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Acute primary mesenteroaxial gastric volvulus in a 6 years old child; the contribution of ultrasonographic findings to the prompt diagnosis (a case report and review of the literature)

DIMITRIOS PATOULIAS¹, VASILEIOS RAFAILIDIS², MARIA KALOGIROU³,
KONSTANTINOS FARMAKIS⁴, DIMITRIOS RAFAILIDIS⁵, IOANNIS PATOULIAS⁴

¹Department of Internal Medicine, General Hospital of Veria, Veria, Greece

²Department of Radiology, Aristotle University of Thessaloniki, General Hospital 'AHEPA', Thessaloniki, Greece

³Department of Internal Medicine, General Hospital of Trikala, Trikala, Greece

⁴1st Department of Pediatric Surgery, Aristotle University of Thessaloniki, General Hospital 'G. Gennimatas'
Thessaloniki, Greece

⁵Department of Radiology, General Hospital 'G. Gennimatas', Thessaloniki, Greece

Dimitrios Patoulis: MD, Resident in Internal Medicine

Vasileios Rafailidis: MD, Resident in Radiology

Maria Kalogirou: MD

Konstantinos Farmakis: MD, PhD, Consultant Pediatric Surgeon

Dimitrios Rafailidis: MD, Consultant Radiologist

Ioannis Patoulis: MD, PhD, Consultant Pediatric Surgeon

Corresponding author: Dimitrios Patoulis, MD

M. Alexandrou 3B, Pefka, Thessaloniki, Postal code 57010, Greece

Phone: +30 23 10 225 083; E-mail: dipatoulis@gmail.com

Abstract: The aim of the present case study is to raise concern on the proper diagnostic approach of acute gastric volvulus (AGV) cases, in which, the key issue is the timely diagnosis and the prompt therapeutic intervention. After thorough and systematic research of the current literature, it is concluded that early diagnosis remains challenging, while there is no relevant publication with emphasis on the contribution of ultrasonography to the diagnostic documentation of AGV.

A 6 years old boy was admitted to our Department due to repeatedly non bilious vomiting and food refusal during the last 72 hours before admission. Physical examination revealed the presence of a spherical,

painful mass in the epigastrium, which did not recede after placement of a nasogastric tube. Abdominal radiography showed the presence of a large gastric air bubble. Ultrasonography highlighted a distended and fluid-filled stomach, which was displaced in a cephalic position compared to esophagus and a pylorus pointing downward, in a cranial caudal orientation. Following barium meal examination confirmed the diagnosis of gastric volvulus.

Patient underwent an urgent exploratory laparotomy, revealing the presence of acute mesenteroaxial gastric volvulus with a serosal ecchymosis in the major arc. After restoration of the gastric volvulus, thorough intraoperative investigation on the existence of a subject cause followed. Presence of relaxation of stomach's ligaments was finally documented. Fixation of the stomach's fundus to the diaphragm and anterior gastropexy were then conducted. Postoperative period was uneventful and the patient was discharged home on the 4th postoperative day.

In conclusion, we believe that ultrasonography plays a significant role in the diagnostic approach of acute gastric volvulus, as it has the potential to detect findings suggestive of the diagnosis. Once the diagnosis is suspected on ultrasonography, contrast series should be performed, without further delay, in order to confirm the diagnosis.

Key words: Gastric volvulus, child, ultrasonographic diagnosis, anterior gastropexy, Borchardt triad.

Introduction

The term "volvulus" originates from the latin word "volvere" meaning winding and refers to the twisting of an organ around its own axis, at least 180°. Gastric torsion is defined as the rotation of the stomach around its own axis <180° [1, 2]. Gastric volvulus — first described by Berti in 1866 — is uncommon and affects mainly, up to 86%, children younger than 5 years old [3, 4]. Berg reported the first case with successful surgical management in 1897 [5].

Gastric volvulus can be classified into three types based on the rotation axis: the organoaxial, being the commonest (59%), defined as a rotation of the stomach around its own longitudinal axis that extends from the gastroesophageal junction to the pylorus, the mesenteroaxial (29%), defined as a rotation around its own axis that extends from the greater to lesser curvature and the least common (12%), which consists a combination of the above two types [6].

