

# Gastric Volvulus, a Delayed Surgical Complication After Debulking and HIPEC for Advanced Ovarian Cancer - A Case Report and Review of Literature

Souad Ghattas\*, Hani Maalouf, Ribal Aby Hadeer, Fawzi Elias, Hadi Khaled Abou Zeid, Anthony Kahy and Raja Wakim

Department of General Surgery, Mount Lebanon Hospital University Medical Center, University of Balamand, Beirut, Lebanon

## Abstract

Gastric volvulus in conjunction with diaphragmatic hernia is an uncommon but life-threatening presentation that is usually associated with congenital para-esophageal hernia and traumatic diaphragm injury. However, it has been rarely described with cytoreductive surgery followed by hyperthermic intraperitoneal chemotherapy (HIPEC). We herein report the case of a 68-year-old woman presenting with signs and symptoms of acute upper gastro-intestinal (GI) obstruction with back and chest pain, 3 years after debulking surgery and HIPEC for peritoneal carcinomatosis secondary to advanced ovarian cancer. A diagnosis of gastric volvulus was established based on gastroscopy, barium swallow, and computed tomography (CT) scan, and urgent laparotomy revealed a rotated stomach adherent to the spleen and left diaphragm. After reduction, a diaphragmatic defect that was missed on CT scan was discovered and repaired, and the patient recovered uneventfully. Diaphragmatic hernia with gastric volvulus can occur many years after cytoreductive surgery and HIPEC despite initial diaphragm intactness, and should be suspected in this patient population when they present with upper GI obstruction.

**Key words:** Gastric volvulus • Diaphragmatic hernia • Cytoreductive surgery • Hyperthermic intraperitoneal chemotherapy (HIPEC)

## Introduction

Eventration of diaphragm is an abnormal elevation of an intact diaphragm and most often is characterized by a developmental abnormality of the diaphragm musculature. This provides the potential for gastric volvulus [1]. It is a rare entity defined as an abnormal rotation of the stomach around its short or long axis leading to variable degrees of gastric inlet and outlet obstruction [2]. An acute episode of gastric volvulus can have a mortality of 30 to 50%, hence the importance of early diagnosis and treatment [3]. We report a case of a 68-year-old patient presenting three years post cytoreductive surgery and HIPEC, with gastric outlet obstruction, found to have a gastric volvulus secondary to diaphragmatic eventration.

## Case Report

This is the case of a 68-year-old female patient diagnosed with advanced ovarian cancer complicated with peritoneal carcinomatosis in December 2018. Patient received neoadjuvant chemotherapy then underwent interval debulking in February 2019. Intraoperative evaluation showed peritoneal carcinomatosis involving the pelvis, the omentum and the undersurface of both diaphragmatic domes leading to a peritoneal cancer index, according to Sugar baker of 14. The patient underwent pelvic peritonectomy with total hysterectomy and bilateral salpingo-oophorectomy, appendectomy, omentectomy and bilateral

subphrenic peritonectomy yielding a completeness of cytoreduction (CC) score of 0. When the surgical procedure ended, hyperthermic intraperitoneal chemotherapy (HIPEC) was given with 40 mg Mitomycin C over 90 minutes using the closed abdomen technique. She received an additional five cycles of chemotherapy after surgery. Patient was doing regular follow up with PET scan and CA 125 and was in remission till June 2021, when she was readmitted for intestinal obstruction that was treated conservatively. During this event, CT scan of the abdomen and pelvis showed marked dilatation of the jejunal and ileal loops with a transition zone possibly located in the right lower quadrant, the stomach is not distended and no diaphragmatic hernia was seen. We also noted the presence of moderate ascetic fluid surrounding the small bowel loops and peri gastric region. Ascitic TAP cytology was taken and returned positive for cancerous cells compatible with the known ovarian cancer of the patient. The patient received five new cycles of chemotherapy with Avastin and Carboplatin-Taxol between July 2021 and September 2021. Follow up PET scan in November 2021 was negative and patient was put on Femara which she did not tolerate, so she was switched to Arimidex. On March 2022, this patient presented to our emergency department with two days history of upper abdominal discomfort, nausea, recurrent retching, production of little non bilious vomiting with food content, constipation, and back pain radiating to the chest with no other complaints. On physical exam, abdomen was soft, non-distended with epigastric tenderness, hypoactive bowel sounds, and a huge incisional hernia from the previous surgery. Vitals were stable. Laboratory results were within the normal range. CT scan abdomen pelvis with IV contrast showed significant gastric distension with air fluid level proximal to the antropyloric region with collapse of the duodenum and distal bowels (Figure 1).

