American Journal of Surgery Case Reports

ISSN: 2766-8304

Case Report

Concurrent Robotic-Assisted Right Transthoracic Esophagogastrectomy and Robotic-Assisted Pulmonary Lobectomy for Synchronous Primary Lung Cancer and Esophageal Cancer

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Abstract

Introduction: Standard treatment for early-stage esophageal cancer and for early-stage lung cancer includes surgical resection.

Case presentation: We present 72-year-old man diagnosed with synchronous Thyroid Transcription Factor-1 (TTF1)-negative T3N1 gastroesophageal adenocarcinoma and TTF1-positive Right Lower Lobe (RLL) adenocarcinoma. He was treated with neoadjuvant chemotherapy and radiation therapy for the esophageal cancer, and then underwent concurrent robotic-assisted right transthoracic (Ivor-Lewis) esophagectomy and robotic-assisted RLLobectomy. *Via* hand-assisted laparoscopic approach in supine position, gastric mobilization, celiac and paraaortic lymphadenectomy, feeding jejunostomy, and pyloric botulinum injection were performed. With the patient in left lateral decubitus, three thoracoscopy ports, including a 4.5 cm camera port along the anterior axillary line at the 6th Intercostal Space (ICS) and two 1 cm instrument ports, one along the anterior axillary line at the 3rd ICS and another along the posterior axillary line at the 9th ICS were created. The 6th ICS port incision doubled as the assistant's access port. Robotic-assisted video-thoracoscopic RLLobectomy, with Mediastinal Lymph Node Dissection (MLND), was then performed. Robotic-assisted right transthoracic esophagogastrectomy was then performed through the same thoracoscopy ports, with primary re-anastomosis using a circular endostapler and orally-introduced anvil. Intraoperative estimated blood loss totaled 100 mL, while operative (skin-to-skin) time totaled 517 min, including 131 min for the RLLobectomy and MLND. No anastomotic leak was noted on esophagram performed on postoperative day (POD)#4, and chest tube was removed on POD#6. Nutrition was given *via* jejunostomy, as dysphagia delayed oral intake until POD#8. He required antibiotics for *Pseudomonas* and *E. coli* jejunostomy site infection, but he was tolerating post-esophagectomy diet upon discharge to home on POD#12. He had a pT2N0M0 lung adenocarcinoma and no residual esophageal cancer on final pathology. He required readmission on POD#16 for contained anastomotic leak, aspiration pneumonia, and grade 1/2 sacral decubitus. He was treated with nutrition via jejunostomy, NPO status, IV antibiotics, and sacral wound care and was discharged to skilled-nursing facility on hospital day#19. Although he was tolerating oral diet at 5-month follow-up, he was noted to have gastritis and small gastric ulcer, which resolved with sucralfate by 8-month and 11-month follow-up, respectively.

Discussion: Although concurrent robotic-assisted Ivor-Lewis esophagogastrectomy and robotic-assisted RLLobectomy were associated postoperatively with complications related to feeding and nutritional status, single-stage treatment of concomitant lung and esophageal cancers using a robotic-assisted approach in appropriately selected patients is safe and feasible, with no delay in treatment of these cancers.

Conclusion: We report the first successfully performed concurrent robotic-assisted right transthoracic esophagogastrectomy and robotic-assisted pulmonary lobectomy.

Keywords: Robotic-assisted surgery; Pulmonary lobectomy; Esophagectomy; Lung cancer; Esophageal cancer

Citation: Parvathaneni S, Khalil F, Baldonado JJAR, Meredith KL, Toloza EM. Concurrent Robotic-Assisted Right Transthoracic Esophagogastrectomy and Robotic-Assisted Pulmonary Lobectomy for Synchronous Primary Lung Cancer and Esophageal Cancer. Am J Surg Case Rep. 2021;2(1):1008.

Publisher Name: Medtext Publications LLC

Manuscript compiled: Feb 04th, 2021

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Introduction

Synchronous esophageal and lung cancers are not common and present a diagnostic and treatment dilemma to most physicians. The workup and the actual treatment modalities can either extend or else inappropriately shorten a patient's life. Surgical treatment for each of these two cancers may carry significant morbidity when performed separately. Staged procedures have been shown to result in higher mortality or morbidity. One example is aortic arch surgery performed in two stages, where more than 45% of patients were not able to undergo the second stage procedure [1]. In addition to the technical challenges of combining the resections themselves, the morbidity of the combined procedures may be increased several-fold, as seen in hepatic resections for colorectal metastasis during primary colorectal cancer resections [2,3].

