Institutional report - Esophagus

The use of the LigaSure in esophagectomy

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Abstract

This study aimed to evaluate the efficacy of the LigaSure vessel sealing system (LVSS) when used for esophagectomy. We compared 56 consecutive patients (32 male and 24 female, mean age: 56.64 ± 12.61 years), who had undergone Ivor–Lewis esophagectomy for esophageal carcinoma between January 2005 and May 2009. Among them, from January 2005 to April 2007, 27 patients (group 1) were operated on with the conventional clamp-and-tie technique, whereas from April 2007 to May 2009, 29 patients (group 2) underwent total esophagectomy for esophageal cancer with the LVSS. Both groups were compared for operation duration, amount of intraoperative bleeding, postoperative hospitalization time, and intraoperative complications. In the evaluation of the patients, the two groups had similar distributions of age and gender. The duration of operation (349.44 ± 46.82 min vs. 288.27 ± 60.09 min, P < 0.05) and the amount of intraoperative bleeding (414.82 ± 137.04 ml vs. 217.41 ± 111.78 ml, P < 0.05) were significantly lower in LVSS group than in the conventional method group. There were no differences for hospitalization time and intraoperative complications between the groups. LVSS significantly shortens operation duration and decreases the amount of intraoperative bleeding compared with the conventional methods, but does not provide advantages for hospitalization time and/or intraoperative complications. We believe LVSS is an effective and reliable method for esophageal surgery.

Keywords: LigaSure™ vessel sealing system; Esophagectomy; Operating duration; Bleeding

1. Introduction

The LigaSure™ vessel sealing system (LVSS) (Valleylab, Boulder, CO, USA) is an electrosurgical device to seal tissue vs. conventional clamps and suture ligatures. The LVSS is an energy-based method, which works by applying a precise amount of pressure and bipolar energy to the tissue and thus, permits vessel seal to be achieved by changing the nature of the vessel walls. LigaSure™ melts the collagen and elastin in the vessel walls and fuses the intimal layers and reforms into a single structure obliterating the lumen due to reduced risk of hemorrhage [1]. The system has been used in urological, thoracic, gynecological, abdominal (biliary, hepatic, gastric cancer resection) and laparoscopic surgery as well as in thyroidectomy and hemorrhoidectomy [2–8]. Clinical results with the LigaSure™ system have demonstrated that it is safe, effective, and can lead to shortened operating times for abdominal surgery, cancer surgery, hepatectomy, and others [2, 7, 8]. However, a review of literature in English reveals few studies using LVSS in the malign diseases of the esophagus. In this study, the operation time, the amount of bleeding, and intraoperative complications of the patients who had undergone esophagectomy in our clinic by using LVSS for esophageal carcinoma and of the patients who had undergone esophagectomy based on our clinic by using LVSS for esophageal carcinoma.
operative complications (Table 3) and surgical parameters (Table 2) in 56 consecutive patients who underwent Ivor–Lewis esophagectomy for esophageal carcinoma between January 2005 and May 2009. Among them, from January 2005 to April 2007, 27 patients (group 1) were operated on with the conventional clamp-and-tie technique, whereas from April 2007 to May 2009, 29 patients (group 2) underwent total esophagectomy for esophageal cancer with the LVSS. During the specified date range, the Ivor–Lewis surgical procedure was consecutively applied with both methods to 56 patients with a diagnosis of esophageal carcinoma. All of the patients were diagnosed with esophageal carcinoma based on the histopathological evaluation of the endoscopically obtained biopsy specimens. In the preoperative evaluation, all the patients were screened for any metastases, and those that were determined to be operable and needed resection had an esophagectomy. Patients with cervical and/or proximal esophagus involvement and patients with cervical incision were excluded from the study because LigaSure™ is never used in the cervical region or its use is very limited. All of the patients had distal and middle esophagus involvement. All the anastomoses were performed using a stapler in the intrathoracic and thoracic apertures. The esophagus was resected at a minimum 5 cm proximal of the palpable tumor margins, and after frozen section study of the surgical margins, anastomosis was performed.

2.2. Surgical technique

In this study, all the operations were made by a single surgical team that included a senior surgeon and a junior surgeon. Both surgeons had similar experience in using the LigaSure™ and conventional clamp crushing methods. The patients in both groups were applied the same general anesthesia protocol. All the patients underwent laparotomy plus right thoracotomy. In the esophagectomy based on Ivor–Lewis method, anastomosis was achieved using a mechanical circular stapler in the thoracic aperture. In all the patients, along with the esophagectomy, routine two-field lymph node dissection was performed. All of the patients underwent proximal gastrectomy and stomach reconstruction. The arteria and vena gastrica sinistra were ligated with 2/0 Vicryl (Ethicon, CO, USA).

