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Original Article

Radiology Section

MDCT appearance of Organoaxial, Mesenteroaxial Types of Gastric Volvulus

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ABSTRACT

Introduction: Gastric volvulus is a rare cause of acute or recurring abdominal pain in adults, with significant mortality and morbidity. Gastric volvulus is rotation of stomach along its axis, causing gastric outlet obstruction and can result in ischaemia and infarction.

Aim: Evaluation of differentiating findings of organoaxial, and mesenteroaxial types of gastric volvulus on Multidetector Computed Tomography (MDCT).

Materials and Methods: This was a retrospective study of 20 cases of radiologically suspected cases of gastric volvulus, extracted by keyword search (gastric volvulus) from our reviewed Teleradiology RIS/PACS between the periods Nov-2014 to May-2017. The age group, gender and presenting symptoms of cases were evaluated and statistically analysed. Differentiating CT features of organoaxial volvulus and mesenteroaxial volvulus were evaluated and analysed.

Results: In our study, 80% cases were of the organoaxial type of gastric volvulus, while the remaining 20% were of mesenteroaxial type. Mean age of presentation was 77 years with higher incidence among older population. 65% of the patients in our study were females. The majority (85%) in our series presented with classical abdominal pain, nausea and vomiting, and the presence of a hiatal hernia. In our series MDCT was helpful in diagnosing gastric volvulus based on abnormal axis of rotation (100% of both OAV and MAV) and abnormal location of the pyloric antrum above the fundus (85% of OAV). Pylorus lying above the gastroesophageal junction is a differentiating feature (100% of cases of MAV).

Conclusion: MDCT is useful in diagnosing gastric volvulus as well as in differentiating OAV and MAV types by specific findings such as axis of rotation of the stomach, position of GEJ, pylorus, greater and lesser curvatures.

Keywords: Fundus, Gastro-esophageal junction, Mesenteroaxial volvulus, Organoaxial volvulus, Pyloric antrum, Pylorus

INTRODUCTION

Gastric volvulus is a rare and clinically significant cause of acute or recurring abdominal pain in adults, with significant mortality and morbidity. Prompt diagnosis is critical to avoid life threatening complications such as gastric ischaemia, infarction and perforation.

Gastric volvulus is the rotation of stomach along its axis, causing gastric outlet obstruction. Of all the available imaging modalities, CT is used increasingly because it provides essential diagnostic information such as axis of rotation, position of GEJ, pyloric antrum, greater and lesser curvatures and also evaluates for complications.

Types: Organoaxial (OAV) Volvulus is the obstruction of the stomach due to rotation around the long axis of the stomach, resulting in the antrum moving anterosuperiorly and the fundus rotating posteroinferiorly, so that greater curvature lies superior to the lesser curvature.

In Mesenteroaxial Volvulus (MAV), the stomach rotates around its short axis, such that the antrum moves above the gastroesophageal junction, twisting its vascular supply.

Mixed/combined type [1,2].

MATERIALS AND METHODS

In this retrospective study, 20 cases of radiologically suspected cases of gastric volvulus, extracted from key word search in the Department of Teleradiology, RIS/PACS between the periods November 2014 to May 2017.

Ethical approval was not applicable as we conducted the study retrospectively from anonymised reviewed cases selected by key word search from our Teleradiology RIS/PACS. The age group distribution and presenting symptoms of gastric volvulus were evaluated CT features of organoaxial volvulus like abnormal gastric configuration, axis of rotation along the cardiopyloric line, abnormal location of pyloric

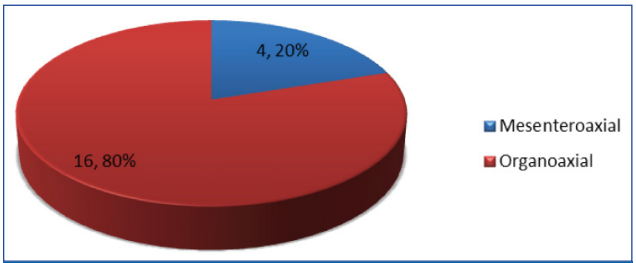
antrum were evaluated. CT features of mesenteroaxial volvulus like abnormal position of gastro esophageal junction were evaluated and reviewed for differentiating CT features between the types of gastric volvulus.

