Akiyama and consisted of preoperative embolisation of the left gastric artery, short gastric vessels and left gastroepiploic vessels, reporting a decrease in the rate of fistulas from 8% to 2% after this procedure (13).

The laparoscopic application of the procedure was combined with a staging laparoscopy, sectioning of the left gastric artery and placement of a jejunostomy. Nguyen et al (14) found no difference in rates of fistulas or strictures after ischemic conditioning. Hölscher et al (15) initially reported a fistula rate of 6% with ischemic conditioning; however, they updated their results, with no significant difference in the rate of fistulas between the two groups (9.4% compared to 7.6% without and with conditioning), in a large series in 2010 (16).

The results of these studies are comparable

to those of a randomized study of Gastric Ischemic Conditioning which did not show that ischemic conditioning improves vascularity in the cranial portion of the gastric tube (17). Currently, the procedure is considered feasible and safe, but is unlikely to be a major factor in the onset of postoperative fistulas.

The Patient's Position on the Operating Table

The left lateral decubitus, extrapolated from open technique, is the standard position for Ivor Lewis hybrid techniques. Prone or semi-prone positioning was used as an alternative to lateral positioning for esophagectomy procedures in the minimally invasive Mc Keown procedure. This approach offers many advantages: better visualization of the esophagus, aortopulmonary lymph nodes, infraaortic area, tracheobronchial tree, tissue around the left recurrent laryngeal nerve, the lung does not obliterate the operating field, the procedure may not require isolation of the lungs (19,20). However, the approach is not without its drawbacks: the training time is longer, the anatomy is not familiar to many surgeons, this positioning can complicate anesthetic management (21).

Especially useful in minimally invasive Mc Keown triple-approach esophagectomy, this position is also used by some surgeons in Ivor Lewis esophagectomy with double-layer manual anastomosis and extraction of the specimen by suprapubic incision (22).

Starting with Nanson's technique of approach to open abdomino-thoraco-cervical esophagectomy, some authors have designed a unique patient positioning system that provides access to the abdominal and thoracic cavities sequentially through a minimally invasive approach (23).

With the patient laying on their back, initially the upper torso and shoulders of the patient are rotated to the left with the right arm brought to the chest in the corkscrew position. Then, the right chest is rotated to the left of the patient; the patient's right arm is lifted on an arm support and fixed with gauze. The abdomen, right thorax and right armpit are all included in the operating field. With access to both the thoracic cavities and the abdomen, the operation can be divided into four phases:

Phase I: Epigastric minilaparotomy facilitates placement of a hand port. This phase involves gastrolysis and dissection of the esophagus, lymph dissection at the origin of the left gastric artery and celiac trunk, paraesophageal ganglia, sectioning of the left gastric artery and short gastric vessels.

Phase II: Thoracoscopically, the esophagus is dissected en block with the periesophageal lymph nodes and the fatty tissue between the aorta, pericardium and left pleura, then the esophagus is sectioned with a linear stapler at the level of the azygos vein or above.

Phase III: Laporoscopic, distal esophagus and stomach are externalized by minilaparotomy. The gastric tube, with a diameter of 5 cm, is made using a linear stapler. A gastric drainage procedure and a jejunostomy are performed. The tube is ascended in the thorax through the hiatus.

Phase IV: Thoracoscopically, the esophageal stapling line is perforated to allow the passage of a 25 mm OrVil device. The gastric tube is then positioned in the posterior mediastinum and opened along the small curvature. A 25 mm EEA circular stapler is placed in the gastric tube and the tip of the docking rod is exteriorised on the large curvature. The components of the stapler are docked and the stapler is fired; the anastomosis is completed by using a linear stapler that excises the excess gastric tube.

The results of this study were: incidence of anastomotic fistula - 4.2%, positive histological margins - 7.4%, in most cases gastric, average lymph nodes harvested - 17 lymph nodes (2,3).