First, nasogastric tube (NG) decompression was done and drained two liters of water and food content without bile. Then a gastroscopy was done and showed the pylorus near the cardia in favor of gastric volvulus or rotation (Figure 2). The gastroscopy was completed with a barium swallow that confirmed the presence of a gastric volvulus and rotation. The contrast was seen in the duodenum and proximal bowel loops after 11 minutes, suggestive of stasis in the stomach with a reflux reaching the upper third of the oesophagus (Figure 3).

Patient was scheduled for urgent surgery. A midline laparotomy was performed where a large abdominal defect was encountered from the previous surgery, and multiple peritoneal deposits were identified. After careful

\*Address for Correspondence: Souad Ghattas, Department of General Surgery, Mount Lebanon Hospital University Medical Center, University of Balamand, Beirut, Lebanon, Tel: +9613721876; E-mail: souadnajibghattas@gmail.com

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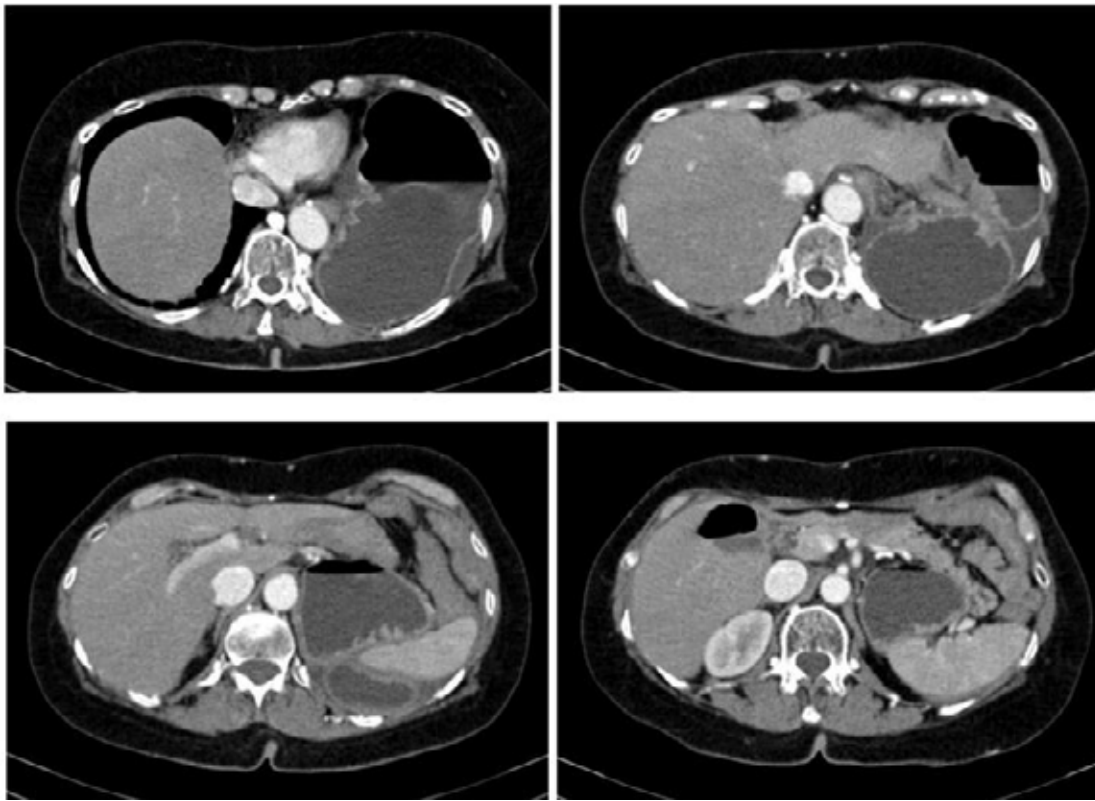


Figure 1. Transversal view of CT scan abdomen and pelvis showing significant gastric distension with air fluid level proximal to the antro-pyloric region with collapse of the duodenum.