STATISTICAL ANALYSIS

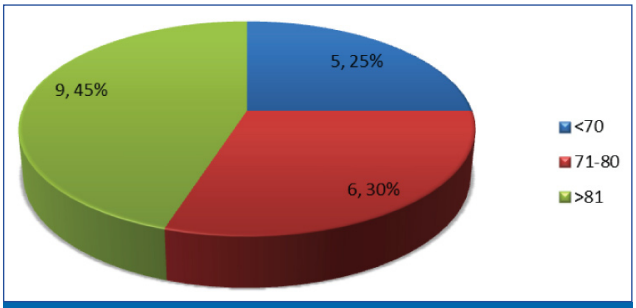
Sector graphs for percentage of types of gastric volvulus, age distribution, gender distribution and bar graphs for presenting symptoms and CT findings.

RESULTS

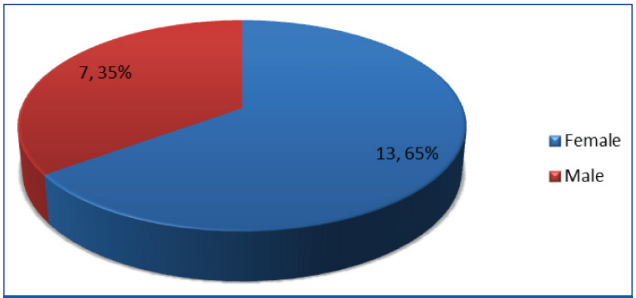
In this study, 16 people out of 20 cases were of organoaxial type of gastric volvulus constituting 80% of cases. Four people out of 20 cases were of mesenteroaxial type of gastric volvulus comprising 20 % of all vovlulus [Table/Fig-1]. Mean age was 77 years [Table/Fig-2]. Out of 20 cases, 13 were females constituting 65% and 7 were males (35%) [Table/Fig-3]. In all 13 patients presented with abdominal pain and 8 (40%) cases presented with vomiting and nausea. Four (20%) patients were presented with hiatal hernia and two cases with chest pain. Atypical symptoms such as back pain, cough and difficulty in breathing, gastrointestinal bleeding, hyperactive bowel sounds, diarrhoea was one case each [Table/Fig-4]. In our study, 85% of patients presented with the classical triad of abdominal pain, nausea and vomiting, and the presence of a hiatal hernia, reconfirming the existing data [Table/Fig-5]. CT findings of organoaxial volvulus in our series of patients were 17 (85%) out of 20 cases were presented with abnormal gastric configuration. 17 (85%) cases were presented with abnormal location of pyloric antrum, 16 (80%) cases were presented with hiatal hernia, 6 (30%) cases were presented with gastric distension, 1 (5%) case was presented with



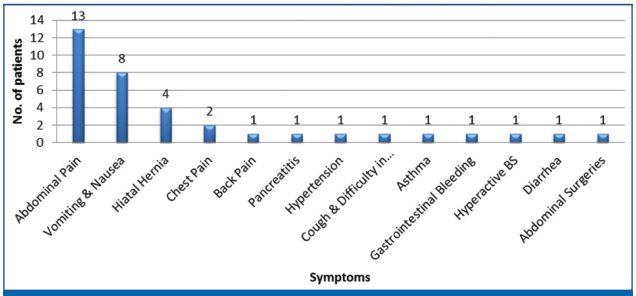
[Table/Fig-1]: Percentage of organoaxial and mesenteroaxial gastric volvulus.



[Table/Fig-2]: Agewise distribution of all gastric volvulus.



[Table/Fig-3]: Sex distribution- Majority of gastric volvulus are in females.



[Table/Fig-4]: Presenting symptoms in gastric volvulus.

gastric wall pneumatosis [Table/Fig-6]. On CT examination of mesenteroaxial volvulus, 8 (40%) patients were presented with abnormal position of the gastro esophageal junction [Table/Fig-7].