Minimally invasive surgery, such as robot-assisted surgery, has been shown to mitigate perioperative risks and improve perioperative outcomes after lung cancer resection and after esophageal cancer resection [4-6]. We herein report the first successful concurrent robot-assisted pulmonary lobectomy and robotic-assisted transthoracic esophagogastrectomy for synchronous primary lung and esophageal cancer. We then summarize our review of the literature.

Case Presentation

A 72-year-old man was diagnosed with synchronous thyroid transcription factor-1 (TTF1)-negative clinical T3N1M0 gastroesophageal adenocarcinoma and TTF1-positive Right Lower Lobe (RLL) clinical stage-1 adenocarcinoma (Figures 1-3). He received neoadjuvant chemotherapy and radiation therapy for his esophageal cancer and then underwent concurrent robotic-assisted RLLobectomy and robotic-assisted right transthoracic esophagogastrectomy.

Laparoscopic ports included an 8 cm right subcostal hand-port incision, a 12 mm supraumbilical laparoscope port, two 5 mm ports in the right upper quadrant for the primary surgeon's dissecting instruments, a 5 mm port and a 12 mm port in the left upper quadrant for the assistant surgeon's dissection and stapling instruments, and a 5 mm subxiphoid liver retractor port incision (Figure 4). Using hand-assisted laparoscopy in supine position, gastric mobilization, celiac and para-aortic lymphadenectomy, feeding jejunostomy, and pyloric botulinum injection were performed.

With the patient turned to left lateral decubitus position, three thoracoscopy ports were created, including a 4.5 cm camera port along the 6th Intercostal Space (ICS) at the anterior axillary line, a 1 cm instrument port along the 3rd ICS at the anterior axillary line, and a 1.5 cm instrument port along the 9th ICS at the posterior axillary line (Figure 4). The 6th ICS port incision doubled as the assistant's access port. Robotic-assisted video-thoracoscopic right lower lobectomy, with Mediastinal Lymph Node Dissection (MLND), was then performed. Through the same thoracoscopy ports, robotic-assisted right transthoracic esophagogastrectomy was then performed, with primary re-anastomosis using a circular endostapler and orally-

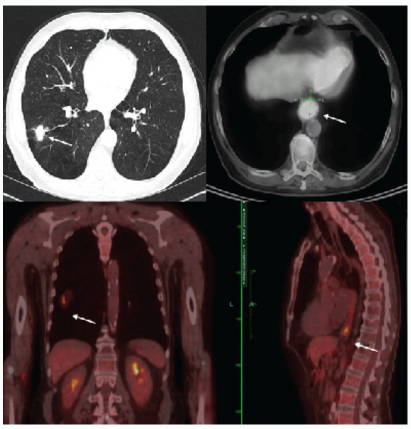

Figure 1: Axial image from preoperative chest Computerized Tomography (CT) scan (upper left panel) and axial (upper right panel), coronal (lower left panel), and sagittal (lower right panel) images from preoperative Positron-Emission Tomography (PET)-CT scan showing the right lung mass (upper and lower left panels) and the esophageal mass (upper and lower right panels).