After laparotomy, the arteria and vena gastroepiploica dextra were preserved in both groups and the stomach was released and thus, the celiac lymph node was dissected. In three patients in the conventional method group, when the major curvature was being released, a minimal laceration occurred in the spleen capsule. Splenic injuries in the conventional group were minor injuries such as capsule laceration. These complications were managed by conventional methods (cauterization, tampon, etc.) and hemostatic agents (surgical, etc.). Blood transfusion was not needed for patients with complication. In the LVSS group, LigaSure™ XTD and AXS (Fig. 1a,b) probes were used and the major curvature (Fig. 2a,b), the minor curvature and the gastro-splenic ligament (Fig. 2c) were released safely in all the patients with no problems. After thoracotomy, in both groups, the vena azygos was ligated with 3/0 Vicryl (Ethicon, CO, USA). In the LVSS group, LigaSure™ AXS probe proved to be very safe and efficient particularly in the esophageal area where the tumor was located, in the ligature of aortic branches on the posterior wall, in mediastinal dissection of the esophagus and in the thoracic lymph node dissection (Fig. 2d).

In this study, the data on the operation duration, the amount of intraoperative bleeding, intraoperative complications, and hospitalization time were obtained from the patient files. The data were statistically compared.

2.3. Statistical analysis

In this study, both descriptive [mean, standard deviation (S.D.) etc.] and inferential statistical methods were used together in the analysis of the data obtained. A descriptive method was used to determine the characteristics of the patients represented in the sample, inferential statistical methods were used to analyze the research questions. The Kolmogorov–Smirnov test was performed to determine whether the distribution of data is normal or not (Table 1).

Implementation of non-parametric tests was decided on a negative normality test. The Mann–Whitney U-test was used to define the non-difference between the two groups. Also, the Spearman rank correlation test was performed in order to determine a relationship between operation duration and intraoperative bleeding. Statistical analyses were con-
dducted using a statistical analysis package (SPSS version 11.5 for Windows, SPSS, Chicago, IL, USA).

3. Results

Fifty-six consecutive patients [32 male (57.1%) and 24 female (42.9%); age range: 29–79 years, and total mean age: 56.64 ± 12.61 years] who had undergone esophagectomy between January 2005 and May 2009 were selected for the study. The mean age of the LVSS group and the conventional method group were 55.72 ± 12.98 and 57.62 ± 12.38 years, respectively. All of the patients were operated on for malignancies in the conventional group and the LVSS group. The distribution of tumor locations was middle esophagus n = 34 (60.7%), distal esophagus n = 15 (26.7%), and gastro-esophageal junction (GEJ) and cardiac n = 7 (12.5%). In the histopathological evaluation of the patients, 42 (75.0%) patients were diagnosed with squamous cell carcinoma; 13 (23.2%) patients had adenocarcinoma; one (1.7%) patient had signet ring cell carcinoma. The stomach was used as a replacement organ for all patients. In the evaluation of the 56 patients based on the tumor node metastasis (TNM) classification, four patients (7.1%) were in stage I; 23 patients (41.0%) were in stage Ila; 19 patients (33.9%) were in stage Iib, and 10 patients (17.8%) were in stage III. The patients in both groups showed similar clinical features and characteristics (Table 2).

The mean operation duration on the patients that were operated on by a conventional method (clamp-and-tie) was 349.44 ± 46.82 min, while it was 288.27 ± 60.09 min in the LVSS group. The mean amount of intraoperative bleeding in the conventional method group was 414.82 ± 137.04 ml. However, it was 217.41 ± 111.78 ml in the LVSS group (Table 3).

The comparisons of the intraoperative complications of the two groups showed that three patients in the conventional method group suffered splenic capsule laceration. No statistically significant differences were determined between the two groups for length of hospitalization stay (group 1: 14.81 ± 11.48 days, group 2: 13.72 ± 5.05 days and P = 0.70) (Table 3).

