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# Intrathoracic gastric volvulus complicating a robotic left upper lobectomy: A case report and review of literature

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## ABSTRACT

Unrecognized intrathoracic gastric volvulus can be a life-threatening condition, especially in elderly individuals undergoing major surgical procedures. We herein report the first case of a gastric volvulus after a robot-assisted left upper lobectomy for non-small-cell lung cancer in a patient with a known paraesophageal hernia. The operative procedure was performed by Dr Jacques Fontaine a senior thoracic surgeon at Moffitt Cancer Center in Tampa Florida a major academic institution. This operation was complicated by a large type-III hiatal hernia, with most of the stomach having herniated into the left pleural cavity and demonstrating organo-axial torsion one day after the indexed operation for the lung cancer. The patient required emergency surgery due to gastric ischemia. The patient underwent exploratory laparotomy with reduction of the volvulus and closure of the esophageal hiatus at that time. The patient was taken back to the operating room for a planned relook 24 h after the exploratory laparotomy to assess viability of the stomach. Unfortunately, the second look revealed necrotic areas of the stomach, which required to be resected. Given her age and poor nutritional status, we elected to place a feeding jejunostomy tube. Her postoperative course was marred by an abdominal wound infection treated with a wound vacuum-assisted closure device. Ultimately she was discharged home on POD#19 tolerating a regular diet. This case report highlights that in the elderly patients undergoing left lung resection with a known large hiatal hernia, the index of suspicion for herniation must be high and prompt recognition can avert mortality or morbidity.

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## 1. Introduction

Robot-assisted pulmonary lobectomies are generally better tolerated by elderly individuals compared to open thoracotomies and have gained traction in the United States over the last decade [1]. We herein report a case of intrathoracic gastric volvulus after a robot-assisted left upper lobectomy for lung cancer in a patient with a known hiatal hernia. This work has been reported in line with the SCARE criteria [14].

## 2. Presentation of case

The patient is a 79-year-old female with a remote history of smoking, chronic obstructive pulmonary disease, obesity,

long-standing gastroesophageal reflux disease, and a prior hysterectomy. She presented to our cancer center for evaluation of a left upper lobe primary lung cancer.

During the work-up for a dry cough and dyspnea in 2017, the patient underwent chest computed tomography (CT), which revealed a 1.7-cm left upper lobe lung nodule. Follow-up interval CT scans in 2018 and 2019 by her local physician demonstrated steady nodule growth. Her most recent CT scan in August 2020 showed that the left upper lobe pulmonary nodule had grown in size from 1.7 cm to 3.2 cm (Fig. 1). A positron emission tomography (PET)/CT scan demonstrated hypermetabolism in the left lung nodule, with maximum standardized uptake value (SUVmax) of 10.2 g/mL, but without any associated adenopathy or distant disease (Fig. 2). Navigational bronchoscopy with needle biopsies confirmed a left upper lobe non-small-cell carcinoma consistent with adenocarcinoma that had a clinical stage of cT2N0M0, cStage Ib.

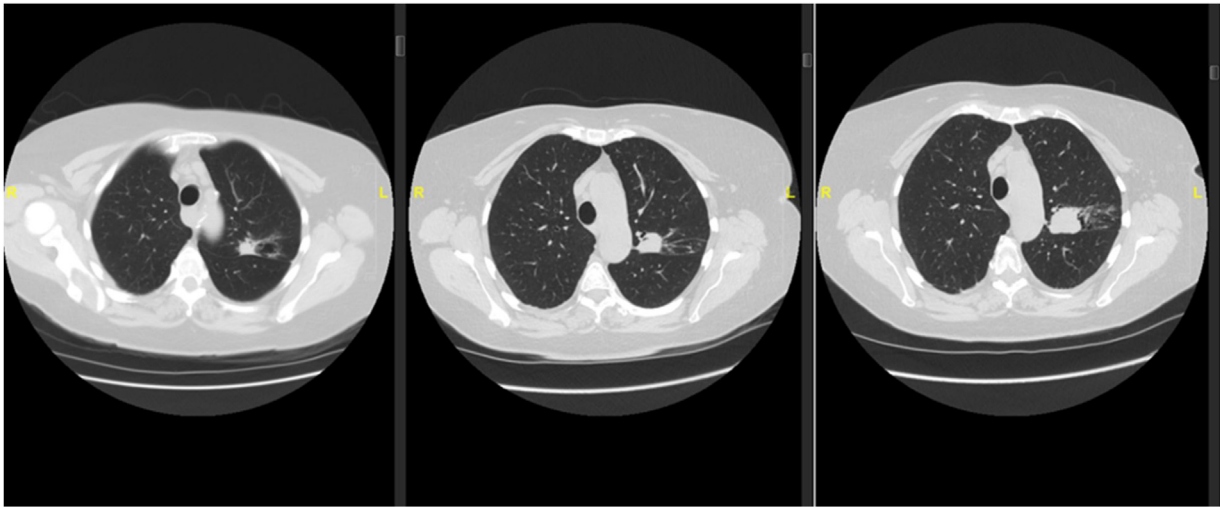
Her CT scan did reveal a paraesophageal hernia (Fig. 3). However, upon further assessment, the patient did not complain of any symptoms, except for occasional gastroesophageal reflux. She stated that