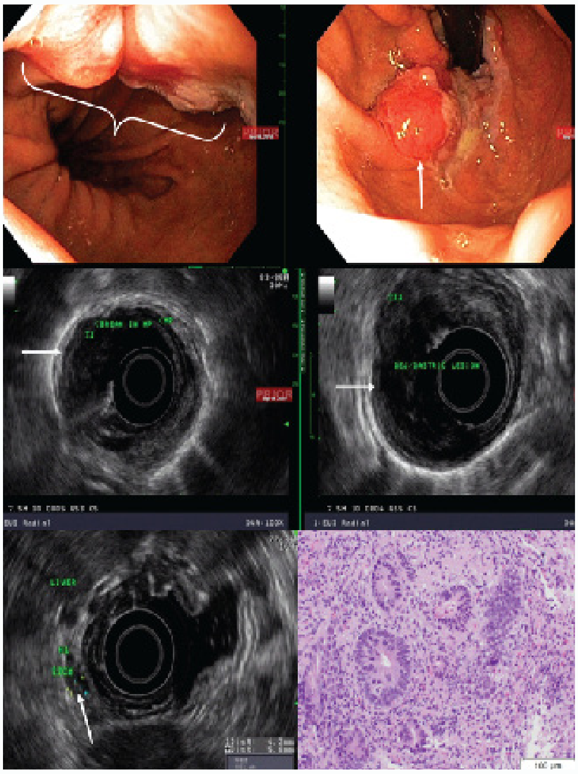

Figure 2: Endoscopic images of distal esophageal portion (top left panel) of the esophageal cancer, with retroflexed view of the gastric portion of the esophageal cancer at the gastroesophageal junction (top right panel). Endoscopic Ultrasound (EUS) images of distal esophageal portion (middle left panel) and gastric portion (middle right panel) of the esophageal cancer as well as an adjacent lymph node (bottom left panel). Photomicrograph of gastroesophageal junction mass biopsy stained with hematoxylin & eosin and showing invasive adenocarcinoma glands within the mucosa (bottom right panel).

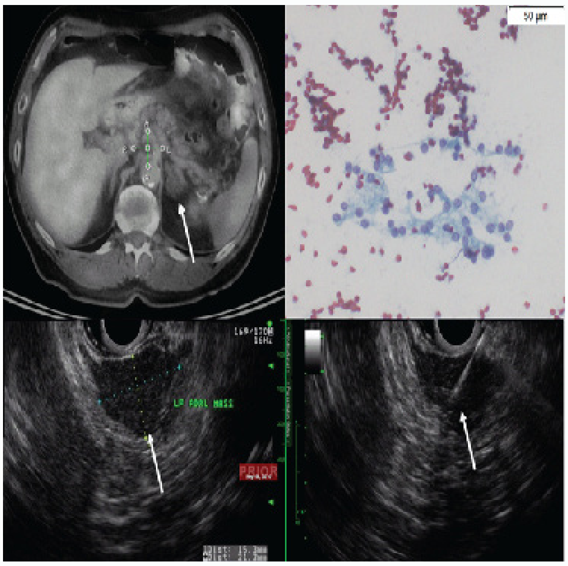

Figure 3: Axial image from preoperative Positron-Emission Tomography (PET)-Computerized Tomography (CT) scan revealing a PET-negative left adrenal mass (arrow; top left panel). Endoscopic Ultrasound (EUS) images of left adrenal mass (arrow; bottom left panel), with EUS-guided Fine Needle Aspiration (FNA) of left adrenal mass (arrow; bottom right panel). Photomicrograph of EUS-guided FNA of the left adrenal mass stained with Papanicolaou stain and showing benign adrenal cortical cells indicative of an adrenal adenoma (top right panel).

anvil. Intraoperative estimated blood loss totaled 100 mL, while operative (skin-to-skin) time totaled 517 min, including 131 min for the pulmonary lobectomy and MLND.

No anastomotic leak was noted on esophagram on postoperative day (POD)#4, and chest tube was removed on POD#6. Nutrition was provided via jejunostomy tube, as dysphagia delayed oral intake until POD#8. Antibiotics were required for jejunostomy site infections with *Pseudomonas* and *E. coli*, but he was tolerating post-esophagogastrectomy diet upon discharge to home on POD#12. A pT2N0M0 lung adenocarcinoma and no residual esophageal cancer were noted on final pathology (Figure 5).

Aspiration pneumonia, grade 1/2 sacral decubitus, and contained anastomotic leak prompted readmission on POD#16. He was treated with nutrition *via* jejunostomy tube, NPO status, IV antibiotics, and sacral wound care, and was able to be discharged to skilled-nursing facility on hospital day#19. He was tolerating oral diet at 5-month follow-up, but had gastritis and small gastric ulcer, which resolved by 8 months and 11 months follow-up, respectively, with sucralfate treatment. The patient survived 6.4 years after surgery, at which time he died of unspecified causes.