The present study demonstrated that the rate of morbidity was similar in the LigaSure™ and conventional method groups. In the postoperative follow-up of the two groups, one patient in the conventional method group died on postoperative day 9 due to a pulmonary embolization, and one patient suffered an anastomosis leak on the postoperative day 7. This patient was discharged after prolonged

![Image](image_url)

Fig. 2. The use of the LigaSure™ in esophagectomy. a) in the omentum, b) visual indication of sealed tissue after application of the LigaSure™ vessel sealing system, c) in the gastro-splenic ligament, d) intrathoracic.

### Table 1

<table>
<thead>
<tr>
<th>Most extreme differences</th>
<th>Operating time (min)</th>
<th>Intraoperative blood loss (ml)</th>
<th>Postoperative stay (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute</td>
<td>0.552</td>
<td>0.785</td>
<td>0.186</td>
</tr>
<tr>
<td>Positive</td>
<td>0.552</td>
<td>0.785</td>
<td>0.088</td>
</tr>
<tr>
<td>Negative</td>
<td>0.000</td>
<td>0.003</td>
<td>0.186</td>
</tr>
<tr>
<td>Kolmogorov–Smirnov z</td>
<td>2.063</td>
<td>2.937</td>
<td>0.697</td>
</tr>
<tr>
<td>Asymp. sig. (two-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.716</td>
</tr>
</tbody>
</table>

Grouping variable: group (1, conventional; 2, LVSS). LVSS, LigaSure™ vessel sealing system.

### Table 2

<table>
<thead>
<tr>
<th>Table 1 Patients data</th>
<th>Total (n: 56)</th>
<th>Conventional (n: 27)</th>
<th>LigaSure™ (n: 29)</th>
<th>Sign. (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years, mean±S.D.)</td>
<td>56.64 (±12.61)</td>
<td>57.62 (±12.38)</td>
<td>55.72 (±12.98)</td>
<td>0.70</td>
</tr>
<tr>
<td>Sex ratio (M:F)</td>
<td>32:24</td>
<td>15:12</td>
<td>17:12</td>
<td>1.00</td>
</tr>
<tr>
<td>Tumor location (malign)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle (23–31 cm of esophagus)</td>
<td>34 (60.7%)</td>
<td>15</td>
<td>19</td>
<td>0.51</td>
</tr>
<tr>
<td>Distal (31–40 cm of esophagus)</td>
<td>15 (26.7%)</td>
<td>8</td>
<td>7</td>
<td>0.76</td>
</tr>
<tr>
<td>GEJ* and cardia</td>
<td>7 (12.5%)</td>
<td>4</td>
<td>3</td>
<td>0.76</td>
</tr>
<tr>
<td>Type of cell</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squamous cell</td>
<td>42 (75.0%)</td>
<td>20</td>
<td>22</td>
<td>0.60</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>13 (23.2%)</td>
<td>7</td>
<td>6</td>
<td>0.75</td>
</tr>
<tr>
<td>Signet ring cell carcinoma</td>
<td>1 (1.7%)</td>
<td>0</td>
<td>1</td>
<td>0.32</td>
</tr>
<tr>
<td>TNM** stage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>4 (7.1%)</td>
<td>2</td>
<td>2</td>
<td>0.82</td>
</tr>
<tr>
<td>Ila</td>
<td>23 (41.0%)</td>
<td>10</td>
<td>13</td>
<td>0.61</td>
</tr>
<tr>
<td>Iib</td>
<td>19 (33.9%)</td>
<td>10</td>
<td>9</td>
<td>0.78</td>
</tr>
<tr>
<td>III</td>
<td>10 (17.8%)</td>
<td>5</td>
<td>5</td>
<td>0.82</td>
</tr>
</tbody>
</table>

*GEJ, gastro-esophageal junction, **TNM, tumor, node, metastasis. S.D., standard deviation.
hospitalization (75 days) with a self-expandable covered stent applied on the anastomosis line. One patient in each group developed pleural effusion in the contralateral hemithorax, and thus, a tube thoracostomy was performed.

4. Discussion

Esophageal cancer accounts for 2–5% of all the cancers detected and is the fourth most common digestive system cancer [9]. One of the main characteristics of this lethal disease is its specific geographical distribution. For instance, its incidence has been reported to be 3/100,000 in Europe and USA, while it is 165–200/100,000 in eastern Turkey, northern Iran and China [10, 11]. Thus, esophageal carcinoma and its surgery comprise most of the workload on the thoracic surgeons in our region.

