In the Western countries, the incidence of esophageal carcinoma is 3-6 cases per 100,000 persons. Despite tremendous success of other therapeutic options, surgical treatment still represents the best therapeutic option whenever possible. For the long period, debate has centered on which of the available surgical procedures is superior - transhiatal or transthoracic esophagectomy. Minimally invasive esophagectomy (MIE) could offer both minimally invasive approach and proper mediastinal lymph node dissection. Minimally invasive esophagectomy is safe and adequate, but time consuming and technically demanding procedure. It is procedure reserved for the surgeons experienced in open esophagectomy for cancer, and specially trained in advanced minimally invasive procedures. Even in that case, learning curve is steep.

Key words: surgery, minimally invasive surgery, esophageal neoplasm, esophagectomy

INTRODUCTION

Despite the progress of other therapeutic options, surgical treatment still represents the best therapy for esophageal cancer, whenever possible. When it comes to surgical treatment, some dilemmas achieved a consensus, while others are still subject of debate. It is generally accepted that the aim of surgical treatment is the removal of the esophagus with a tumor and the establishment of digestive continuity, in order to provide as early as possible an adequate oral food intake. However, even though there is no possibility of adequate preoperative and intraoperative detection of the affected lymph nodes with tumor tissue, there are still doubts about the extent of lymph node dissection and optimal position of the esophagogastric anastomosis. That basically personifies the dilemma of whether to conduct the operation through a wide incision on the right thorax or without thoracotomy through transhiatal approach.

The advantage transthoracic approach is possibility to completely remove lymph nodes in the posterior mediastinum, and the drawback is the fact that the opening of the body cavity significantly increases operative trauma and cause specific complications. If the operation is performed without the opening of the chest (transhiatal), the operative trauma decreases, but it is impossible to remove the lymph nodes in the middle and upper mediastinum. Minimally invasive esophagectomy (MIE) summarizes the good features of both approaches: minimally invasive entrance to the chest, without a significant increase in surgical trauma and the possibility of adequate lymph node dissection on the posterior mediastinum.

The first written data about the thorascopic mobilization of the esophagus was published by Cushieri in 1992. The first thoracoscopic esophageal mobilization due to cancer with two field standard lymph node dissection, at the Center for Esophageal Surgery in Belgrade, was performed in August 2009. The first large series of MIE with transhiatal approach was published by the Brazilian surgeon De Paola, analyzing the experience of the new procedure with 48 consecutive patients. Currently the largest number of single series is attributed to James Luketich at UPMC ("University of Pittsburgh Medical Center") in Pittsburgh with over 500 patients. In this series surgical experience has evolved from the minimally invasive (MI) transhiatal esophagectomy, through laparoscopic and thoracoscopic esophagectomy with cervical anastomosis, to the minimally invasive (MI)Vor Lewis procedure, which is standard today.

The attempt to define the current position of MIE in the treatment of esophageal cancer is linked to numerous problems. The largest number of published papers represents a description of the small surgical series of individual surgical institutions, and which analyze the initial experience...
with the new approach. Even in the small quantities, as surgical experience evolves, descriptions of several different operative procedures can be found. In rare case control studies the number of analyzed cases is small, and for the control group historical cohort was used. Biere et al. published in the Minerva Chirurgica in 2009 a systematic literature review and the meta-analysis in which the MIE was compared to open surgery for esophageal cancer. Out of 1388 papers in English in which MIE is mentioned in the treatment of esophageal cancer, only 10 published papers fulfilled the criteria for the inclusion in the meta-analysis. These ten studies were further divided into five types of operations, e.g. five types of comparative analysis. These are: total MIE, thoracoscopic and laparoscopic esophagectomy with cervical esophagogastric anastomosis, thoracoscopic and laparoscopic or laparotomic esophagectomy with cervical anastomosis, laparoscopic transhiatal esophagectomy and hand-assisted laparoscopic transhiatal esophagectomy (Table 1). Finally, in a certain number of studies it is not possible to define the extent of lymph node dissection in the posterior mediastinum. It is clear that the results of the analysis designed in this manner, with highly heterogeneous data, are inconclusive. However, the analysis provides some of the answers that can currently represent a guideline for further work.