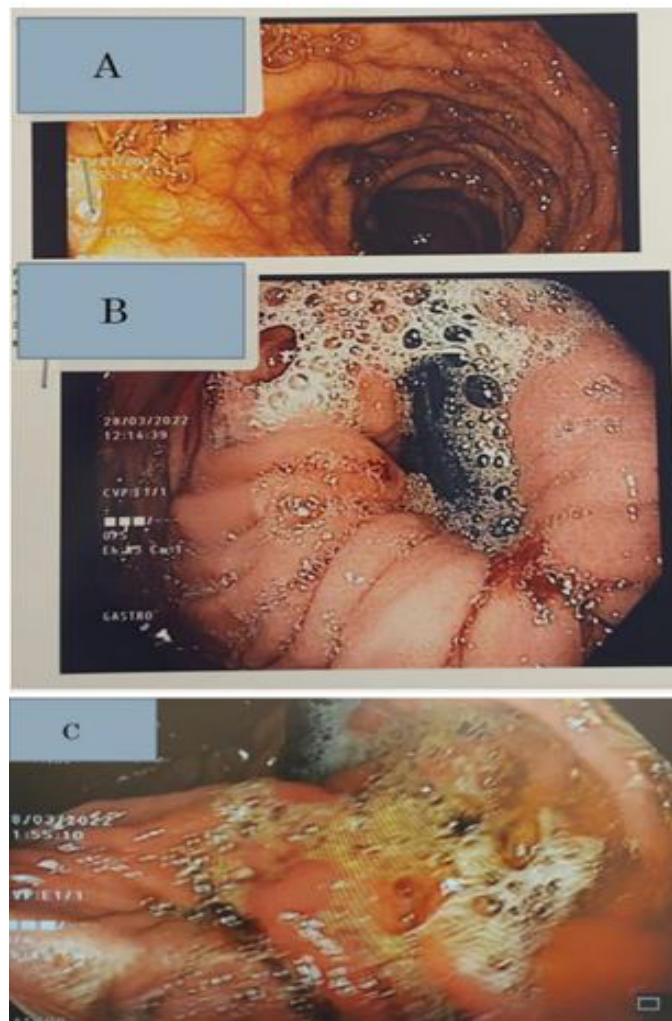


Figure 2. Gastroscopy (A), Duodenum (B) and Pylorus (C) Pylorus near the Cardia.

adhesiolysis, the gastric volvulus was visually confirmed and was adherent to the spleen and left diaphragm. After reduction of the stomach, we noted the presence of a huge left diaphragmatic eventration which allowed the stomach to move through the thoracic cavity and lead to the gastric volvulus.

The diaphragm was closed primarily using a continuous full thickness suture using Polydioxanone (PDS) 1 and a chest tube was inserted. A gastropexy was done on the left side and the large incisional hernia was repaired using PDS 1 interrupted figure of eight sutures (Figure 4). Pathology of peritoneal deposits

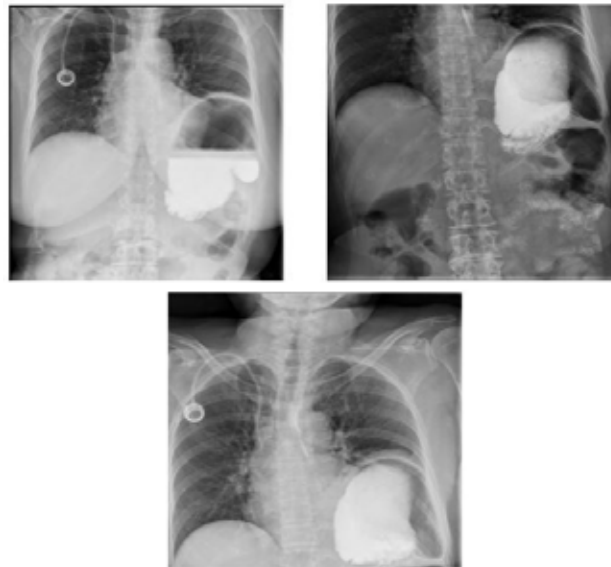


Figure 3. Barium swallow showing stomach upside down and with mirror image of normal anatomy suggestive of gastric volvulus/rotation.