Abdominal and Mediastinal Lymph Node Dissection

The fact that the esophagus crosses the abdominal and thoracic cavity, with a longitudinal and horizontal spread of its lymphatic vessels, as well as the connection with the

cervical lymph nodes, leads to a complex pattern of lymphatic drainage. Tumors of the lower esophagus and eso-gastric junction metastasize more frequently in the lower mediastinal and perigastric nodes (24).

For all types of adenocarcinoma of the esogastric junction, the paracardial lymph nodes (stations 1 and 2) and the lymph nodes along the left gastric artery (station 7), the celiac trunk (station 9) and the small curvature (station 3), have the largest risk of metastatic involvement (25,26).

For type II tumors, Siewert observed a rate of lymph node metastases in stations 1 (67.8%) and 2 (56.9%), stations 3 (67.8%), and stations 7, 11, and 9 (26, 8% all together), station 4 (greater curvature) (16.1%) and lower mediastinal ganglia (15.6%). In contrast, the lymph node stations of the right gastroepiploic vessels (station 6), the hepatoduodenal ligament (station 12) and the right gastric artery (station 5) were rarely positive.

In addition, Siewert type I tumors have a high rate of metastasis to the lower mediastinal lymph nodes, while the middle and upper mediastinal lymph nodes are rarely involved (27).

Other authors believe that the rate of lymph node metastases in the middle and upper mediastinum in Siewert type II cancers remains unclear because lymphadenectomy in these areas has not always been performed (28,29).

There is currently no consensus on the extent of lymphadenectomy for Siewert type II cancers with their epicentre located 1 cm above and 2 cm below the anatomical esogastric junction.

A large multicenter study of 2303 patients with esophageal cancer recommended a resection of at least 23 lymph nodes to improve survival (30).

Creation of the Gastric Tube

The use of the gastric tube is now the most commonly used method for reconstructing the digestive tract after esophagectomy. Since Beck and Carrell (31) first reported their method of gastric tube reconstruction in 1905, different methods of gastric tube preparation and anastomosis have been used; however, the rate of anastomotic fistula remains greater than 12% and up to 30% (32). To prevent anastomotic fistula, it is important that the gastric tube is well vascularised and long enough to allow the tube to be ascended as needed, without mechanical tension to perform the anastomosis. Some authors consider that the subtotal gastric tube is superior to the narrow gastric tube in terms of maintaining a sufficient blood supply in its cranial portion, because the vascular plexus in the centre of the anterior and posterior wall of the stomach is preserved (33).

Other authors propose a "flexible" gastric tube designed to provide enough blood to the cranial portion (as well as a subtotal gastric tube), while providing sufficient length for stress-free anastomosis in the cervical surgical field.

The small curvature is stapled towards the large curvature, starting approximately 5 cm proximal to the pyloric ring and keeping a 4 cm diameter gastric tube, in the region where the right gastroepiploic artery is well represented, to obtain a sufficient length of the gastric tube. At 3-5 cm from the entrance of the last branches of the right gastroepiploic artery, the section line is redirected to the small curvature, the cranial portion of the gastric tube being prepared as a wide gastric tube to keep as much as possible the vascular plexus in the stomach wall.

The results obtained by using this technique on 615 patients with subtotal esophagectomy with reconstruction with gastric tube and esogastric end-to-side anastomosis using a circular stapler, were: incidence of anastomotic fistula - 1.8%, gastric tube necrosis was found in 1 patient (34).

Compared to an open approach, laparoscopic intracorporeal creation of the gastric tube makes more difficult to expose the stomach and assess the extent of the tumor on the junction. Still, most approaches use the intracorporeal laparoscopic construction of the gastric tube. However, Crenshaw et al. demonstrated fewer anastomotic fistulas and a low

incidence of positive margins after extracorporeal gastric tube creation (35).