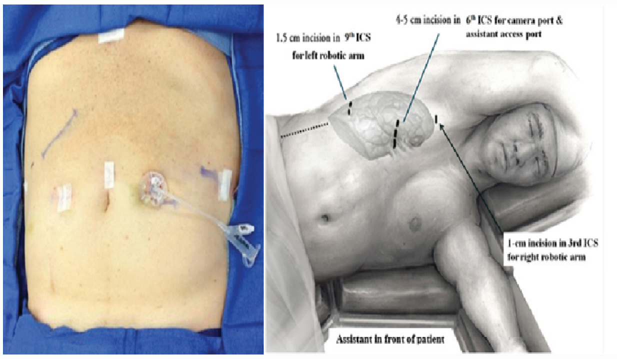

Figure 4: Port placements for the hand-assisted laparoscopic portion of the procedure (left panel), with an 8 cm right subcostal hand-port incision (covered with liquid skin sealant in the photo), a 12 mm supraumbilical port for the laparoscope, two 5 mm ports in the right upper quadrant for dissecting instruments for the primary surgeon, a 5 mm port (used for the jejunostomy tube in the photo) and a 12 mm port in the left upper quadrant for dissection and stapling instruments for the assistant surgeon, and a 5 mm subxiphoid incision for the liver retractor. Port placement for the right robotic-assisted video-thoracoscopic portion of the procedure (right panel), with a 4.5 cm camera port along the 6th Intercostal Space (ICS) at the anterior axillary line, which doubled as the assistant's access port, a 1 cm instrument port along the 3rd ICS at the anterior axillary line, and a 1.5 cm instrument port along the 9th ICS at the posterior axillary line.

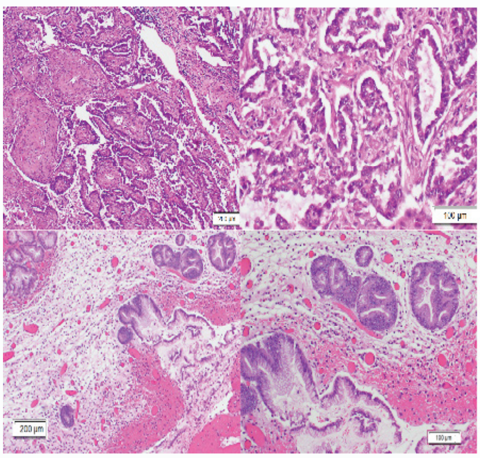

Figure 5: Photomicrographs of the right lung tumor (top panels) stained with Hematoxylin & Eosin (H&E) and showing well-formed acini within the center of the tumor and lepidic pattern towards the periphery. Photomicrograph of the esophageal tumor (bottom panels) stained with H&E and showing a minute focus of residual epithelial dysplasia, with no residual invasive carcinoma.

Discussion

Synchronous esophageal and lung cancers are not common and, when encountered, present diagnostic and treatment dilemmas. Without accurate staging and knowledge, the patient could be undertreated for a cure or else over-treated inappropriately causing early mortality [7]. A synchronous lung cancer is estimated to occur in 0.5% to 3% of esophageal cancers [8-11]. Most of the cases reported are in the Japanese literature and involve squamous cell carcinoma (Table 1). Our case highlights the possibility of adenocarcinoma presenting as two synchronous primaries requiring immunohistochemical markers to distinguish metastatic versus primary cancers. A case study by Lindenmann et al. [7] highlights the need to be vigilant and mindful of the possibility of two separate primaries occurring concurrently. Initially, their patient with esophageal cancer was deemed to have a lung metastasis and was deemed inoperable. Due to a perforation, the patient underwent esophagectomy and lung resection at the same time. Immunohistochemical studies on the permanent sections determined the lung mass to be a separate primary cancer [7].

Synchronous esophageal and lung cancers in the previous era of large-incision open surgery can provide a survival advantage over the dismal prognosis of relegating these patients to palliative care, which had the best-case survival of 18 months [9]. Even though the morbidity was high in that era of large incisions, with pulmonary complications being prevalent, the 5-year survival was approximately 11% [9]. With the literature documenting proof of concept that synchronous tumors can be resected concurrently with acceptable survival, a more recent study by Zhao et al. [4] showed a 0% mortality in patients with concurrent resections. We believe patients should be offered this therapeutic option instead of staged procedures due to high rates of patients noted to have refused a second operation after their first operation for other diseases [1,3,4].