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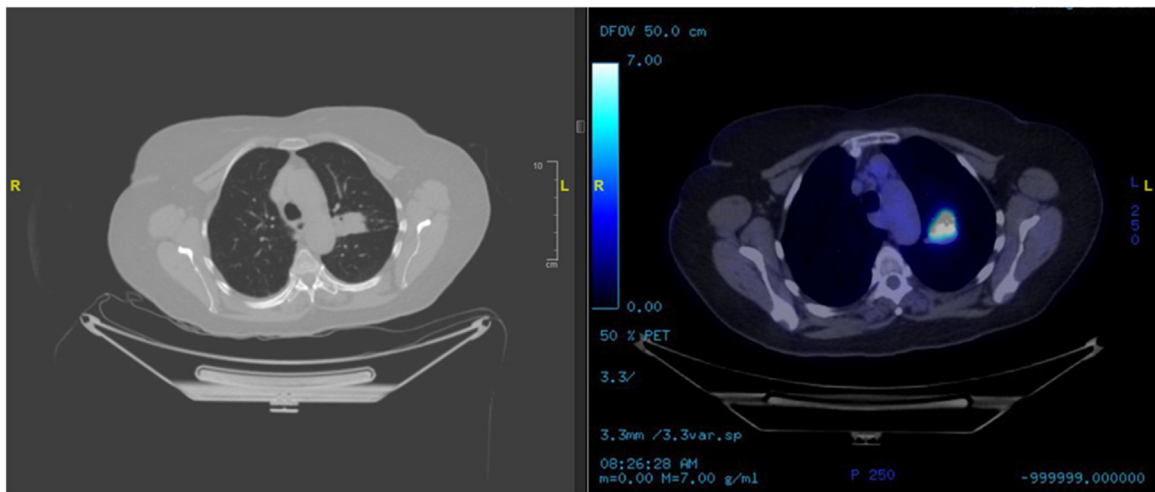
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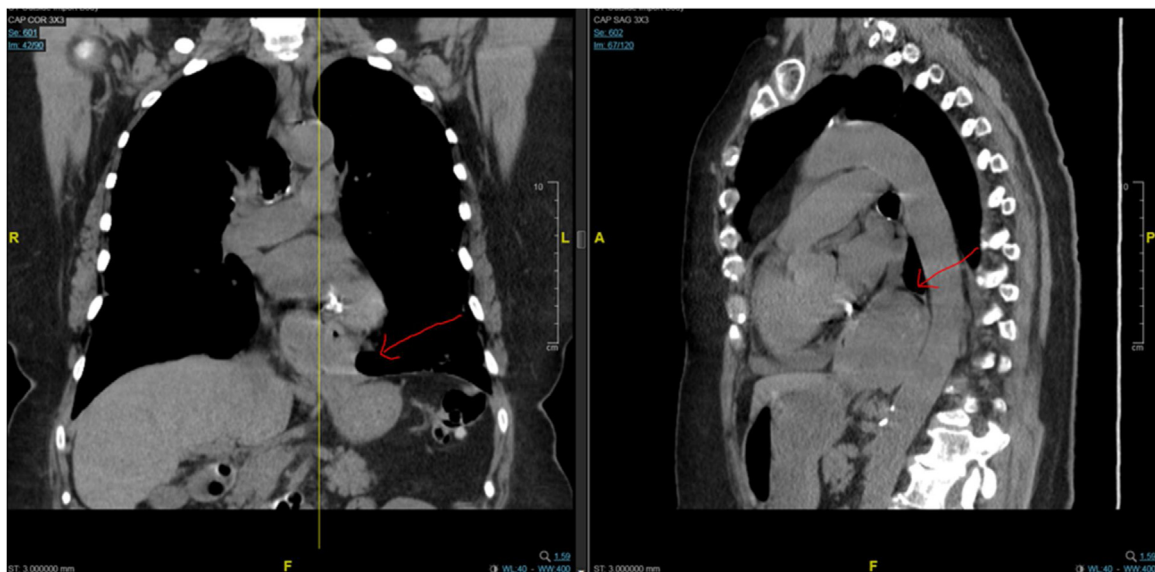
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**Fig. 1.** Axial images from computed tomography (CT) images taken in 2017 (left panel), 2019 (middle panel), and 2020 (right panel) showing preoperative progression of the left upper lobar lung nodule.