This is primarily a concern for tumors of the esogastric junction, which can invade the cardia and extend to the upper portion of the gastric tube. The reason for the extracorporeal creation of the gastric tube also lies in the possibility of reducing the rate of positive distal margin. The extracorporeal creation of the tube, however, requires that the intrathoracic esophagus is being sectioned before it, so that the distal esophagus, gastroesophageal junction, and stomach can be externalized through the incision in the epigastrium (23). Other authors believe that the major disadvantage of laparoscopic gastric tube creation (in addition to the difficulty of properly orienting the stomach for the application of linear staplers) is the commitment to esophageal resection in the laparoscopic phase, even if some unexpected thoracic findings may occur. Other potential deficiencies include: risk of torsion of the tube or separation of the specimen during ascent in the thorax, inability to feel the gastroepiploic arch or trauma to the tube from its handling with forceps (36).

Some authors propose the transthoracic preparation of the extracorporeal gastric tube, a method that has the potential to alleviate the deficiencies of laparoscopic tube preparation. The posterior intercostal trocar port is extended to 6-7 cm in length and a small wound retractor is placed. By using a combination of thoracoscopic and direct visualization, the specimen together with the stomach are exteriorised through this access. The 4-5 cm gastric tube is made using the linear stapler type Endo-GIA, starting from the fornix (37).

Intraoperative Evaluation of Gastric Tube Vascularisation

Anastomotic integrity is considered to be dependent on good vascularisation of the gastric tube (38). The right gastroepiploic artery is the vascular source of the gastric tube. However, the perfusion along the tube varies, the most proximal segment blood supply being often provided by smaller vessels and intramural capillaries. Conventionally, the evaluation of vascularity was mainly based on the subjective assessment of the colour of the gastric serosa. Consequently, indocyanine green angiography in fluorescent light (ICG-FA) and Doppler examination have emerged as a more accurate way to assess the vascularisation of the gastric segment in which the anastomosis will be performed, thus intending to reduce the rate of anastomotic fistulas (39,40).

After the gastric tube has been created during the laparoscopic time, the anaesthetist injects 7.5 mg of ICG dye intravenously, followed by 10 ml of saline. Blood flow is confirmed by real-time ICG imaging - its presence in the right gastroepiploic vessels in the first 60 seconds after injection. Simultaneously, an improved evaluation of the tracer image in the gastric tube can be performed by examination in ICG-FA fluorescent light. This is how the vascularisation of the tube can be assessed based on the PINPOINT® evaluation: good perfusion — rapid visualization of the ICG-FA to the tip of the gastric tube or non-infusion — any demarcated area along the gastric tube (41).

Pyloroplasty

The need for a pyloroplasty is still a controversial topic (42). Known prospective randomized studies have shown no long-term benefit from surgical procedures for gastric drainage, such as pyloromyotomy or pyloroplasty (43). Luketich et al typically perform Heineke-Mikulicz pyloroplasty with minimal complications. In their report of over 1000 patients, 85% of patients received a pyloric drainage procedure. (5) Nguyen et al.33 reported a series of 140 patients with minimally invasive esophagectomy, of which 31 patients with pyloroplasty. Of the 109 patients who did not undergo pyloroplasty, 5.5% developed delayed gastric emptying, which responded well to endoscopic dilation or Botox injection, compared with 3.2% in the pyloroplasty group. They concluded that pyloroplasty could be safely omitted from the

minimally invasive procedure (44).

Another study concluded that omission of pyloric drainage may lead to a reduction in long-term biliary reflux, but the effect on gastric emptying in the immediate postoperative period is controversial and has no definite relevance (42).

Anastomotic Techniques

There is no consensus on the ideal anastomotic technique for esogastrostomy. Several options are available for intrathoracic esogastric anastomosis.

Circular stapler anastomosis

Similar to the open procedure, in a minimally invasive or robotic technique, (45) a 28 mm EEA circular stapler is used, the anvil being inserted into the esophageal stump. Two circular sutures fix the anvil to the esophageal stump. The EEA stapler is inserted through the distal end of the gastric tube, and the docking rod is exteriorised on the great curvature at a point where there will be minimal tension between the anastomotic partners and minimal redundancy of the gastric tube. Gastrotomy is closed using an Endo-GIA linear stapler (46,47).

Several authors believe that the tissue bridge between the EEA circular anastomosis and the closure of the gastrostomy is fragile, recommending keeping a distance of 1.5 cm between the stapling lines (45,48). Anastomosis can be strengthened with additional manual suturing, omental flap, or mediastinal pleura (49).