Upon the etiology, it is divided into primary and secondary. Primary is due to the absence or to the lack of adhesion or finally to the stretching of the gastric ligaments (gastrocolic, hepatogastric, gastrosplenic and gastrophrenic). Based on the results of the experimental study he conducted, Dalgaard [7] believes that gastric volvulus can develop only when gastrosplenic and gastrocolic ligaments are absent or sheared [7, 8]. Secondary may occur due to the presence of anatomic or functional disorders of the stomach, such as pyloric stenosis, gastric dilatation, hourglass stomach, either to abnormalities of the adjacent organs (Table 1) [3, 6].

Gastric volvulus can be either acute or chronic. Cribbs *et al.* in their retrospective study analyze 581 cases published in English speaking medical journals from 1929 to

Table 1. Major abnormalities of the adjacent to the stomach organs that can lead to gastric volvulus.

Organ	Disease
Small intestine	Malrotation
Liver	Hypoplasia of the left lobe Liver dislocation
Spleen	Wandering spleen, Splenomegaly, asplenia, polysplenia
Diaphragm	Bochdalec hernia, hiatal hernia type II, III, or IV, phrenic nerve palsy, diaphragm eventration, diaphragm rupture

2007. In 252 out of 582 cases (43%) gastric volvulus was acute, while in 69% of all cases was secondary [3]. It should be noted that in 12.5% of all cases of chronic gastric volvulus acute volvulus can also develop, with the potential of life threatening clinical manifestations, for which urgent resuscitation may be required, raising up to 60% [3]. According to Jacob *et al.* 75.8% of all cases of gastric volvulus are secondary [4].

The aim of the present case study is to raise concern on the proper diagnostic approach of acute gastric volvulus (AGV) cases, in which the key issue is the timely diagnosis and the prompt therapeutic intervention. After thorough and systematic research of the current literature, it is concluded that early diagnosis remains challenging, while there is no relevant publication with emphasis on the contribution of ultrasonography to the diagnostic documentation of AGV.

Case report

A 6 years old boy was admitted to our Department due to repeatedly non bilious vomiting and food refusal during the last 72 hours before admission. Physical examination revealed the presence of a spherical, painful mass in the epigastrium, which did not recede after placement of a nasogastric tube. Along with the intravenous administration of crystalloid solutions, a complete and comprehensive preoperative control was conducted.

Abdominal radiograph revealed the presence of a sizeable gastric air bubble in the left hypochondriac region, elevation of the left hemidiaphragm, while the end of the nasogastric tube was located in an inferior position (Fig. 1).

Conduction of ultrasonography of the upper abdomen followed, where deviation of the first part of the duodenum left to the pancreatic head (Fig. 2) as well as translocation of the mesenteric vessels (Fig. 3) and high position of the gastric antrum were depicted. Elongation of the first two parts of the duodenum and lumen's stenosis were also depicted instead of evaluated.

Barium meal examination was then conducted, in which it was found that the contrast medium remained entrapped below the gastric air bubble, without passing peripherically, while the end of the nasogastric tube was located within the gastric air

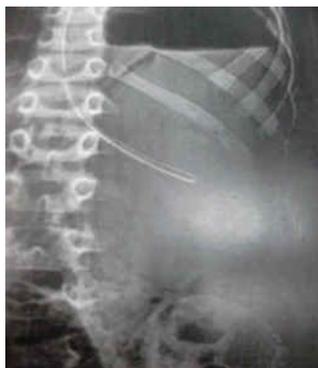


Fig. 1. Sizeable gastric air bubble in the left hypochondriac region. Note the elevation of the left hemidiaphragm without a subject cause and the course of the nasogastric tube.



Fig. 2. Transverse ultrasound image on admission (A) showing a dislocated duodenal bulb (asterisk) and pylorus (P) to the left in comparison with the head of the pancreas (U: uncinus process, arrowhead showing the portal vein).

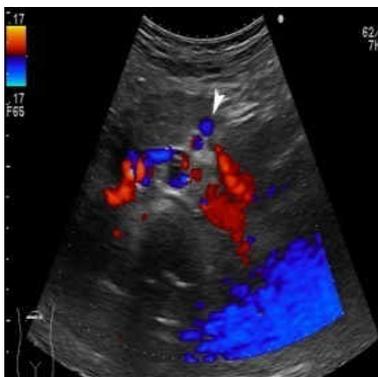


Fig. 3. Transverse ultrasound image on admission showing the dislocation of the mesenteric vein (arrow) to the left of the artery.