DISCUSSION

In our study, 80% of cases were organoaxial and 20% cases were mesenteroaxial whereas, in the study conducted by Ahmed A et al., acute mesenteroaxial gastric volvulus on computed tomography only 66% were organoaxial volvulus. Also, a majority, were females, constituting 65% and 35% were males in our study. Gastric volvulus is common in the elderly, with a mean age of presentation of 77 years. Similar to study conducted by Peterson CN et al., and Guniganti P et al., [2,3].

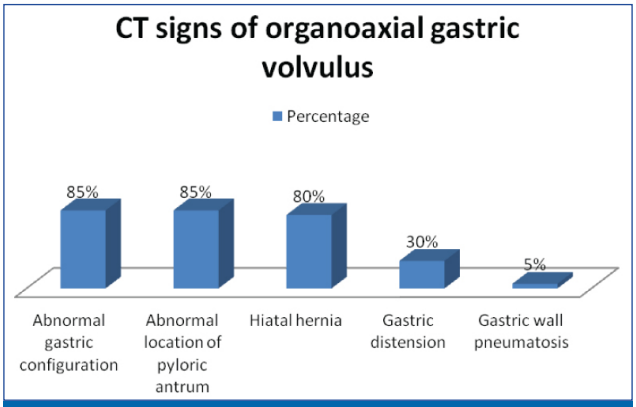
Total 85% of patients in our study, presented with the classical Borchardt triad of abdominal pain, nausea and vomitting Guniganti P et al., had similar observations [2].

CT Findings of Organoaxial Volvulus: Abnormal axis of rotation along the long axis of stomach. About 85% had abnormal gastric configuration, abnormal location of pyloric antrum, rotating anteriosuperiorly in 85%. Hiatal hernia was present in 80% of cases Sunnapwar A et al., [1] and Peterson CN et al., [3] had similar observations in their studies. 30% patients had significant gastric distension and 5% had gastric wall pneumatosis.

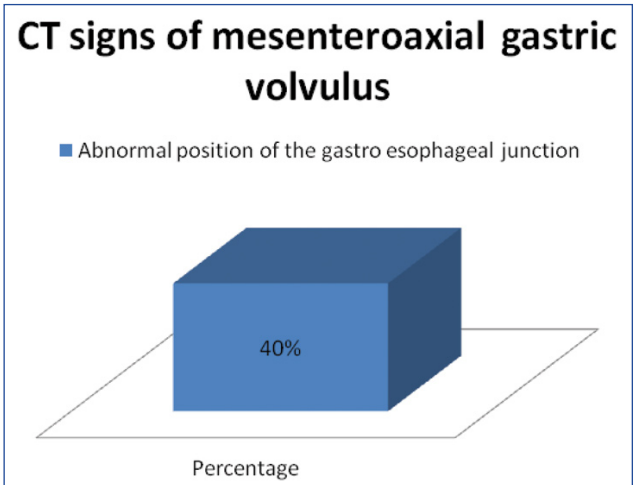
In our study the differentiating CT finding of mesenteroaxial volvulus was the rotation along the trans gastric line, abnormal position of gastroesophageal junction, lying below the pylorus, in close proximity to each other, creating a tapered pedicle ,