The limitations of using the EEA circular stapler during a thoracoscopic approach are: the need for a few centimetres intercostal incision, to insert the stapler into the chest, difficulties in inserting and securing the anvil to the esophageal stump.

The biggest series of esophageal resections, with intrathoracic anastomosis, using an EEA circular stapler, was reported by Luketich, in which anastomotic fistula requiring reoperation occurred in 4% of patients (2). Another study reported a fistula rate of 9.8% and a stricture rate of 28%, in a series of patients who benefited of an intrathoracic anastomosis using an EEA stapler (50).

The variant of inserting the stapler in the gastric tube

Some authors propose that near the cardia, the gastric tube remains attached to the specimen for about 3 cm, and during the thoracoscopic time, last piece of the specimen will be cut with scissors and the hole in the gastric tube will serve as the inlet of the EEA circular stapler (51).

Other authors consider that keeping the gastric tube partially attached to the resection specimen and completing the separation in the thorax increases the risk of twisting the tube. Therefore, they complete the gastric tube by laparoscopy, and then attached it to the specimen by separate sutures, and the insertion of the stapler into the gastric tube is done by a gastrotomy at the cranial end of the gastric tube (45).

Other authors insert the stapler into the extracorporeal created gastric tube through a subcostal minilaparotomy, externalize the docking rod, and manually guide transhiatal the stapler to the anvil (52).

The variant of introducing the anvil into the esophageal stump

One author proposes a particular method of mounting the anvil of a circular stapler, by a technique similar to mounting the Orvil. Attach a 2-0 threaded needle to the hole at the tip of the anvil's piercing head. The anterior face of the esophagus is sectioned approximately 3 cm from the upper edge of the tumor. Insert the anvil deep into the esophagus, so that the tip of the puncture head is located 3 cm above the esophageal incision. The externalization of the anvil is done by passing the needle with the thread attached to the tip of the stinging head of the anvil from inside to outside on the anterior wall of the esophagus about 3 cm above the incision.

After externalizing the centre stem of the anvil, the piercing head with the attached needle is removed. The esophageal stump is

closed with an Endo GIA linear stapler near the external site of the anvil stem. The circular stapler is inserted into the gastric tube, its stem is exteriorised on the great curvature and is docked at the anvil (51).

Using OrVil

The introduction of the OrVil circular transoral stapling device eliminated the procedure for securing the anvil to the esophageal stump. The device consists of a 25 mm OrVil attached to a nasogastric tube. The tube is passed transorally by the anaesthesiologist and kept in tension until it bulges at the end of the stapled closure of the esophagus. An esophagostomy is performed, large enough to allow the tube to pass through. Once the OrVil stem exits the esophagus, the suture that secures the OrVil nasogastric tube is sectioned and the tube is removed from the thorax through one of the ports. The esogastric anastomosis is then performed with an EEA stapler as standard (53).

During the use of the circular stapler anastomosis, there are difficulties in inserting the circular stapler into the gastric tube and piercing the tip of the stapler through the gastric wall, limitations given by the narrow intercostal space. Postoperative anastomotic stricture is also reported, especially after the use of circular staplers (54), some authors propose to abandon the use of 25 mm OrVil (55).

Manual anastomosis

Similar to the open approach, in minimally invasive approach, the classic anastomosis is used, sewn by hand in one or two layers: The extra mucosal outer layer is closed with interrupted 3-0 silk sutures. The inner layer is closed with a continuous suture 3-0 resorbable thread. Cerfolio et al (56) used the manual suturing technique in robotic esophagectomy with excellent results.

There are several reports of manual intrathoracic robotic anastomosis. These have a small number of surgical cases and the method is still being explored without widespread acceptance (57).

