

Introduction

The surgical approach for esophageal resection is determined by location, intent to cure, planned method of reconstruction and surgeon preference. [1] A significant morbidity and mortality is associated with both benign or malignant disease regardless of approach. [2] Experience with transhiatal esophagectomy that uses a cervical anastomosis and avoids thoracotomy appears to reduce major pulmonary insult [3] and success with minimally invasive techniques has opened the door for future prospective studies. [4]

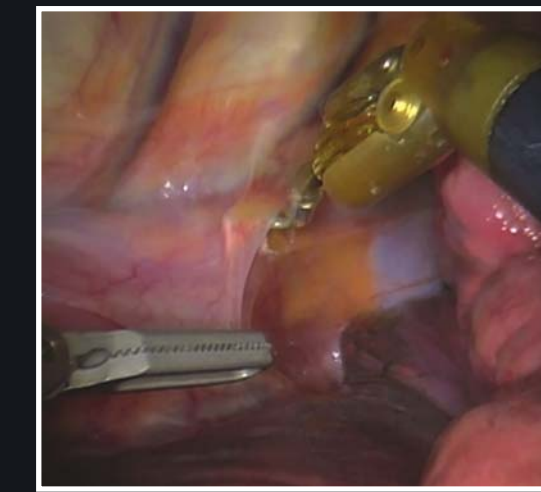
The objective of our study is to evaluate the application of robotic techniques for esophagectomy. Robotic assistance may facilitate this procedure due to the increased dexterity and visualization of the robotic system.

Methods

Eight patients have undergone three-hole esophagectomies utilizing transthoracic mobilization of the esophagus with the da Vinci Surgical System at our institution. A retrospective analysis with SPSS 11.0 was performed on our prospectively maintained database.

Via a right thoracotomy position, ports are placed in the posterior axillary line. A 12mm thoracoscopic port is placed in the sixth space and two 7mm ports are placed in the fourth and eighth interspaces. An auxiliary port is used for assistance through the seventh space anteriorly.

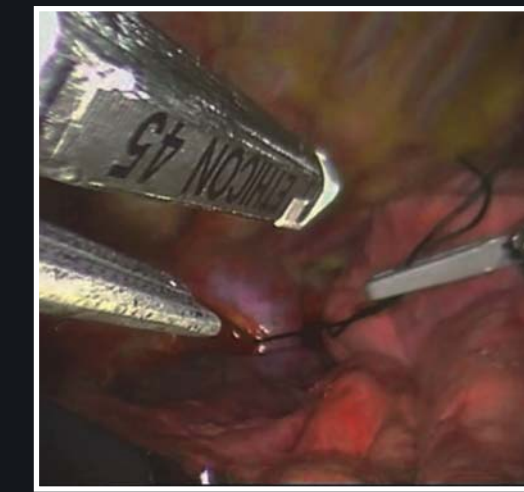
The thoracic esophagus is mobilized from the diaphragm to the thoracic inlet. Wide excision with nodal dissection is performed along the entire esophagus. The stomach is mobilized through a laparotomy incision and used as a conduit for the anastomosis which is performed in the left neck.