**Fig. 2.** Preoperative axial computed tomography (CT) images (left panel) and fused positron emission tomography (PET)/CT axial image (right panel) showing the fluoro-deoxy-glucose (FDG)-avidity of the left upper lobar lung nodule (right panel).



**Fig. 3.** Large paraesophageal hernia (arrows) shown in coronal (left panel) and sagittal (right panel) images from preoperative computed tomography (CT) images.

her local gastroenterologist had previously mentioned the presence of a hiatal hernia but had not recommended surgical correction.

In September 2020, the patient underwent an uneventful robot-assisted left upper lobectomy, with complete mediastinal lymph node dissection, using the daVinci® Xi™ robotic surgical platform (Intuitive Surgical Inc., Sunnyvale, CA, USA). All our robot-assisted pulmonary lobectomies are performed with temporary CO<sub>2</sub> insufflation through two 8-mm ports and two 12-mm ports using the da Vinci Xi robotic platform. Our standardized technique is described in detail elsewhere [2]. The operation lasted 102 min, with an estimated blood loss of 25 mL and no intraoperative issues. The patient's immediate postoperative upright portable chest X-ray (anterior–posterior [AP] view) taken in the recovery room after left upper lobectomy showed normal diaphragm position and adequate left lower lobe expansion. Surgical pathology confirmed a pT2N0M0 adenocarcinoma, with negative surgical margins. A total of 19 hilar and mediastinal lymph nodes were resected, none of which showed evidence of malignancy.

As per our standardized Enhanced Recovery after Surgery protocol, the patient's urinary catheter and arterial line were removed in the postanesthesia care unit, after which she was transferred to our telemetry ward. Within 6 h postoperatively, the patient consumed a meal and ambulated while breathing easily on room air. On the first postoperative night, she became hypotensive but responded to a 500 mL bolus of intravenous (IV) fluids. By the morning of postoperative day #1 (POD#1), she started complaining of substernal chest pressure, dysphagia, and had another episode of mild hypotension that required another IV fluid bolus. Her laboratory tests on the morning of POD#1 demonstrated evidence of hypoperfusion, with an increase in both creatinine (from 1.1 mg/dL to 1.6 mg/dL) and liver transaminases. Upright portable chest X-ray (anterior–posterior [AP] view) taken on postoperative day #1 after left upper lobectomy showed the gastric fundus had herniated into the left chest with left lower lobe compression. A CT scan (Fig. 4) on the morning of POD#1 confirmed evidence of a large incarcerated hiatal hernia.

A nasogastric (NG) tube was promptly placed to decompress the stomach, and the patient responded well to IV fluid resuscitation. Although the NG tube initially drained 1200 mL of food and clear gastric fluid, its output over the subsequent 4 h became bloody rather than bilious. The patient was brought to the operating room in the afternoon of POD#1 for an exploratory laparotomy, subsequently confirming the presence of a large type-III hiatal hernia, with most of the stomach having herniated into the left pleural cavity and demonstrating organo-axial torsion. The stomach was gently reduced, the torsion corrected, and the esophagus mobilized sufficiently to allow the gastro–esophageal junction to return into the abdomen without any tension. No evidence of a shortened esophagus was noted. The hiatus was closed primarily by reapproximating the right and left crura with interrupted, pledgeted silk sutures. Although severe ischemia was observed in two areas of the stomach by Esophagogastroduodenoscopy, no evidence of transmural necrosis or perforation was present. Therefore, a second-look laparotomy after 24 h had been planned to evaluate for gastric perfusion and viability.

The patient was extubated in the operating room and transferred to the intensive care unit for monitoring. Over the next 24 h, the patient remained hemodynamically stable without the need for vasopressors and had adequate urine output without any additional IV fluid resuscitation. She was feeling much better and was able to ambulate. Her creatinine and liver transaminases were trending back toward normal values.