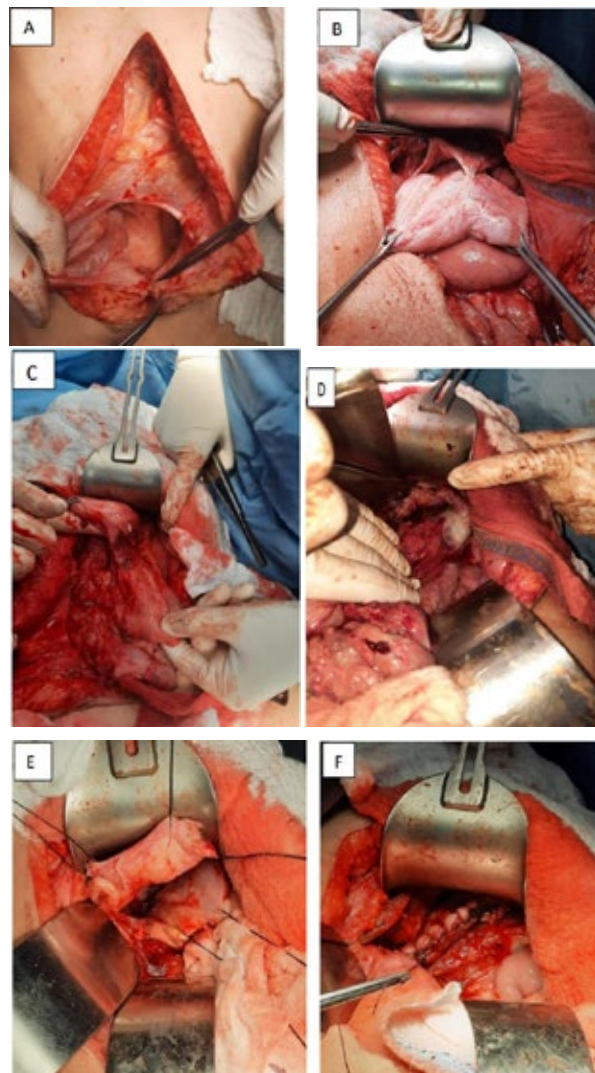


Figure 4. (A) Large abdominal defect, (B) Gastric volvulus adherent to the spleen and left diaphragm, (C) Gastric volvulus and adhesions, (D & E) Left diaphragmatic eventration and (F) Closure of the diaphragm using a continuous full thickness suture with PDS 1.

returned positive for metastatic deposits of a tubulo-papillary adenocarcinoma consistent with the known primary cancer in the ovary. The postoperative course was uneventful. The patient soon recovered completely and was discharged on day 6 post op (Figure 5).

## Discussion

Gastric volvulus is a rare entity defined as an abnormal rotation of the stomach around itself. Berti was the first to describe it in 1866 as an autopsy finding and Berg was the first to treat it surgically in 1897 [1]. The peak age group of incidences is in the fifth decade with children less than one year of age making up 10-20% of cases. The mortality rates for acute volvulus range from 30 to 50%, highlighting the importance of early diagnosis and treatment [3]. Gastric volvulus can first be classified based on the etiology. Primary gastric volvulus is associated with tumors, adhesions and problems in the normal ligamentous attachments of the stomach. However, secondary gastric volvulus is the most common and is associated with disorders of gastric motility and anatomy or with issues related to neighboring structures like the diaphragm and spleen. In adults, secondary gastric volvulus is usually associated with paraesophageal hernia and traumatic diaphragm injury. The second classification of volvulus is according to the axis of rotation. The first type, type I (A), is organo-axial, where the rotation occurs along the longitudinal axis connecting the gastro-esophageal junction with the pylorus so that the antrum moves from an inferior to superior position; this occurs in 60% of cases. This subtype is associated with paraesophageal hernias and diaphragmatic eventration. The second type, type II (B) is mesentero-axial volvulus, defined as a rotation along the vertical axis extending from the liver to the greater curvature; this occurs in 30% of cases. Type III (C) is the rarest, and is a combination of organoaxial and mesentero-axial rotations (Figure 6). Type IV is unclassified and occurs in 10% of cases. Finally, gastric volvulus is generally recognized as an intra-abdominal condition, but there are reports of intra thoracic gastric volvulus that is considered a surgical emergency due to the risk of ischemia, necrosis, perforation, and cardiorespiratory compromise [3]. Our patient was classified as secondary type and type II gastric volvulus with mesentero-axial rotation, the pylorus was seen near the cardia and it was intrathoracic due to diaphragmatic eventration.