Although anastomotic or conduit leak represents the most dreaded complication of esophagectomy, other causes of morbidity and mortality for esophagectomy and lung resection include delayed gastric emptying, vocal cord paralysis, airway injury, atrial fibrillation, respiratory failure, pulmonary embolism, myocardial infarction, prolonged air-leak, broncho-pleural fistula, torsion, and cerebrovascular accident [2]. Since pulmonary complications make up most of the morbidity for these operations, patients with questionable lung function must be optimized appropriately prior to an operation. In fact, pneumonectomy was associated with high risk of mortality, such that Fekete et al. [9] cautioned against performing concurrent pneumonectomy with esophagectomy [7]. It is likely that the dissection near the airway, with possible skeletonization of the bronchial stump, and a fresh esophagogastric anastomosis in a pneumonectomy space may increase the risk of bronchopleural fistula and/or empyema [12]. More recent case studies by Fukuda et al. [11] and by Song et al. [13] described more acceptable morbidity and mortality in the setting of concomitant lobectomy and esophagectomy.

As surgeons have developed more minimally invasive strategies for esophageal and lung diseases, numerous studies have demonstrated

Table 1: Patient characteristics of reported cases of concurrent resection of synchronous lung and esophageal cancers.

Author, Year (Ref)	# of study patients	Age(s) or Mean Age (Range)	n(%) synchronous	Esophageal CA Histology	Esophageal CA Location	Esophageal CA Stage	Lung CA Histology	Lung CA Location	Lung CA Stage	Recurrence/ Survival	Remarks
Fukuda et al. [11]	1	69	S=1 (100%)	SCCa	Mid-thoracic		SCCa	RUL			
Morimotot et al. [10]	2	74, 66	S=2 (100%)	SCCa	Mid-thoracic		Adenoca	LUL		74y pt alive at 22-mo follow-up; 66y pt alive at 18-mo follow-up	
Fekete, [9]	39	Mean 58 (46-68)	S=22 (58%)	SCCa	Thoracic=32; Cervical=7	I=7; II=10; III=9; NA=13	SCCa=33; Adenoca=4; Small Cell=2	Lobar=27; Bilobar=5; Lung=7	I=17; II=6; III=1; NA= 15	Synchorous: 12 curative, 11% 5-year survival; palliative, died	Synchrous: 14 operative (12 curative 1-stage surgery; 2 palliative surgery); 8 nonoperative (3 radiation, 1 C-RT, 4 palliative stenting)
Ishii et al. [16]	4	Mean 62.5 (55-69)	S=3 (75%)	SCCa=4	Mid-thoracic=3; Low Thoracic=1	I=1; IIA=2; III=1	SCCa=2; Adenoca=2	RUL=2; RLL=1; LLL=1	IA=1; IB=1; IIA=1; IIB= 1	Variable follow-up (range 10-34 mo); all patients alive	Multimodal treatment, including 2-stage definitive surgery (esophageal and lung resection)
Li et al. [17]	16	Mean 67 (51-76)	S=16 (100%)							87.5% 1-yr Survival	
Shien t al. [18]	6	Mean 75 (69-80)	S=1 (17%)	SCCa	Upper Thoracic=3; Low Thoracic=3	II=2; III=4	SCCa=4; Adenoca=2	RUL=2; RLL=1; LUL=1; LLL=1	IA=6	Variable follow-up: median 25 mo (range 13-73 mo); EC rec=2; alive=4	EC=all 6 with C-RT; salvage surgery in 1; LC=4 segmentectomy, 2 lobectomy, 5 had mediastinal LND; 5 VATS, 1 open
Wang et al. [19]	14	Mean 60.7 (49-76)	S=6 (43%); EC invading lung=8 (57%)	SCCa-12; Adenoca =2	Mid-thoracic=5; Low Thoracic=7		SCCa=1; Adenoca=4; Tuberculosis=1; TE fistula=1	RUL=2; RLL=1; LUL=1; LLL=2		Variable follow-up (range 1-90 mo); 6 of 14 patients alive	1 death immediate postop from cardiopulmonary issues, 1 death by local recurrence, 6 deaths by mets; mean hospital stay=17d (7-30d); 4/14 (30.8%) postop complication rate
Song et al. [13]	1	63	S=1 (100%)	SCCa	Mid-thoracic	IIA	Adenoca		IA	no recurrence after 6 mo	Synchorous esophageal + Lung + thymoma (type AB, stage 1) concurrent (in the sequence) 1. VATS thymectomy, 2. VATS RULobectomy +LND, 3. laparoscopic/ VATS esophagectomy +2-field LND
Zhao et al. [4]	16		S=16 (100%)					Lobar=16; Segmental=3; Pneumonectomy =1			
our Case Report, 2020	1	72	S=1 (100%)	Adenoca	Mid-thoracic	IIIA	Adenoca	RLL	I		