As planned, the patient returned to the operating room in the afternoon of POD#2 for the 24-hr reassessment of gastric perfusion and viability. Gastric perfusion was adequate, except for the same two areas noted previously, which were now necrotic and

well-demarcated (Fig. 5). Both necrotic areas were resected via wedge resection (partial gastrectomy) using the Signia™ endostapler with black stapler loads (Medtronic, Fridley, MN, USA). The gastric staple line was reinforced using several imbricating silk sutures and covered by a pedicled well-vascularized portion of omentum (omentoplasty). A feeding jejunostomy tube was placed for postoperative nutrition, and a 19-Fr drain was placed in the upper abdomen.

Her chest X-ray on the day after the 2nd abdominal exploration (POD#3) showed a reduction in the hiatal hernia, with the stomach being below the diaphragm. From a pulmonary standpoint, the patient had no air leak following her left upper lobectomy, and her chest tube was removed on POD#3 after the left upper lobectomy. She remained on a proton-pump inhibitor and *nil per os* for the next 7 days until a barium swallow and CT scan confirmed no contrast extravasation from the partial gastrectomy staple line. She slowly increased her oral intake, weaned off tube feeding, and had her jejunostomy tube removed. The remainder of her postoperative course was complicated by an infection at her laparotomy incision that required drainage and placement of a wound vacuum-assisted closure device (Kinetics Concepts Inc. [KCI]; San Antonio, TX, USA) on POD#10. She was discharged to home tolerating a regular diet on POD#19. At 2 month follow up she is tolerating a diet with no reflux and her abdominal wound has healed. Her performance status has improved to the level prior to her lung resection.

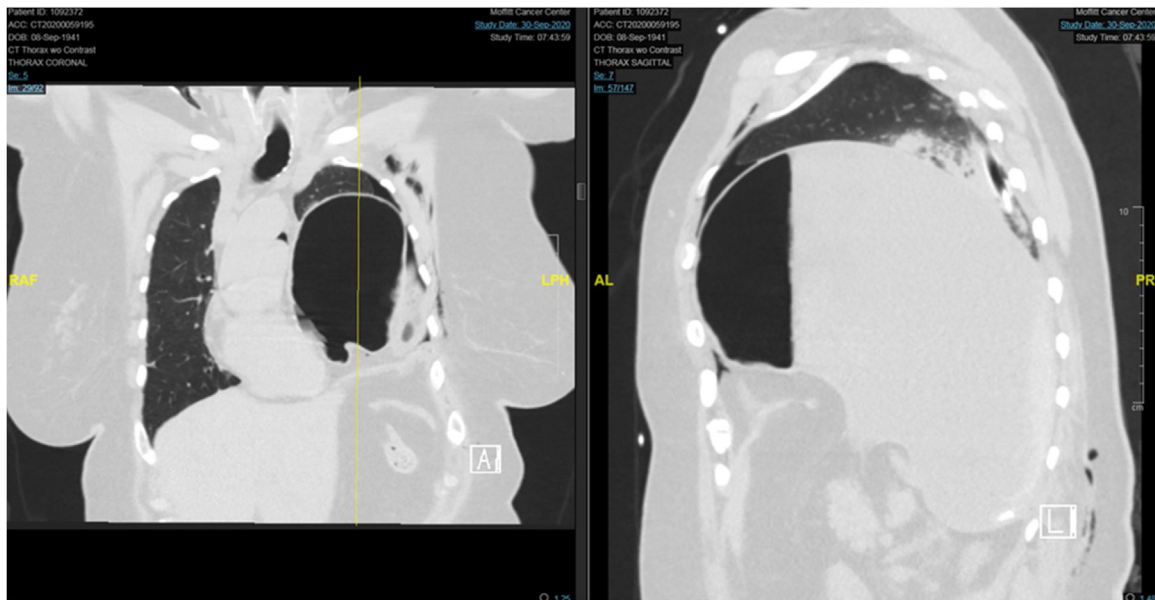
### 3. Discussion

Although gastric volvulus has been conventionally considered an intra-abdominal condition, reports have revealed an intrathoracic variant, which, although uncommon, is considered a surgical emergency due to the risk of ischemic necrosis, perforation, and serious cardiorespiratory compromise. Therefore, prompt diagnosis and treatment are imperative [3].