Case No	Age	Sex	Clinical history	Type of gastric volvulus
1	87	F	Back pain.	Organoaxial
2	88	F	Large hiatal hernia.	Organoaxial
3	96	F	Lipase 619-Pancreatitis. Generalized abd pain N/V* 10 hours. Patient unable to drink much oral -drank what she could and waited for an hour 1/2 to scan.	Organoaxial
4	88	F	Upper abdominal pain , suspect gastric pathology.	Organoaxial
5	73	F	Epigastric pain, nausea, vomiting, hiatal hernia, hypertension.	Organoaxial
6	53	M	Left sided chest pain.	Organoaxial
7	92	M	Abdominal pain with nausea and vomiting, history of volvulus.	Organoaxial
8	85	M	Rule out mass, cough, difficulty in breathing.	Organoaxial
9	61	M	Vomiting blood, upper abdominal pain.	Organoaxial
10	74	F	Epigastric pain left sided pain, nausea and vomiting. History of hiatal hernia, appendectomy, hysterectomy and left mastectomy.	Organoaxial
11	72	F	Chest pain, periumbilical area pain/tenderness. Evaluate for aortic aneurysm/dissection.	Mesenteroaxial
12	75	F	Vomiting, diarrhoea, nausea and periumbilical pain.	Mesenteroaxial
13	74	M	Vomiting, nausea, hyperactive BS, soft, mild tenderness in the abdomen.	Organoaxial
14	70	F	Epigastric pain.	Organoaxial
15	85	M	Severe abdominal pain/small bowel obstruction versus volvulus/persistent vomiting.	Mesenteroaxial
16	75	M	Vomiting and rectal bleeding for two days, asthma, gastrointestinal bleeding.	Organoaxial
17	65	F	Rule out right lobe opacity.	Mesenteroaxial
18	81	F	Epigastric pain since four hours after meal. History of hiatal hernia.	Organoaxial
19	61	F	Left sided abdominal pain radiating to pelvis, nausea and vomiting.	Organoaxial
20	85	F	Abdominal pain, acute.	Organoaxial

[Table/Fig-5]: Data compilation.



[Table/Fig-6]: CT findings of organoaxial volvulus in our series of patients.



[Table/Fig-7]: CT findings of mesenteroaxial volvulus in our series of patients.

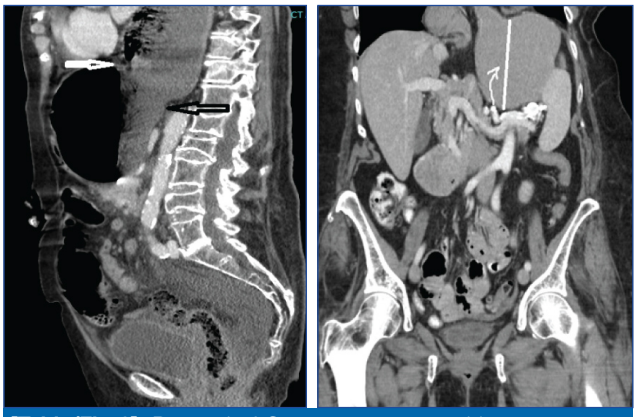
about which stomach can rotate, was seen in 40%. Similar to the findings reported by Sunnapwar A et al., [1] Guniganti P et al., [2] and Ahmed A et al., [5].

Anatomy of ligaments: The stomach is a wide muscular viscus. It consists of two surfaces, anterosuperior and posteroinferior, lesser and a greater curvature forms the medial and lateral borders respectively.

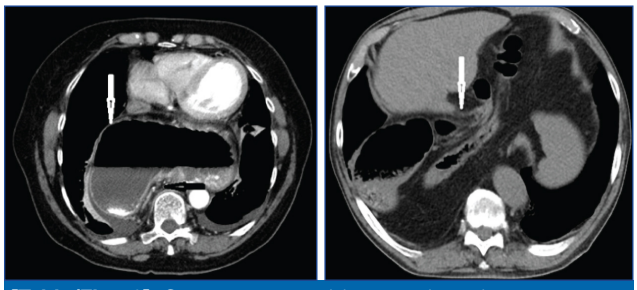
The stomach is divided into Fundus (F), Body, Pyloric Antrum (PA) and Pylorus (P).

Ligamentous attachments: The gastrosplenic ligament is a short ligament continuous with the greater curve of the stomach to the spleen [Table/Fig-8]. It contains the gastroepiploic and short gastric vessels.

The two layers of greater omentum drapes the greater curvature, with the proximal duodenum passing inferiorly anterior to the



[Table/Fig-8]: Reversal of Greater curvature and lesser curvature positions-organoaxial Volvulus.
[Table/Fig-9]: Axis of rotation along the cardio-pyloric line (long axis) in organoaxial Volvulus. (left to right)



[Table/Fig-10]: Greater curvature lying superior to lesser curvature in organoaxial volvulus. **[Table/Fig-11]:** Laxity of gastrohepatic ligament in mesenteroaxial volvulus. (left to right)

small bowel for a variable distance, and the omentum then turning superiorly to insert into the anterosuperior aspect of the transverse colon.