The signs and symptoms of gastric volvulus depend upon the rapidity of onset, the degree of rotation, the chronicity, the degree of obstruction, and whether the volvulus is above or below the diaphragm. Classic symptoms of acute gastric volvulus are known as Borchardt's triad which consist of retching without vomiting, severe epigastric pain and inability to pass NG tube [4]. Patients with unilateral diaphragmatic eventration are generally asymptomatic; however, some complain of dyspnea on exertion or rarely orthopnea, due to

the decrease in ventilation and oxygenation because of paradoxical motion of the affected diaphragm during inspiration and expiration. The severity of either symptom depends on presence or absence of underlying pulmonary disease [1]. This complication is sometimes overlooked until strangulation of hernial content occurs. Gastrointestinal symptoms may even predominate when related to volvulus of the stomach with intermittent or complete outlet obstruction [5]. In our case, the patient presented with symptoms of gastric obstruction and in an acute setting. The diagnosis of gastric volvulus is usually based on barium studies. Plain radiographs may give a clue to suspect this condition, but most patients undergo an abdominal CT scan to confirm the diagnosis where an upside-down stomach with the pylorus higher than gastro-esophageal junction is seen [6]. In our case CT scan was not sufficient to have a diagnosis since it only showed gastric outlet obstruction, so a barium swallow test was needed to confirm the diagnosis of volvulus. Endoscopy also helped to visualize the volvulus so it can be considered as a mean to diagnose gastric volvulus. Initial management is nasogastric decompression to decrease the intragastric pressure followed by surgery to check gastric viability, resect gangrenous portion, and perform de-rotation and gastropexy with or without gastrostomy with repair of secondary factors. Emergent laparotomy is still the most common surgical option for patients with gastric volvulus, though laparoscopic interventions have been described. Surgical reduction with or without gastropexy is the most frequently performed procedure [2]. Tanner found good long-term follow-up results after colonic dislocation associated with anterior gastropexy. This procedure consists of separation of the transverse colon from the stomach and sectioning of the gastrocolic ligament, then the small gastric curvature is attached to the hepatic capsule and the transverse colon is attached to the left subphrenic space [7]. Symptomatic gastric volvulus associated with diaphragmatic eventration is a surgical emergency and always requires surgical repair. The most widely accepted approach is repair via an abdominal subcostal incision because this allows ready access to both diaphragms for plication, permits anterior gastric fixation via a gastropexy or gastrostomy, and allows abdominal exploration for associated gastrointestinal anomalies [1]. In our case, gastric volvulus was due to diaphragmatic eventration after cytoreductive surgery related to advanced ovarian cancer. Peritoneal invasion is a common feature in patients with primary, advanced or recurrent ovarian cancer. The volume of residual disease is an important prognostic indicator in patients with advanced ovarian cancer. For a desirable surgical outcome, the patient should undergo an extensive cytoreductive surgery to obtain microscopic residual disease. An aggressive surgery, as in other peritoneal carcinomatosis, including HIPEC is needed. The most frequent complications of cytoreductive surgery and HIPEC are anastomotic leakage, digestive perforations, fistulas, and abscesses. Diaphragmatic complications are rare, but should be considered, especially when peritonectomy of the upper quadrants was performed, even in the absence of diaphragmatic resection [8].