Abbreviations: Adenoca: Adenocarcinoma; CA: Cancer; C-RT: Chemo-Radiotherapy; EC: Esophageal Cancer; LC: Lung Cancer; LLL: Left Lower Lobe; LUL: Left Upper Lobe; LND: Lymph Node Dissection; mets: Metastases; postop: Postoperative; rec: Recurrence; RLL: Right Lower Lobe; RUL: Right Upper Lobe; S: Synchronous; SCCa: Squamous Cell Carcinoma; TE: Tracheo-Esophageal; VATS; Video-Assisted Thoracoscopic.

improved outcomes for both Minimally Invasive Esophagectomy (MIE) and Video-Assisted Thoracoscopic (VATS) lobectomies, with lower rates of pulmonary infections as a primary endpoint. Secondary endpoints of pain score, intraoperative estimated blood loss, hospital length of stay, and quality of life 6 weeks after surgery were significantly better with these less invasive procedures, with no detriment to the oncologic outcomes [4]. Over the last decade, the emergence of robotic-assisted surgery and its refinement have demonstrated even more benefits, as witnessed by the Robot-Assisted Minimally Invasive Esophagectomy (RAMIE) Trial and other studies, such as that by Meredith et al. [5,6,14-20].

The study by Zhao et al. [4] from three high-volume cancer centers demonstrated that combined esophagectomy and lung resection for synchronous primary cancers compared to esophagectomy alone for cancer did not show any excess hospital length of stay, morbidity, or mortality. All those end points were not significantly different between the two groups [4]. Their findings give validation that patients, with synchronous primary cancers of the lung and esophagus and who are appropriate surgical candidates, should be offered surgery for cure and that curative resection can be done concurrently with low morbidity and good long-term survival in the modern era.

Conclusion

We report herein the first successfully performed concurrent robotic-assisted right transthoracic esophagogastrectomy and robotic-assisted pulmonary lobectomy, with an acceptable morbidity and no mortality. Although concurrent robotic-assisted lobectomy and robotic assisted transthoracic (Ivor-Lewis) esophagogastrectomy was associated with postoperative complications related to feeding and nutritional status, we believe this minimally invasive concurrent approach is safe, reproducible, and feasible, thus decreasing the number of patients denied curative surgery for synchronous lung and esophageal cancers. Concurrent lung and esophageal cancer resections also avoid the risk that such patients do not proceed with the second of two staged operations.

Acknowledgement

This case report was presented in part as a poster at the CHEST World Congress 2014 in Madrid, Spain, in March 21-24, 2014.

We gratefully acknowledge Joseph R. Garrett MPH ARNP-C, Nasreen Vohra MD, Dale Y. Han MD, and David H. Kim MD for their assistance with the care of this patient. We also gratefully acknowledge Holly R. May RN, Lindsey Bendure MD, and Christian Sobky BS for their assistance with the initial literature search and review for the preliminary draft of this manuscript.

Informed consent: Permission was obtained from the patient for publication of this case report and any accompanying images for education purposes as part of our institutional surgical informed consent. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Conflict-of-Interest (COI) Disclosures

K.L.M. and E.M.T. have had financial relationships with Intuitive Surgical Inc. in the form of honoraria as robotic surgery proctors and observation sites. No other authors have any COI to disclose. K.L.M. is currently Medical Director for Gastrointestinal Surgical Oncology at Sarasota Memorial Hospital, Sarasota, FL, USA.

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