Surgical therapy remains the cornerstone in managing resectable esophageal cancer. There is no demonstrated benefit of postoperative chemotherapy or radiation therapy for completely resected patients. However, in patients with advanced stage esophageal carcinoma, a postoperative combination of multimodal therapy, chemotherapy and radiotherapy is the best approach [12]. In patients with esophageal cancers in the middle and distal esophagus and at the esophagus–gastric junction, the Ivor–Lewis esophagectomy is one of the common surgical procedures. An Ivor–Lewis esophagectomy is a safe surgical approach for esophageal cancer. The technique allows direct visualization and resection of most of the lymph node stations at risk [13].

In this study, patients with cervical and proximal esophagus involvement were excluded because in the surgical procedure used, LigaSure® was almost never used in cervical exploration. Therefore, the Ivor–Lewis surgical procedure was used in 36 patients from both groups. Two-field lymph node dissections were performed in both groups. The efficiency and success of LVSS in closing vessels of 1–7 mm in diameter have been shown. In recent years, this technology has been used safely in abdominal, urological, and gynecological surgery. In all the surgical disciplines where this technology has been used, ultrasonic coagulation, bipolar coagulation and the use of surgical clips and sutures were compared with this technology. All of these studies have demonstrated that the technique shortens the operation time and reduces intraoperative hemorrhage [6–8].

The use of LVSS has become widespread and it has been used in thoracic surgery as well [3]. Nevertheless, there are few studies on the use of LigaSure® in esophagus surgery. In the study by Eroglu et al. in which the system was used in esophagus surgery, the efficiency of LigaSure® has been shown [14].

The arteria and vena gastrica sinistra of all the patients was manually sutured and ligated. Except in this procedure, LigaSure® was used throughout the entire surgical procedure. The releasing of the stomach along the big curvature and small curvature was achieved by LigaSure®. During this dissection, celiac lymph node dissection was performed using the same method. Similarly, LigaSure® was used in mediastinal dissection of the thorax, releasing the esophagus, and resection of the tumor.

In esophagus surgery, when the stomach is being released, the resection of the omentum by preserving the arteria and vena gastroepiploika dextra in the big curvature is time-consuming. Likewise, the releasing of the small curvature after the manual ligature of the a.v gastrica sinistra is time-consuming. However, use of LigaSure® in both of these regions and in celiac lymph node dissection reduces the operating time [14].

In this study, esophagus resection by LigaSure® use reduced the operation duration by 61.17 min and the intraoperative bleeding by 197.41 ml compared to the conventional method. Evaluation of intraoperative complications revealed minimal laceration of the splenic capsule in three patients who were operated on using a conventional method. However, no complications occurred in the patients operated on using the LigaSure® system. Although the findings are compatible with the findings of earlier studies, the non-significant differences in hospitalization time and complications might be a consequence of the insufficient number of patients.

Surgery of esophageal cancer is a prolonged procedure and requires patience. The high incidence of esophageal cancer in our region necessitates resection procedures that are required for malignant diseases of the esophagus and rarely for benign diseases of the esophagus. The procedure is time-consuming, which prompted investigations of new approaches. The present study has indicated that use of LVSS for malignant pathologies of the esophagus reduces the operation duration by 61.17 min and the amount of intraoperative bleeding by 197.41 ml. The use of LigaSure® has rendered separation of the stomach from the spleen during
big curvature dissection and dissection of the posterior and contralateral walls of the mediastinal tumor safer. This indicates that the use of LVSS in esophagus resection is a safe and efficient method.

References


eComment: The use of the LigaSure™ vessel-sealing system is effective for preventing postoperative chylothorax following esophagogastrectomy

Authors: Nikolaos Barbetakis, Department of Thoracic Surgery, Theagenio Cancer Hospital, A. Simeonidi 2, 54007 Thessaloniki, Greece; Christos Asteriou, Nikolaos Salveridis, Vassilios Lagopoulos doi:10.1510/icvts.2009.222109A

We have read with interest the article by Yekeler et al. concerning the use of LigaSure™ in esophagectomy. The aim of our brief comment is to present our experience with the routine use of this electrosurgical bipolar vessel sealer device. Except for the fact that LigaSure™ significantly shortens the operation duration and the amount of intraoperative bleeding, it also produces reliable and durable sealing of large lymphatic vessels including the thoracic duct. As a result the risk of postoperative chylothorax is very low and this has to be highlighted.

We have also used LigaSure™ for the treatment of refractory chylothorax in two patients with satisfactory results. Thoracoscopic coagulation and section of the thoracic duct above the diaphragm with the LigaSure™ device appears to be a simple, effective, and safe therapeutic option for the treatment of refractory chylothorax.

Reference