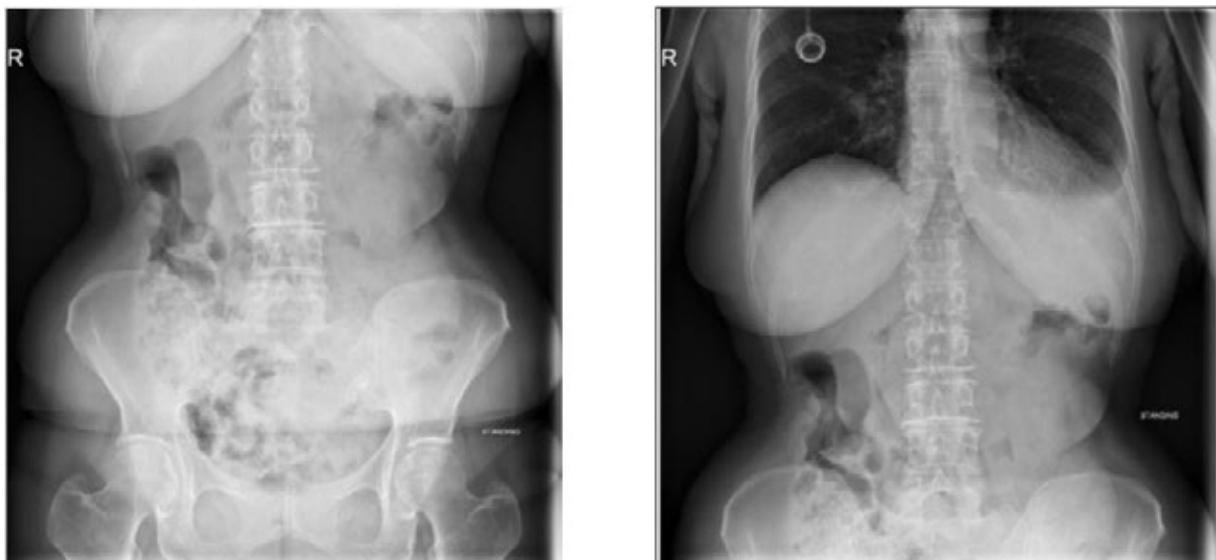
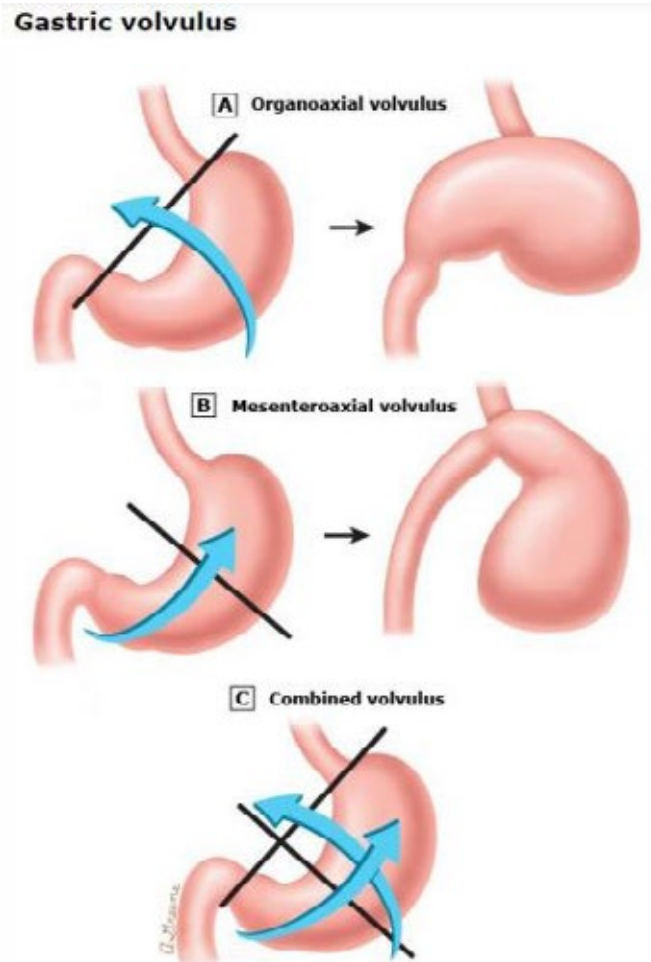


Figure 5. Post-operative KUB.

In patients with advanced ovarian cancer, the diaphragm is frequently involved and generally must be stripped or resected in order to achieve complete gross resection. While the most common complication after diaphragm peritonectomy/ resection during debulking is symptomatic pleural effusion, a very rare complication is herniation of the stomach or bowel through the diaphragm into the thoracic cavity [9]. To date, only eight cases of diaphragmatic hernia post cytoreductive surgery were found after a review in the literature done using PUBMED engine (Table 1). Male to female ratio was 1:3 and age at presentation

ranged from 19 to 65 years of age. Five cases report diaphragmatic hernia post cytoreductive surgery for ovarian cancer, two cases post-surgery for pseudomyxoma peritonei and one case post cytoreductive surgery for gastric cancer. Four of these cases underwent HIPEC and four patients presented with gastric volvulus as our case. Three of the cases presented with signs of intestinal obstruction as was our case otherwise the others were incidental findings. Two of the cases were diagnosed intraoperatively as was our case



**Figure 6.** (A) Organoaxial volvulus results from rotation along the long axis of the stomach from the gastroesophageal junction to the pylorus, (B) Mesenteroaxial rotation occurs with rotation along the transverse axis such that the pylorus rotates above the gastroesophageal junction and (C) Combined volvulus results from a combination of both.