Pre-treatment-assisted manual anastomosis

Based on the experience of manual anastomosis in open surgery, some authors propose a pre-treatment-assisted robotic intrathoracic manual anastomosis (PRILA) technique. It is a hybrid technique that uses a minilaparotomy to externalize the gastric tube created robotically intracorporeal. Extracorporeal preparation of the place of gastrostomy on the anterior wall of the gastric tube: the seromuscular layer of the gastric tube is incised, keeping the submucosa and mucosa intact. After completion of the mediastinal lymphadenectomy and mobilization of the esophagus, the esophagus is sectioned with an Endo-GIA stapler approximately 5.0 cm from the upper edge of the tumor. A 3.5 cm intercostal incision is then made at the assistant port to remove the specimen. The esophageal muscle layer is incised approximately 0.5 cm from the esophageal closure with robotic scissors, keeping the submucosa and mucosa intact. The posterior esophageal muscle layer and the posterior seromuscular layer of the gastric tube are sutured using a 3-0 barbed running suture, and then the esophageal mucosa and the mucosa of the tube are opened and sutured with continuous thread of 4/0 Vicryl, then the continuous seromuscular anterior layer is closed with another barbed suture 3-0 (58).

Linear stapler anastomosis

A linear stapler anastomosis has potential benefits, but there are few reported data on its application to minimally invasive resection techniques for esophageal cancer.

For linear stapler anastomosis, the gastric tube is placed posterior to the esophageal stump. A gastrotomy is performed on the anterior face of the tube. Support sutures are placed between the esophagus and the gastric tube. A linear stapler is inserted between the end of the esophagus and the gastrotomy previously performed, to create a functional anastomosis. The anterior defect is closed by a manual suture in an interrupted manner or with another linear stapler. (59) This technique of intrathoracic anastomosis has the

lowest published rate of intrathoracic strictures. Another study using this technique reported a rate of anastomotic fistulas of 5.1%, without the need for surgery, and the rate of anastomotic strictures was 5.1% requiring only endoscopic dilation (60).

Most authors, who use the gastric tube, orient it with the stapling line posterior and the circular or linear anastomosis is placed near the large gastric curvature. Another author proposes an anastomosis with the line of stapling of the gastric tube. Align the left middle side of the upper third of the intrathoracic esophagus with the gastric tube stapling line. Mount four fixing sutures about 2 to 3 cm apart to maintain alignment. The esophagus is sectioned 1 cm distal from the last fixation suture, 1 to 2 cm gastrostomy in the gastric tube along the stapling line. The gastric tube adjacent to the esophageal wall is sutured with separate threads. The 45 mm linear endoscopic stapler is inserted into the esophageal lumen and the large anvil into the gastric tube. The stapler is fired, which cuts and recaps the gastric tube stapling line. The remaining tranches are equalized, and then the common lumen is closed manually in two layers (61).

Another author's opinion is that for linear anastomosis, it is necessary to ensure a certain length of the proximal esophageal stump, which limits the use of this anastomotic technique to tumors located in the lower thoracic esophagus and esogastric junction (62).

Conclusions

In the last two decades, minimally invasive esophagectomy has gained popularity due to its favourable influence on reducing morbidity and shortening the postoperative recovery period. Ivor Lewis minimally invasive esophagectomy is now the preferred approach by most surgeons who treat esophageal and esogastric malignancies. Although there is a consensus on the essential steps in minimally invasive Ivor Lewis esophagectomy, current practice shows that they are performed in different ways, sometimes with controversial opinions on some manners, each surgeon taking into account primarily their own experience and existing facilities in each hospital - laparoscopic or robotic approach. There is a continuous change of technical variants: the replacement of Endostich manual suturing procedures with other new types of sutures, the abandonment of 25 mm circular staplers due to the frequency of anastomotic strictures, the successful use of linear staplers for anastomosis, the abandonment of the procedures of ischemic conditioning and pyloroplasty, the increasingly frequent use of intraoperative evaluation of gastric tube vascularisation with ICG-FA, all these being determined by the search for the variant with the best immediate and long term postoperative results.

Author's Contribution

All authors equally contributed to literature search, drafting the manuscript and revising the final form.

Conflicts of Interest

The authors declare no conflicts of interest.

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Not necessaty; no human subjects involved in this research.

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