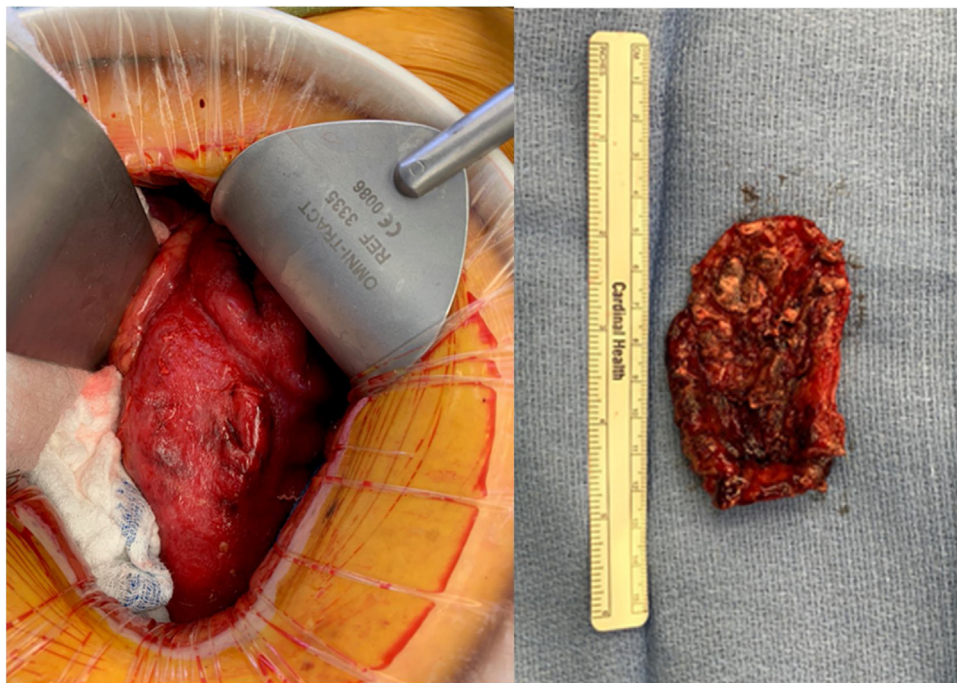
Our review of the literature revealed nine reported cases of gastric volvulus resulting from pneumonectomy or lobectomy, among which only three have been associated with lobectomies (see Table 1) [4–7,9–13]. Gastric volvulus can be categorized as organo-axial, mesentero-axial, or a combination of both, although organo-axial has been the most common. An organo-axial volvulus occurs when the stomach rotates along its long axis, placing the greater curvature anteriorly and the lesser curvature posteriorly [4]. On the other hand, a mesentero-axial volvulus occurs when the stomach rotates along its short axis, placing the antrum anteriorly and superiorly [4]. The intrathoracic variant of gastric volvulus is almost always associated with a known pre-existing hiatal hernia and more likely occurs following a left pneumonectomy [4,8–11] and rarely after lobectomies [5–7].

We herein report the first intrathoracic volvulus following a robot-assisted left upper lobectomy, which occurred in the acute setting within 24 h of the index operation. Our patient had been known to have a chronic, moderate-sized hiatal hernia, which was only mildly symptomatic and caused occasional gastro–esophageal reflux. Given that she had presented for left lung cancer treatment, we decided to proceed with lung resection and address her hiatal hernia at a later date. We routinely divide the inferior pulmonary ligament and remove level 9 mediastinal lymph nodes during an oncologic lung resection. This division of the inferior pulmonary ligament is what we believe weakened the mediastinal hernia sac and contributed to the herniation and torsion of the stomach. Furthermore, the patient had increased negative intrathoracic pressure and positive intra-abdominal pressures following surgery, which increased her risk of gastric herniation and volvulus. Her negative intrathoracic pressure was increased by the suction (–20 cmH<sub>2</sub>O) applied to the chest tube drainage in addition to having a par-





**Fig. 4.** Coronal (left panel) and sagittal (right panel) computed tomography (CT) images taken on postoperative day #1 after left upper lobectomy and showing the incarcerated stomach in the left chest.



**Fig. 5.** Serosal gastric changes observed during exploratory laparotomy (left panel) and everted gastric wedge resection showing necrotic mucosal tissue (right panel).

tially empty pleural space following left upper lobectomy. This negative intrathoracic pressure was further increased by encouraging the patient to use their incentive spirometer. Moreover, the coughing requested of our patients as part of their pulmonary toilet after lung resection promoted bouts of significantly increased intra-abdominal pressures.