**Table 1.** Literature review of all the diaphragmatic hernia post cytoreductive surgery reported in the reviewed literature.

Publication	Age	Sex	Clinical presentation	Etiology	Diagnosis	Timeline	Treatment
Lampl B, et al. [8]	36	M	Incidental finding on regular follow-up, chest pain, and dyspeptic disorder	Left diaphragmatic Hernia	CT	N/A	Surgical
Lampl B, et al. [8]	65	M	Pleural effusions, leftsided pneumonia with elevated inflammatory markers	Anastomotic leak of the left colonic flexure communicating with the left hemithorax	Incidental finding in surgery	2 weeks	Surgical
Caronna R, et al. [10]	51	F	Gastric outlet obstruction	Gastric Volvulus secondary to left diaphragmatic hernia	Incidental finding in surgery	1 month	Surgical
Mestre A, et al. [5]	19	F	Abdominal pain, vomiting, and watery diarrhea	Gastric Volvulus secondary to left diaphragmatic hernia	CT	4 months	Surgical
Ehmann S, et al. [9]	36	F	Nausea and vomiting	Gastric incarceration secondary to left diaphragmatic hernia	CT	5 months	Surgical
Ehmann, et al. [9]	50	F	N/A	Left diaphragmatic hernia	N/A	18 months	Surgical
Ehmann S, et al. [9]	45	F	Incidental finding on regular follow-up. Initially asymptomatic then developed belching and infrequent right upper discomfort	Gastric incarceration secondary to left diaphragmatic hernia	CT	6 months	Surgical
Ehmann S, et al. [9]	56	F	Incidental finding on regular follow-up	Left diaphragmatic hernia	CT	8 months	Surgical

however the rest of the cases were identified preoperatively using CT scan. Time from cytoreductive surgery to diaphragmatic hernia presentation was two weeks to one and a half year; our patient had a late presentation after three years. All were treated surgically like our case. diaphragm and might cause some ischemia, which makes it more vulnerable to herniation. In addition, a HIPEC procedure, even for a short time with the closed abdomen technique, can cause intra-abdominal pressure to increase and in turn might put a patient who has received peritonectomy of the diaphragm at higher risk of developing a diaphragmatic hernia. Second, neoadjuvant chemotherapy may increase friability of the diaphragm and risk of complications [10]. A hernial defect will not close on its own and will likely only expand over time; thus, intraoperatively, the diaphragm must be checked for defects using the "bubble test". The patient is positioned in Trendelenburg and the upper quadrant is filled with normal saline. Air bubbles with inspiration indicate a defect in the diaphragm. Even the smallest defect should be closed primarily to prevent the possible development of a hernia or other sequelae such as pneumothorax or bowel strangulation and incarceration. The thoracoabdominal pressure gradient will lead to widening of the diaphragmatic defect, allowing abdominal contents to herniate into the thoracic cavity. A monofilament, nonabsorbable or long-lasting absorbable suture like Polypropylene or Polydioxanone suture can be used to repair a diaphragm defect [9].

## Conclusion

In this article, we present a case report of diaphragmatic hernia with gastric volvulus three years after cytoreductive surgery and HIPEC. This complication is very rare, and according to the available data, it usually presents months after management. This case report proves that diaphragmatic hernia with gastric volvulus should be on the differential even years after cytoreductive surgery and HIPEC. Surgical management remains the treatment of choice and can be an emergency in obstructive cases.

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Faculty of Medicine and Medical Sciences, University of Balamand, Lebanon.

## Ethical Approval

Case report approved for publishing by ethical committee at Mount Lebanon Hospital, University

Medical Center and Head of General Surgery division.

## Informed 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

Souad Ghattas MD, Hani Maalouf MD, Ribal Aby Hadeer MD, Fawzi Elias MD, Hadi Abou

Zeid MD, Anthony Kahy MD, Raja Wakim MD (Corresponding Author).

## Declaration of Competing Interest

The authors report no conflict of interest.

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