The gastro hepatic ligament is a part of the lesser omentum, extending from the lesser curvature of stomach and proximal duodenum to the liver. The gastro hepatic ligament forms the anterior surface of the lesser sac at its free edge which extends to the porta hepatis, where it forms hepatoduodenal ligament. Superiorly, it is attached to the fissures of the porta hepatis and ligamentum venosum.

Definition: Gastric volvulus is a surgical emergency and is an abnormal, acquired twist of the stomach, creating a closed loop and causing gastric outlet obstruction [1,2,4].

Types: (I) Organoaxial Volvulus (OAV) is the obstruction of the stomach due to rotation around the long axis of the stomach, resulting in the antrum moving anterosuperiorly and the fundus rotating posteroinferiorly, so that greater curvature lies superior to the lesser curvature [Table/Fig-9,10] [1,2].

(II) Mesenteroaxial Volvulus (MAV), the stomach rotates around its short axis, such that the antrum moves above the gastro esophageal junction, twisting its vascular supply [Table/Fig-11] [2-4].

(III) Mixed/combined type.

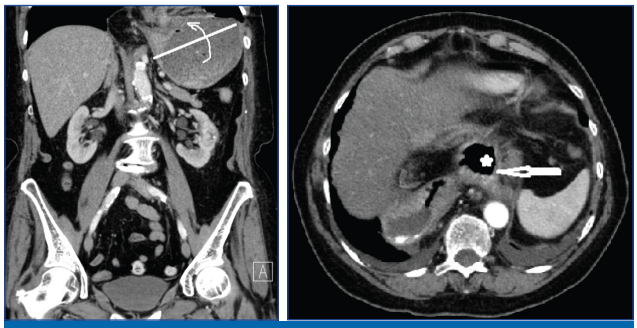
OAV is more common than MAV in the elderly, comprising up to two-thirds of cases, and is commonly associated with congenital and acquired diaphragmatic defects such as post traumatic or paraesophageal hernia [1,4]. Difference between organoaxial and mesenteroaxial volvulus has been depicted in [Table/Fig-12-16].

MAV is more common in the paediatric population and is due to the presence of an abnormality relating to anchoring of the stomach and the surrounding ligaments. The gastro hepatic ligament can be demonstrated in axial and coronal CT [Table/Fig-11]. Usually a long gastro hepatic ligament has been mentioned as predisposing factor for the development of mesenteroaxial volvulus. A large Bochdalek hernia is a predisposing factor for gastric volvulus [1,4,5].

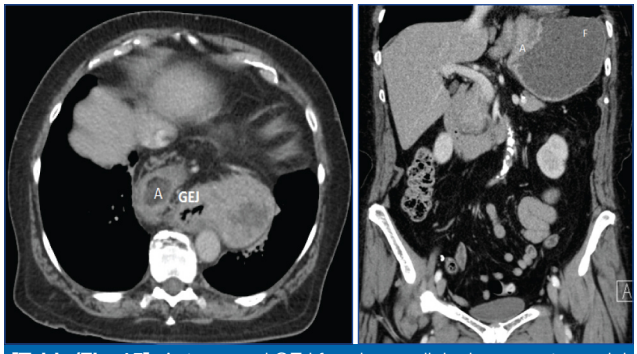
Patients classically present with sudden epigastric pain, intractable retching and inability to pass a nasogastric tube (the Borchardt's triad) [1,2,4].

Organoaxial	Mesenteroaxial
1. Most common, accounts for two-thirds of adult cases [1]. Axis of rotation: Rotation around the long axis of stomach (The cardio pyloric line) [Table/Fig-11] [4]. Antrum moving anterosuperiorly and the fundus posteroinferiorly [Table/Fig-16] [2,4].	1. Less common, can be associated with an underlying diaphragmatic defect [2]. The stomach rotates around its short axis /transgastric axis (line connecting the middle of lesser curvature with the middle of greater curvature) [Table/Fig-13] [4]. Anterior gastric wall flips on itself, [5].
2. Greater curvature lies superior to lesser curvature [Table/Fig-8,10] [1,2,4]. If volvulus is severe or complete, that is twist greater than 180 degree, gastric outlet obstruction occurs and stomach becomes fluid filled and dilated .There is retention of positive oral contrast in the stomach [4,6].	2. Antrum moves above the gastro esophageal junction twisting its vascular supply and causing ischaemia [Table/Fig-15] [2,7].
3. CT confirms the axis of rotation of the herniated stomach and transition point [2,4,6].	3. There is reversal of the GEJ and pylorus, and they may lie in close proximity to each other, creating a tapered pedicle about which the stomach can twist, increasing the probability of gastric ischaemia [Table/Fig-15] [5,6].
4. Chronic or intermittent volvulus may be asymptomatic [7].	4. Rotation is partial, less than 180 degree and is less severe, causing partial obstruction, leading to passage of ingested contrast material through the stomach into duodenum [3-5].

[Table/Fig-12]: Difference between organoaxial and mesenteroaxial volvulus.



[Table/Fig-13]: Axis of rotation along transgastric (short axis) line in mesenteroaxial volvulus.
[Table/Fig-14]: Antro-pylorus (*) lying superior to GEJ in mesenteroaxial volvulus. (left to right)



[Table/Fig-15]: Antrum and GEJ forming pedicle, in mesenteroaxial volvulus, increasing the risk of vascular occlusion and ischaemia.
[Table/Fig-16]: Pyloric antrum lying anterosuperiorly and fundus posteroinferiorly in organoaxial volvulus. (left to right)

Upper gastrointestinal tract contrast studies and CT are the radiographic imaging modalities most often used to make diagnosis of volvulus. In acutely ill patients, who cannot tolerate oral contrast for the fluoroscopic examination, CT is a viable alternative [2,4].

Emergency abdominal CT done for acute abdominal symptoms, help in locating the axis of rotation of the stomach and thus diagnose the type of gastric volvulus.

Emergency abdominal CT helps in diagnosing this acute emergency and aids in surgical management.

CT findings of elevated position of stomach, abnormal axis of rotation, the multiplanar reconstructions, particularly coronal, facilitate display of torsion of the stomach in various planes, confirming the diagnosis [2,4-6].

CT differentiating findings: Coronal reformatted images score over axial images alone, for diagnosing gastric volvulus. The close approximation of the gastro-oesophaseal junction and pylorus, and abnormal antral folds, developing secondary to twisting are best seen on coronal images [4,6].

CECT findings specific for organoaxial volvulus: Axis of rotation along the antro-pyloric line, abnormal location of pyloric antrum, with the antrum moving anterosuperiorly and the fundus posteroinferiorly. Abnormal position of gastro-esophageal junction, lying below the pylorus, with each in close proximity to the other is the key finding in MAV.

Thus, MDCT accurately differentiates organoaxial volvulus from mesenteroaxial volvulus. It also helps in detection of life threatening complications. [2,3].

MDCT is also useful in diagnosing the predisposing risks associated with volvulus such as hiatal/paraesophageal hernias, diaphragmatic defects, defective anchorage of stomach with surrounding ligament such as seen in wandering spleen, secondary to absence of a ligamentous connection between the stomach and the spleen or intra thoracic kidney, malrotation with asplenia [7-9] .

MDCT is helpful in exclusion of extragastric or vascular causes of gastric ischaemia [6,7].

Organoaxial type of gastric volvulus is more frequent than mesenteroaxial type. Mean age of presentation is in elderly, reconfirming the available data.

LIMITATION

Surgical follow-up was unavailable for the majority of cases, the study being conducted in a Teleradiology practice environment. As several of the hospitals we serve are community hospitals, the patients with critical findings are sometimes transferred to other larger facilities and are lost to follow-up.

There was a wide range of data, not confined to one geographical area. This being a retrospective study by key word search, selection bias might be possible.

CONCLUSION

Multidetector Computed Tomography (MDCT) is useful in diagnosing gastric volvulus, differentiating findings in OAV and MAV types, by specific findings such as localising axis of rotation of stomach, position of GEJ with relation to pylorus, greater and lesser curvatures.

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