Although the optimal treatment for gastric volvulus has yet to be determined, this would depend on the site of volvulus and herniation. Rashid and colleagues recommended that the patient be kept in the prone position upon diagnosis of this condition and an NG tube be inserted to facilitate decompression [3]. Immediate surgical consultation should then be obtained, particularly in cases of acute volvulus, which carry increased risks for vascular compro-

mise and death [3]. However, Tsang and associates reported that endoscopic de-rotation was successful on the first attempt in 7 of 8 patients who had the abdominal variant [12]. The intrathoracic variant almost always requires surgical treatment, including hernia reduction, hiatus repair, and possible gastropexy.

Our patient initially underwent gastric decompression with an NG tube following the resolution of her symptoms. However, upon noting the presence of blood in the NG tube aspirate, gastric ischemia was suspected, for which prompt surgical exploration with correction was performed. Despite prompt surgical exploration within hours of symptom onset, the patient developed two small areas of gastric necrosis requiring excision, albeit saving most of her stomach and allowing a full recovery.

**Table 1**  
Patient characteristics of reported cases of gastric volvulus after pulmonary resection.

Author, Year [Ref#]	Sex	Age	Time after Lung Resection	Laterality/Type of Lung Resection	Intra-abdominal/Intrathoracic	Volvulus Type	Hiatal Hernia	Management
Young, 1957 [6]	F	33	1 year	Left Lower Lobectomy	Intra-abdominal	Not Described	Unknown	Gastrostomy
Creedon, 1965 [13]	F	38		Bilateral Lower Lobectomies	Intra-abdominal	Organo-axial	No	
Carlisle, 1967 [9]	M	65	2 years	Left Pneumonectomy	Intra-abdominal	Mesentero-axial	No	Gastrostomy
Simoens, 1994 [5]	M	75	17 days	Left Upper Lobectomy	Intrathoracic	Not Described	Yes	Gastrostomy & hiatal hernia repair
Blum, 2006 [8]	M	54	1 day	Left Pneumonectomy	Intrathoracic	Not Described	Yes	Hiatal hernia repair & Nissen fundoplication
Batirel, 2007 [10]	M	61	33 years	Left Pneumonectomy	Intra-abdominal	Mesentero-axial	No	Laparoscopic Toupet fundoplication & gastrostomy
Thorpe, 2007 [11]	F	69	5 months	Left Pneumonectomy	Intrathoracic	Not Described	Yes	Trans-mesocolic gastrojejunostomy & hiatal hernia repair
Tokuishi, 2008 [7]	F	73	30 days	Left Lower Lobectomy	Intra-abdominal	Mesentero-axial	No	Alpha-loop endoscopic reduction
Farber, 2015 [4]	M	18	13 years	Left Pneumonectomy	Intra-abdominal	Mesentero-axial	No	Gastrostomy & lateral Stamm gastrostomy
Our Case Report, 2020	F	79	1 day	Left Upper Lobectomy	Intrathoracic	Organo-axial	Yes	Hiatal hernia repair; 2nd-look partial gastrectomy/omentoplasty

**4. Conclusion**

Clinicians must be aware that patients presenting with a left lung resection and who have a concomitant hiatal hernia are at risk for developing gastric herniation and volvulus following surgery. Despite being an exceedingly rare complication, early recognition and prompt treatment is imperative to avoid possible mortality.

**Declaration of Competing Interest**

J.P.F. and E.M.T. have had financial relationships with Intuitive Surgical Inc. in the form of honoraria as robotic thoracic surgery proctors and observation sites. No other authors have any conflict of interest to disclose.

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**Ethical approval**

This is a case report and review of the available literature of an uncommon condition.

**Consent**

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

**Author contribution**

*Study concept or design:* Sirish Parvathaneni MD, Eric Toloza MD PhD, and Jacques Fontaine MD.

*Data collection:* Sirish Parvathaneni MD, Martha Penafiel MD, Joseph Garrett MPH ARNP-C1, Eric Toloza MD PhD, and Jacques Fontaine MD.

*Data analysis or interpretation:* Sirish Parvathaneni MD, Eric Toloza MD PhD, and Jacques Fontaine MD.

*Writing the paper:* Sirish Parvathaneni MD, Eric Toloza MD PhD, and Jacques Fontaine MD.

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**Registration of research studies**

Not applicable.

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Sirish Parvathaneni MD.  
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