Most agree that the duration of MIE is significantly longer than open esophagectomy. Nguyen et al. report that in the experienced MI surgeons MIE does not last significantly longer than open surgery, and Fabian et al. report that the thoracoscopic procedure, when the operation is performed with the patient in the prone position is shorter than the open esophagectomy (OE).

A consensus exists as to the fact that the average blood loss during the MIE is significantly lower than with the open esophagectomy (OE), which is dictated by specific work techniques. The length of the stay in an intensive care unit and the hospital stay from surgery until the discharge from the hospital was also shorter with groups of patients which underwent MIE when compared to OE.

The percentage of total complications was slightly lower in the group of patients that were operated with the MIE approach, but the difference when compared to the OE is not statistically significant. When analyzing specific complications, pulmonary complications are less frequent in the group of patients that underwent MIE, but the difference is not statistically significant. The problem in interpreting the incidence of pulmonary complications lies in a different classification of pulmonary complications in different studies. While a number of authors include only "major" complications (respiratory failure, etc.) in pulmonary complications, others include "minor" complications such as atelectasis, pleural effusion, etc. It is also interesting to note that the percentage of the esophagogastric anastomotic dehiscence is slightly lower in the group of patients which were operated by the MIE approach, but not even in this group is the complication of differences compared to OE statistically significant. The reason for fewer complications in the MIE group is probably caused by the fact that the experience is on the side of MIE.

<table>
<thead>
<tr>
<th>Type of surgical procedure</th>
<th>Author</th>
<th>Year</th>
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<tbody>
<tr>
<td>Transthoracic esophagectomy</td>
<td>Morris L</td>
<td>2007</td>
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<tr>
<td>Total MIE vs OE</td>
<td>Smithers BM</td>
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<td>Thoracotomy and laparotomy vs OE</td>
<td>Osugi H</td>
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<td>Shirashi T</td>
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<td>Smithers B</td>
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<td>Thoracotomy and laparoscopy or laparotomy vs OE</td>
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<tr>
<td></td>
<td>Fabian T</td>
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<td>Transhiatal esophagectomy</td>
<td>Bresadola</td>
<td>2006</td>
</tr>
<tr>
<td>Laparoscopic vs OE</td>
<td>Van den Broek W</td>
<td>2004</td>
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<td>Hand assisted laparoscopic vs OE</td>
<td>Scheepers J</td>
<td>2008</td>
</tr>
<tr>
<td></td>
<td>Berbabe K</td>
<td>2007</td>
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</table>

MIE - minimally invasive esophagectomy, EO- open esophagectomy
control group in the analyzed case control studies, as by rule, is a historical cohort.

Total mortality was also lower after MIE, but the difference in comparison to the OE is not statistically significant. The decrease in mortality is probably a consequence of a slightly smaller percentage of specific complications.

In one of the few studies that monitor and compare the survival after MIE and OE, Smithers et al. reported that there are no significant differences in the three-year survival.

It is possible that a better insight into the status of MIE, from the attempts to summarize the experiences of different MI operational procedures, is provided by the analysis of the largest single series of MIE, which is a series by Luketich et al. from UPMC in Pittsburgh. The first written information of this group dates from 1998 when the MI transhial approach esophagectomy was conducted with 8 patients with early esophageal cancer, Barrett’s esophagus and esophageal stenosis. The same group published a paper in the Annals of Surgery in 2003 in which they summed up the experience with 222 consecutive patients who underwent MIE and the surgical approach has evolved in the direction of laparoscopic and thoracoscopic MI esophagectomy with cervical esophagogastrointestinal anastomosis. Finally, same authors published in 2006, in the Disease of the Esophagus the experience with over 500 MIE emphasizing that the surgical approach had changed towards the MI Ivor Lewis procedure.