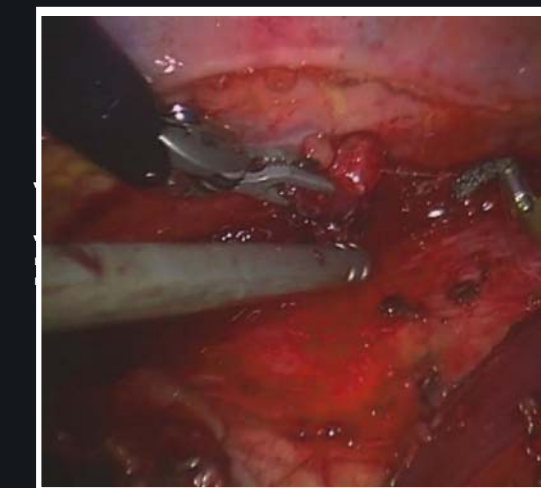
Dissection begins in the mid-esophagus



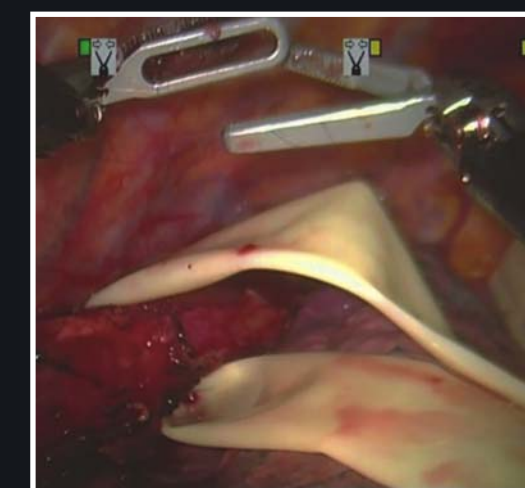
Azygous vein dissected



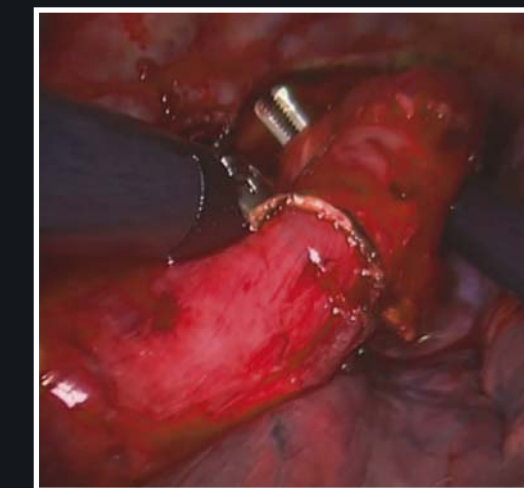
Azygous vein divided with endoscopic stapler



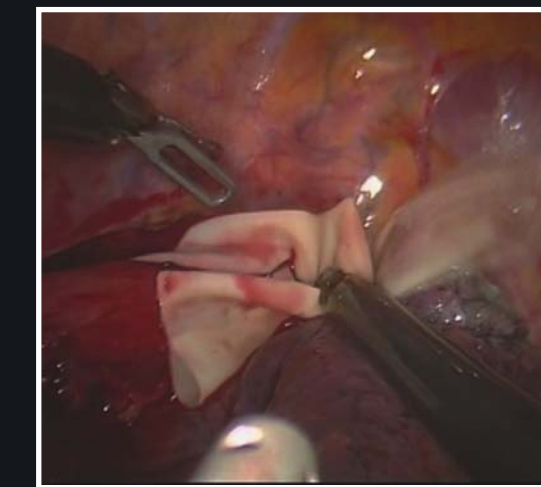
Paraesophageal lymph node sampling



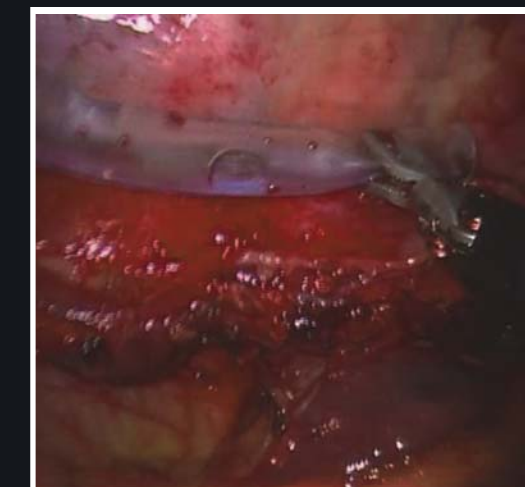
Penrose drain encircles esophagus to aid in retraction



Dissection around esophagus complete



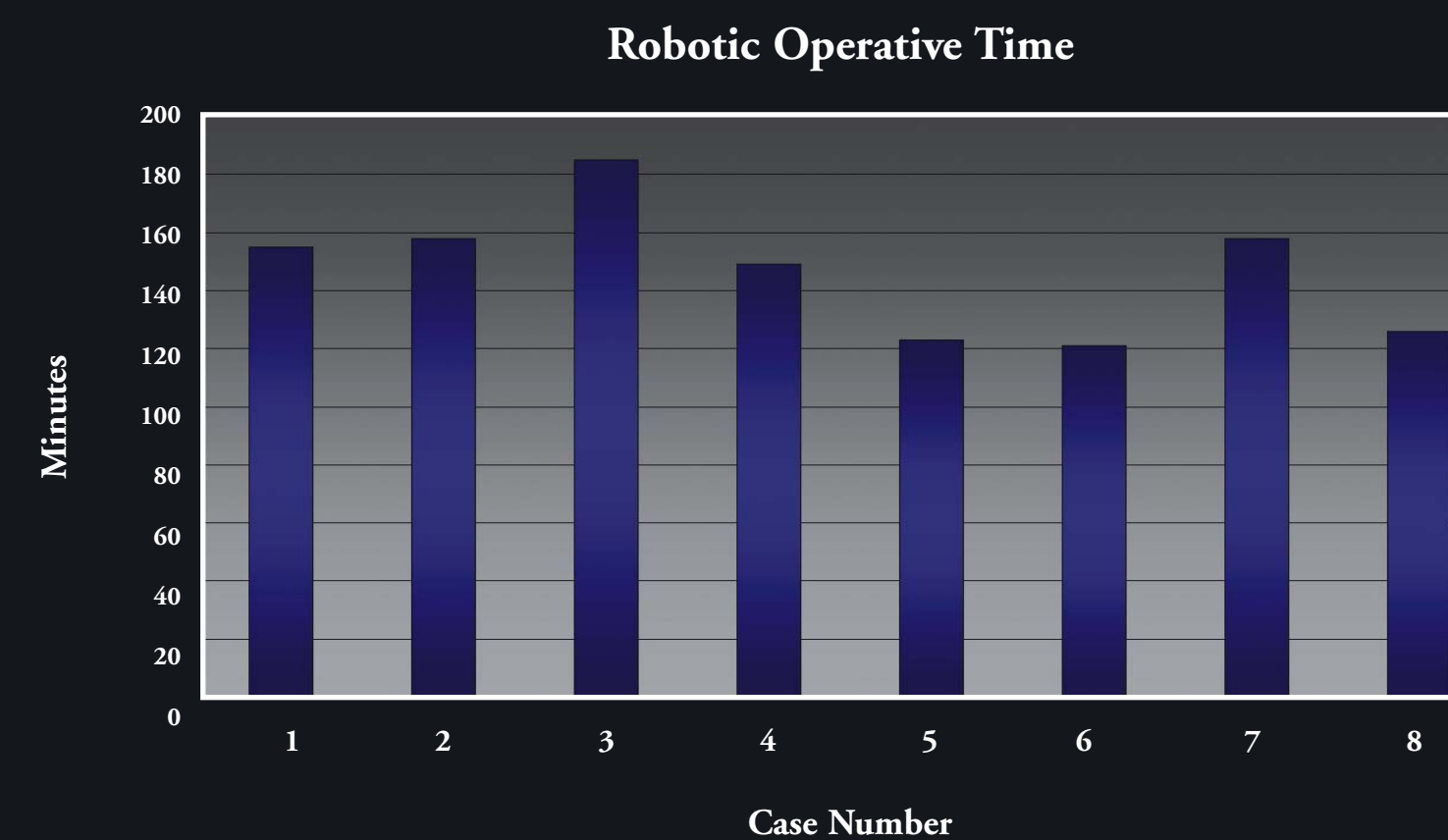
Penrose drain pushed into thoracic inlet for cervical anastomosis



Chest tube placed via inferior arm port prior to patient repositioning

Pictures demonstrate different steps in robotic assisted esophageal mobilization.

Graph displays trends of robotic portion of procedure. Average robotic operative time decreased from 166 ± 17 minutes to 135 ± 20 minutes when comparing the first three procedures with the last three.



Results

A total of 8 esophagectomies were performed: 4 for squamous cell carcinoma, 2 for adenocarcinoma and 2 for benign indications. The average patient age was 60.6 ± 14.5 years (range 34-77). Comorbidities included 50% of patients either obese or overweight with BMI 24.3 ± 5.3 kg/m² (range 17.1-31.3), 25% with hypertension, 8% with diabetes, 8% with COPD and 8% with a history of a previous laparotomy. Total surgery time averaged 436 ± 30 minutes (range 396-473). Average robotic time 146 ± 22 minutes (range 121-185) representing an average of 33.5 ± 3.3 % of total surgical time. There were no intraoperative complications.

Discussion

Although our sample size lacks sufficient power for formal logression analysis, preliminary investigations suggest that robotic esophageal surgery is safe and has a smooth learning curve. Time needed to reach proficiency is very reasonable. The theoretical advantages of this minimally invasive technology include improved visualization and greater intracorporeal dexterity. Despite a significant start-up cost, robotic technology may prove to be less technically exclusive than traditional thoracoscopic or laparoscopic approaches for esophageal surgery. This technology may make minimally invasive esophageal surgical approaches available for a greater number of surgeons and their patients.

Conclusion

Transthoracic robotic assisted esophageal mobilization represents an important step toward the development of a procedure for total robotic esophagectomy. Minimally invasive and robotic techniques may improve the morbidity and mortality of esophageal surgery and make the surgical option available to a greater number of patients. Further studies to demonstrate learning curves and clinical outcomes are necessary in the growing field of robotics.

Bibliography

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2. Millikan KW, Silverstein J, Hart V, et al. A 15-year review of esophagectomy for carcinoma of the esophagus and cardia. Arch Surg 1995; 130: 617-624.
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4. Lukerich, J.D., et al., Minimally invasive esophagectomy: outcomes in 222 patients. Ann Surg, 2003. 238(4): p. 486-94; discussion 494-5.