Fig. 4. Barium meal examination. Notice the sizeable air fluid level and the radiolucent bird beak inselence with abrupt suffix at the left edge of the gastric air bubble (arrow).

bubble producing a sizeable air fluid level. At the left edge of the gastric air bubble radiolucent bird beak inselence with abrupt suffix was noticed (Fig. 4).

Patient — under general endotracheal anesthesia — underwent an urgent exploratory laparotomy after an average subinguinal incision. We observed intraoperatively instead of noticed the 180° rotation of the stomach in the transverse axis and we conducted immediate restoration. We also noticed the presence of a serosal ecchymosis in the major arc and opposite to the angular notch. After restoration of the gastric volvulus, thorough intraoperative investigation on the existence of a subject cause followed. Presence of relaxation of stomach's ligaments and of wandering spleen was finally documented, while we excluded distal pyloric obstruction, malrotation, hiatal hernia, left postero-lateral diaphragmatic hernia and left hemidiaphragm eventration.

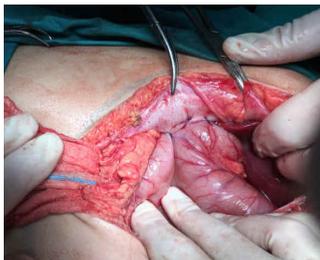


Fig. 5. Conduction of anterior gastropexy by using 4 separate prolene 2/0 sutures between the anterior surface of the gastric antrum and the inner surface of the subject abdominal wall.

Fixation of the stomach' fundus to the left hemidiaphragm dome like umbrella and ensuring of the acute gastroesophageal junction by using 7 separate prolene 2/0 sutures as well as anterior gastropexy by using 4 separate prolene 2/0 sutures between the anterior surface of the gastric antrum and the inner surface of the subject abdominal wall were conducted (Fig. 5).

Results

Postoperative course was uneventful. Nasogastric tube was removed on the 2nd postoperative day, followed by the gradually increasing oral feeding. Patient was discharged home on the 7th postoperative day in excellent general condition.

Follow-up ultrasound gray scale and colour Doppler performed 5 months postoperatively did not reveal any abnormality instead of revealed no abnormality, demonstrating the presence of the duodenum, pylorus and mesenteric vessels in their normal position (Fig. 6 & 7).

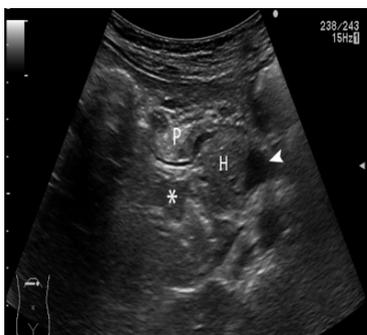


Fig. 6. Transverse oblique post-operative ultrasound image showing the normally-located pylorus (P) and duodenal bulb (asterisk) on the right of the head of the pancreas (H) (arrowhead showing the portal vein).



Fig. 7. Colour Doppler imaging in a boy with mesenteroaxial gastric volvulus. Transverse post-operative colour Doppler imaging showing the restoration of mesenteric vessels to their normal position and relation.

After an 18 month follow-up period the patient remains asymptomatic, in excellent general condition, and develops normally.

Discussion

Gastric volvulus is potentially life threatening, thus prompt diagnosis is crucial. In one third of all cases of gastric volvulus occurring in neonatal age and early infancy, emergent resuscitation may be needed, when patient presents with apnea, cyanosis and acute respiratory distress [3]. Clinician must properly and timely evaluate the presentation of acute symptomatology, the presence of repeated non bilious vomiting and the visible painful mass in the epigastrium, which may not recede after the placement of a nasogastric tube, in order to avoid serious complications, mainly ischemia, followed by necrosis of the gastric wall [9]. Other major complications due to delayed diagnosis and intervention include upper gastrointestinal bleeding, pancreatic necrosis, omental avulsion, splenic vessels disruption and splenic rupture [10, 11].

Presentation of our patient consisted of the most frequent symptoms of gastric volvulus, as described in the relevant literature (non bilious vomiting in 75%, spherical and palpable mass in the epigastrium in 47% and abdominal pain in 34% of all cases) [3]. In the context of an acute gastric volvulus, a close loop obstruction develops, separating the stomach into two closed sub-cavities with anatomical limits consisting of the gastroesophageal junction for the central and the pylorus for the distal cavity. Intermediate limit between the two sub-cavities is the anatomical position of the transverse axis around which the volvulus occurs [9]. Complete antropyloric obstruction develops essentially in cases of mesenteroaxial gastric volvulus [4]. In our case we could not place the nasogastric tube within the completely occluded distal cavity (complete antropyloric obstruction). Failure to empty the stomach via suction by the nasogastric tube was due to the fact that we could not promote the nasogastric tube in the distal sub-cavity.

In our case Borchartd triad (vomiting inability, epigastric distension, and failure to place a nasogastric tube) fully manifested, as it usually occurs in cases of gastric volvulus in early childhood [7, 12]. Rashid *et al.* estimate that Borchartd triad is observed instead of noticed in 70% of all cases of gastric volvulus [13]. It seems that Borchartd triad is manifested either when complete obstruction of the stomach or occlusion of a sub-cavity — induced by the gastric volvulus — occurs [13].

Diagnostic approach of this condition largely relies on imaging with plain chest and abdominal radiographs being the first-line modality potentially identifying chest abnormalities such as gastric double bubble, abnormal distention of the stomach despite the placement of a nasogastric tube, a horizontally lying and distended stomach, an air-fluid level in the epigastrium, elevated left hemi diaphragm and

distal bowel paucity [3, 10, 14, 15]. In children with mesenteroaxial type of volvulus, an erect abdominal radiograph may reveal the presence of two fluid levels situated in the fundus and the antrum of the stomach. Abdominal radiograph in our case revealed the presence of a sizeable gastric air bubble in the left hypochondriac region and elevation of the left hemidiaphragm, while the end of the nasogastric tube was located in an inferior position. The above imaging findings alongside with the clinical presentation contributed substantially to the diagnosis of acute gastric volvulus.

The reference method for diagnosis of gastric volvulus is the emergent conduction of upper gastrointestinal contrast series or computed tomography, which provides signs of gastric rotation or obstruction. In mesenteroaxial gastric volvulus contrast series reveal a pylorus situated anterior and superior to the gastroesophageal junction [16]. According to Teague *et al.*, barium meal examination may confirm the diagnosis in 56% of all cases [17]. Depiction instead of notice of the bird beak sign leads to the diagnosis of complete antropyloric obstruction, as in our case [6].

Ultrasound can be search for instead of evaluate for associated anomalies like dislocated spleen or mesenteric vessels [14]. Nevertheless, there are reports in which ultrasound identified specific findings, which raised suspicion of a gastric volvulus. For instance, ultrasound in an infant has been reported to detect a distended and fluid-filled stomach, which was displaced in a cephalic position compared to esophagus and a pylorus pointing downward, in a cranial caudal orientation. These findings suggested the potential diagnosis of a gastric volvulus which was confirmed by upper gastrointestinal contrast series [18]. In another paper, ultrasound of an adult patient identified a constriction of the middle part of stomach, termed the “peanut sign” which was suggestive of gastric volvulus [19]. After systematic and comprehensive research of the current literature, we did not find a relevant publication, where ultrasonographic findings positively contributed to the diagnosis of gastric volvulus [1, 3, 4, 6, 9, 13–16]. According to Porcaro *et al.*, ultrasonographic diagnosis of gastric volvulus is not feasible [2].

Operative strategy includes the restoration of the stomach, evaluation of its wall viability, investigation on the existence of a subject cause and finally the conduction of an anterior gastropexy [20]. Less invasive techniques include laparoscopic surgery or endoscopic reduction with insertion of a percutaneous gastrostomy tube [21, 22]. Regarding the latter, there is not much experience in cases of gastric volvulus in pediatric population. As for the laparoscopic repair of the gastric volvulus, we consider this approach as appropriate in cases of primary gastric volvulus [9].

Conclusion

It is our belief that ultrasound holds a significant place in the diagnostic approach of gastric volvulus, as it has the potential to detect findings suggestive of the prompt

diagnosis. Once the diagnosis is suspected on ultrasound, it should be always confirmed with contrast series.

Conflict of interest

None of the contributing authors have any conflict of interest, including specific financial interests or relationships and affiliations relevant to the subject matter or materials discussed in the manuscript.

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