In the standard technique, the patient is initially positioned in dorsal decubitus and the laparoscopic procedure is performed with a five-trocar positioned specifically as the surgeon stands by the right side of the patient. After complete gastric mobilization, the lymph nodes are removed from the celiac region and the left gastric artery is divided at the point of origin. Further along, the pyloroplasty, the creation of a tubulized gastric substitute, and abdominal act ends with the formation of feeding jejunostomy. Then the patient is turned on their left lateral decubitus, and the thoracic act is performed with a 4-5 trocar technique. In doing so the esophagus with lymphadenectomy in the middle and lower level of the mediastinum (“two field standard lymph node dissection”) is removed and by pulling-up the tubulized stomach through the hiatus, an intrathoracic stapled esophagogastrointestinal anastomosis is formed. A stapler is introduced through a 5 cm long incision of right thorax. The same incision is used for specimen extraction afterwards.

What are the results of this series? Prior the esophagectomy 51% of patients underwent some sort of a neoadjuvant protocol, and as many as 25% had previous abdominal surgery. Esophagogastrointestinal anastomotic dehiscence in the thorax was verified with 6% of patients. We should bear in mind that this is the result obtained by analyzing the first 50 patients who underwent stapler intrathoracic anastomosis. The average stay in the intensive care unit was 1 day, and the average stay in the hospital from surgery to the discharge was 7 days. The total mortality in the series was 1.4%, a five-year survival of 36%, with the majority of patients were in the stage II and III of the disease.

Thoracoscopy with patients in the prone position provides a new perspective in the MIE approach. This position allows better exposure and ergonomics. The total number of trocars required for the thoracoscopic part of the surgery is reduced to 3 and the average duration of thoracoscopic esophagectomy with two field standard lymphadenectomy is approximately 1.5 hours.

Currently, Palaniveluet al all from in Coimbatore in India, has the greatest experience with MIE with the patient’s in the prone position, who in 2006 published a series of 130 patients with thoracic esophageal carcinoma.

CONCLUSION

Minimally invasive esophagectomy is a safe and oncologically adequate, but technically demanding and time-consuming surgical procedure. It is reserved for surgeons with experience in open surgery of malignant disease of the esophagus and surgeons with significant experience in advanced laparoscopic procedures. Even then, the learning curve is long.

MIE is a procedure that is still evolving. Since the first experiences with the MIE procedures were published in the early nineties they have undergone many changes and innovations. What is the current status of the MIE? According to data of Boone et al. obtained by the survey which included 500 esophageal surgeons on three continents, as much as 40% had experience with one of MI techniques in the diagnosis and treatment of esophageal cancer. Of all surgeons included in the survey, one third believes that MIE has an advantage over OE in the treatment of esophageal carcinoma.

In order to define the position of MIE in the treatment of esophageal carcinoma comprehensive randomized controlled studies are required. One such study is currently underway. The "Eastern Cooperative Oncology Group" study (ECOG 2202), a coordination centre located at the UPMC in Pittsburgh.

SUMMARY

MINIMALNO INVIZIVNE EZOFAGEKTMJE U LEČENJU KARCINOMA JEDNJAKA

U zapadnoj populaciji incidenc karcinoma jednjaka iznosi 3-6 novih slučajeva na 100.000 stanovnika. I pored napretka drugih terapijskih opcija hirurgija in dalje ostaje prva in najbolja terapija karcinoma jednjaka, kad god je to mogoče. U dugom vremenskom period terapijska dilema odnosi se na procesu efekatna dve raspoložive operativne procedure - transfzijalne ezofagektomije (TJE) in transstomalne ezofagektomije (TTE). Devedesetih godina prosllog veka v terapiju je uvedena nova hirurška opcija, minimalno invazivna ezofagektomija (MIE) koja je sublimiralida dobre osobine oba pristupa in to minimalno invazivni ulazak v grudni koš, bez značajnega uvećanja operativne trave in mogučnost adekvatne limfomodalne disekcije zadnjih medijastinuma. Minimalno invazivna ezofagektomija je sigurna in onkološki adekvatna, ali tehnički
i vremenski zahtev na hirurška procedura. Rezervisana je za hirurge sa iskustvom u otvorenoj hirurgiji malignih bolesti jednjaka i hirurge sa značajnim iskustvom u naprednim laparoskopskim procedurama. Čak i tada, kri-va učenja je duga.

Ključne reči: hirurško lečenje, minimalno invazivna hirurgija, neoplazme jednjaka

REFERENCES: