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# Gastric Volvulus in Infants and Children

Randolph Kyle Cribbs, MD<sup>a</sup>, Kenneth William Gow, MD<sup>b</sup>, Mark Lewis Wulkan, MD<sup>a</sup>

<sup>a</sup>Division of Pediatric Surgery, Emory University, Atlanta, Georgia; <sup>b</sup>Division of Pediatric General and Thoracic Surgery, University of Washington, Seattle, Washington

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## ABSTRACT

**INTRODUCTION.** Gastric volvulus is an important cause of nonbilious emesis that must be recognized early to ensure a good outcome. We reviewed 7 cases from our institution, Children's Healthcare of Atlanta (Egleston campus). In addition, we reviewed all gastric volvulus cases in children published to date in the English literature to draw general conclusions about the presentation and treatment of this unusual disease.

**METHODS.** An electronic literature search was performed to find all published cases of pediatric gastric volvulus. The care of all children from January 2002 to December 2007 who were treated for gastric volvulus was also reviewed.

**RESULTS.** There have been 581 cases of gastric volvulus in children published in English between 1929 and 2007. Of these, 252 were acute and 329 were chronic cases. The most common presentation of acute gastric volvulus is in a child <5 years old with nonbilious emesis, epigastric distention, and abdominal pain. Acute gastric volvulus is often associated with deformities of adjacent organs. Definitive diagnosis is made with upper gastrointestinal studies, and definitive therapy requires repair of associated defects and anterior fixation of the stomach to the abdominal wall. The most common presentation of chronic volvulus is in an infant <1 year old with emesis, epigastric distention, feeding difficulties, and growth failure. Treatment may be medical or surgical depending on the underlying etiology of the volvulus.

**CONCLUSIONS.** Acute gastric volvulus is a potentially life-threatening occurrence with a good outcome when treated in a timely fashion. Chronic volvulus may be more difficult to recognize. The common features of acute and chronic gastric volvulus described in this review should assist pediatric health care providers in promptly diagnosing and treating this disease. *Pediatrics* 2008;122:e752–e762

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### Key Words

adolescents, children, gastric, volvulus, infants, newborns

### Abbreviations

PEH—paraesophageal hernia  
UGI—upper gastrointestinal  
HH—hiatal hernia  
CDH—congenital diaphragmatic hernia  
GERD—gastroesophageal reflux disease

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Address correspondence to Mark Wulkan, MD, Emory University, Division of Pediatric Surgery, 2015 Uppergate Dr NE, Atlanta, GA 30322.  
E-mail: mark.wulkan@oz.ped.emory.edu

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**G**ASTRIC VOLVULUS HAS traditionally been considered an uncommon cause of foregut obstruction and is usually described as having a peak incidence during the fifth decade of life.<sup>1–3</sup> In adults, acute gastric volvulus is frequently associated with paraesophageal hernia (PEH) of the stomach.<sup>2–4</sup> Gastric volvulus in infants, children, or adolescents continues to be considered rare. The purpose of this review is to outline important aspects in the diagnosis and treatment of this disease, report 7 additional cases from our institution, and present common features seen in pediatric patients with gastric volvulus to further our understanding of this rare and complex condition.

The term “volvulus” is derived from the Latin verb *volvere*, which means to turn or roll. “Gastric volvulus” refers to the revolution of all or a portion of the stomach at least 180° about an axis that causes an obstruction of the foregut. The obstruction may be acute, recurrent, intermittent, or chronic. A twisting or turning of the stomach of <180° that results in only partial foregut obstruction is best defined as “gastric torsion.”<sup>5,6</sup>

The stomach is normally fixed to the abdominal cavity by 4 ligaments: the gastrocolic, gastrohepatic, gastrophrenic, and gastrosplenic (Fig 1). Together with the pylorus and the gastroesophageal junction, these ligaments normally anchor the stomach and prevent volvulus. Failure of these normal attachments may be the result of agenesis, elongation, or disruption of the gastric ligaments, which results in idiopathic or primary gastric volvulus. Disorders of gastric anatomy or gastric function or abnormalities of adjacent organs such as the diaphragm or spleen may result in secondary gastric volvulus (Table 1).

The stomach may rotate on a longitudinal axis that extends from the gastroesophageal junction to the pylorus (Fig 2). Rotation about this axis causes the greater curvature of the stomach to rest superior to the lesser curvature, resulting in an “upside-down” stomach. This is called “organoaxial volvulus” (Fig 3). The stomach in organoaxial volvulus tends to lie in a horizontal plane when viewed in plain radiography of the abdomen and chest, which is a distinguishing feature that may aid in early diagnosis.

In contrast, rotation of the stomach along an axis perpendicular to its longitudinal axis (Fig 4) has been described with many names. Originally termed “mesenterio-axialis” by Buchanan,<sup>7</sup> it was shortened to “mesentero-axial” by Singleton in 1940.<sup>8</sup> The stomach in mesenteroaxial volvulus typically lies in a vertical plane, with the antrum and

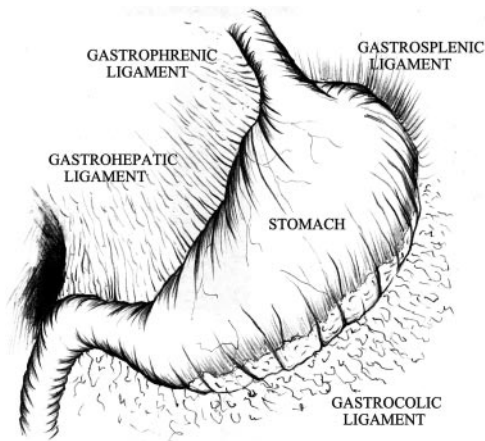


FIGURE 1

The 4 ligaments of the stomach normally function to prevent twisting or turning about 2 anchor points: the gastroesophageal junction and the pylorus.

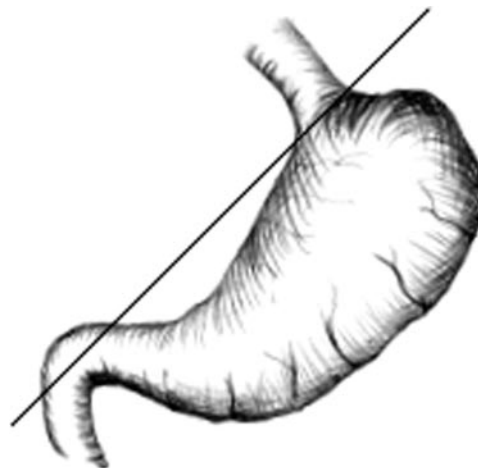


FIGURE 2

The longitudinal or organoaxial axis of the stomach extends from the gastroesophageal junction to the pylorus.

pylorus rotated anterior and superior to the gastroesophageal junction (Fig 5). Rotation of the stomach about both the organoaxial and mesenteroaxial axes is termed “combined volvulus” (Fig 6).

## METHODS

An electronic literature search was performed on the National Library of Medicine Web site ([www.pubmed.gov](http://www.pubmed.gov)) by using the search terms “gastric volvulus” with the search limited to all children aged 0 to 18 years. On January 13, 2008, this search produced 251 citations. Each citation was obtained to determine the age of the case subjects, the type and degree of gastric rotation, and the presence of obstruction. Citations that lacked case subjects who were younger than 19 years or subjects with  $<180^\circ$  of gastric rotation or only transient obstruction or which merely duplicated a case reported in an-

other citation (multiple publications by the same author) were excluded from our review. With these parameters, 207 citations remained under consideration. We also excluded 57 foreign-language citations, leaving a total of 150 articles for review. An additional 26 citations that met the inclusion criteria were retrieved from the bibliographies of the original list of 251 citations and included in this report. Including the 7 cases from Children’s Healthcare of Atlanta (Egleston campus), the total number of reported cases of gastric volvulus in infants and children in these citations is 581.

Our case series was collected after institutional review board approval. The electronic medical chart database was searched by using the terms “volvulus” and “stomach” from January 2002 to December 2007. Data retrieved included dates of birth, dates of presentation, presenting symptoms, physical examination findings, diagnostic tests, imaging studies, operative reports, and discharge summaries.

TABLE 1 Anatomic Etiology of Gastric Volvulus

Primary volvulus: absence, failure of attachment, or elongation of gastric fixation
Gastrocolic ligament
Gastrohepatic ligament
Gastrophrenic ligament
Gastrosplenic ligament
Secondary volvulus
Disorders of gastric anatomy or function
Acute or chronic distention (gastric outlet obstruction, hypomotility, or massive aerophagia)
Peptic ulcer disease
Neoplasm of the stomach
Hourglass stomach
Gastric ptosis
Abnormalities of adjacent organs
Diaphragm (hernia, rupture, eventration, phrenic nerve palsy)
Spleen (asplenia, polysplenia, splenomegaly, wandering spleen)
Transverse colon (volvulus, displacement into chest)
Intestinal malrotation
Liver (dislocation or hypoplasia of left lobe)

Adapted with permission from Scherer J III. Peptic ulcer and other conditions of the stomach. In: Grosfeld J, O’Neill J, Coran AG, Fonksrud E, eds. *Pediatric Surgery*. 6th ed. Philadelphia, PA: Mosby; 2006:1234.

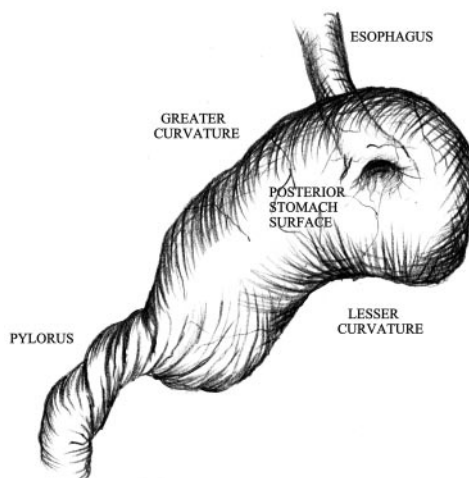
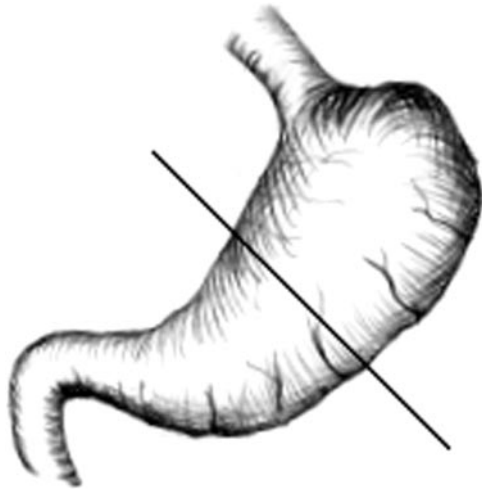


FIGURE 3

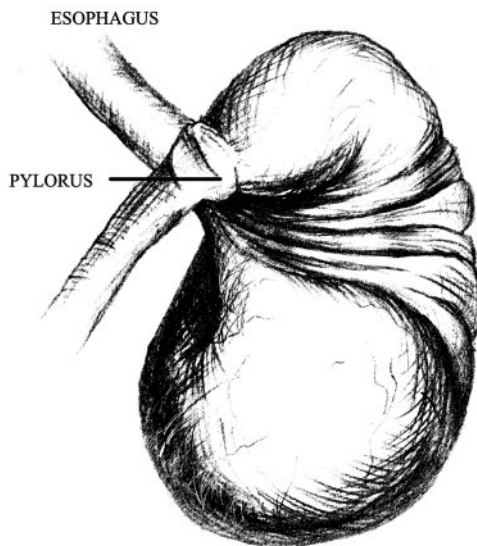
Organoaxial gastric volvulus, or “upside-down” stomach.



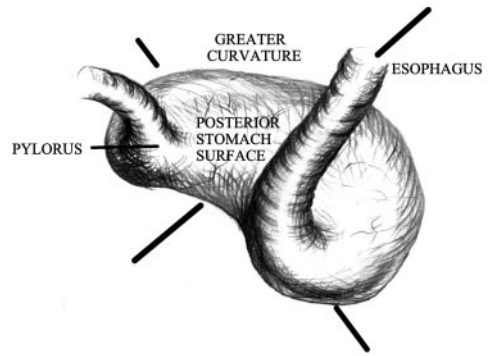
**FIGURE 4**  
The mesenteroaxial axis extends from the greater to the lesser curvatures of the stomach, perpendicular to the organoaxial axis.

## RESULTS

At Egleston campus, there were 7 patients managed for gastric volvulus. The pertinent features from our case series are presented in Table 2. In our first case, the diagnosis was made with an upper gastrointestinal (UGI) study (Fig 7). At laparotomy, the stomach was reduced from the right chest, and a large hiatal hernia (HH) was also repaired. In our second case, the UGI study showed an organoaxial volvulus in proximity to the scar from a previous gastrostomy tube. The UGI study in our third case demonstrated the features of mesenteroaxial volvulus. In our fourth case, the UGI study showed gastric herniation and volvulus through a left congenital diaphragmatic hernia (CDH). The UGI study in our fifth case showed transient and recurrent gastric obstruction



**FIGURE 5**  
Mesenteroaxial gastric volvulus, demonstrating complete obstruction of the distal esophagus.



**FIGURE 6**  
Combined gastric volvulus, with rotation about the organoaxial and mesenteroaxial axes.

with primary volvulus (Fig 8), whereas the UGI study in our sixth case showed a total intrathoracic stomach with volvulus through a PEH. Our seventh case demonstrated UGI findings of mesenteroaxial gastric volvulus through a Morgagni CDH (Fig 9).

Of the 581 total cases in this report and in the current literature,<sup>3,9-183</sup> 252 (43%) children presented in an acute fashion. Those children with acute gastric volvulus were slightly more commonly male (54%) and had an associated pathologic abnormality (69%). Commonly described anomalies included diaphragmatic eventration (25%), CDH (17%), PEH (7%), intestinal malrotation (7%), wandering spleen (6%), asplenism (6%), and HH (5%). Of all children with acute volvulus, 54 (21%) presented in the first month of life, 92 (37%) presented between ages 1 and 12 months, 69 (27%) presented between ages 1 and 5 years, 25 (10%) presented between ages 6 and 12 years, and 11 (4%) presented between ages 13 and 18 years, and in 1 case age was unknown. The majority of the patients presented with organoaxial volvulus (136 of 252 [54%]), with 103 (41%) cases of mesenteroaxial volvulus and 5 (2%) cases of combined volvulus, leaving 8 cases that were not characterized.

Highlighting the need for prompt diagnosis and treatment of this disease, a total of 58 (23%) children presented acutely with life-threatening events that required resuscitation, including apnea (41%), cyanosis (40%), acute respiratory distress (34%), acute epigastric distention (24%), and acute abdominal pain (21%). These children tended to be infants, with 41 (71%) of the 58 children aged  $\leq 12$  months. In fact, 28% of all the infants presenting with acute gastric volvulus required life-saving resuscitation. Of these children, 35 (60%) proceeded to emergent surgical repair. The mortality rate in this group of threatened children was 4 (6.9%) of 58, including the death of 1 child at home shortly after the family refused recommended surgery and while they were in the process of seeking a second medical opinion.

The most common signs and symptoms in the 252 children with acute gastric volvulus are detailed in Table 3. Unlike adults, in whom nonproductive retching is a characteristic feature, most children (75%) presented with nonbilious emesis. Epigastric distention and abdominal pain were also seen frequently.

**TABLE 2 Features of Gastric Volvulus in 7 Children**

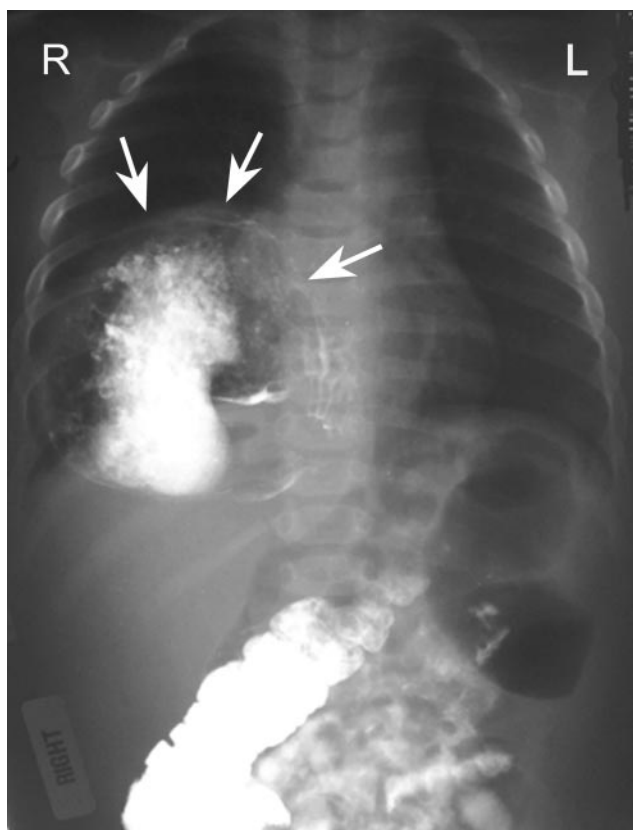
Age, y	Gender	Presentation	Type	Signs and Symptoms	Associated Pathology	Treatment	Follow-up
0.5 y	Male	Chronic	OA	Emesis, feeding intolerance/FTT	HH	Repair HH; gastropexy	Doing well 3 y later
6 y	Male	Chronic	OA	Retching, abdominal pain, epigastric distention	Previous fundoplication, gastrostomy	Excision tract scar; gastropexy	Doing well 4 y later
1 y	Female	Acute	MA	Emesis	CDH	Repair CDH; gastropexy	Lost to follow-up 5 y later
0.8 y	Female	Acute	MA	Emesis, epigastric distention	CDH	Repair CDH; gastrostomy	Doing well at 3 mo; lost to follow-up 2 y later
4 y	Male	Chronic	OA	Abdominal pain, constipation	Ligament laxity	Laparoscopic gastropexy	Doing well 6 mo later
NB	Female	Chronic	OA	Emesis, cyanosis	PEH, wandering spleen	Laparoscopic fundoplication; gastropexy; Ladd's procedure	Death at 6 wk attributable to internal hernia and bowel infarction
NB	Male	Chronic	MA	Emesis, FTT	Morgagni hernia	Laparoscopic hernia repair; gastropexy	No postoperative complications

FTT indicates failure to thrive; MA, mesenteroaxial volvulus; NB, newborn infant; OA, organoaxial volvulus.

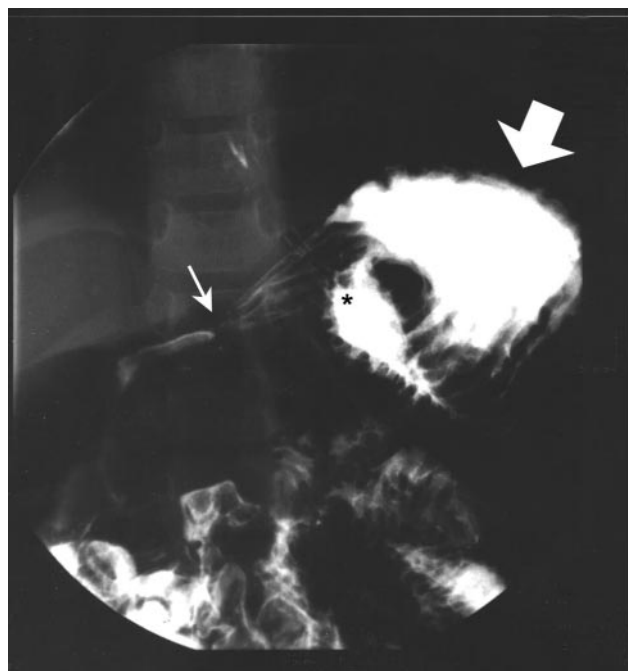
Surgical repair was used in 89% of the cases reported. Procedures performed included 79 (35%) open gastropexies, 51 (23%) open gastrostomy-tube placements, 37 (16%) CDH repairs, and 32 (14%) diaphragmatic plications. Twenty-four laparoscopic procedures were reported, including 20 anterior gastropexies, 3 fundoplications, and 1 gastrostomy-tube placement.<sup>35,40,46,58,93,123,154</sup> Of

225 children, 12 died during or after surgery (operative mortality rate: 5.3%).

A total of 17 deaths were reported of children with acute gastric volvulus (6.7% mortality). Four of 26 children treated nonoperatively died (medical mortality rate: 15.4%). One report of death did not mention whether surgery had been performed.<sup>78</sup> A detailed examination of reported deaths revealed that 12 of 17 might have been preventable with timely and effective surgical intervention, including 8 children in whom necrosis of the stomach was identified either during surgi-



**FIGURE 7**  
A UGI study reveals a right-sided organoaxial gastric volvulus (arrows), which herniated through a right paraesophageal diaphragmatic defect in our first patient.



**FIGURE 8**  
Intermittent complete organoaxial volvulus demonstrated in a UGI study of our fifth patient. Note that the greater curvature (wide arrow) is superior to the gastroesophageal junction (asterisk), and the pylorus is obstructed (thin arrow).



**FIGURE 9**  
A UGI study of our seventh patient shows a small amount of contrast entering the duodenum superior to the gastroesophageal junction, which is characteristic of mesentero-axial volvulus.

cal intervention or at the postmortem examination\*; 1 death of a newborn<sup>53</sup> who survived 3 open abdominal explorations in a 9-day period for CDH repair, whose recurrent volvulus was treated initially with reduction without anterior fixation, and whose death eventually resulted from complete small-bowel obstruction from adhesive disease; another death of a newborn<sup>103</sup> with intrathoracic gastric volvulus that caused displacement of left lung and heart into the right chest, which was treated nonoperatively; 1 immediate postoperative death of a child who was critically ill with progressive dehydration after delayed presentation<sup>84</sup>; and the previously mentioned death at home of a child whose family refused surgical intervention.<sup>67</sup>

A total of 9 acute cases involved children with a history of previous gastric surgery, including 4 Nissen funduplications (2 with gastrostomy tubes), 1 previous repair of gastric perforation, 1 previous CDH repair, 1 previous pyloromyotomy, 1 previous gastropexy for gastric volvulus, and 1 reduction for gastric volvulus. Corrective surgery included 4 gastrostomy-tube placements,<sup>53,73,96,169</sup> 2 gastropexy procedures,<sup>57,182</sup> 1 diaphragmatic plication with gastric reduction only,<sup>161</sup> 1 plication of gastric ligaments,<sup>42</sup> and 1 redo Nissen fundoplication.<sup>176</sup> One of the 9 patients died postoperatively after a gastrostomy-tube placement. There were no other reported cases with recurrences of gastric volvulus.

Of 252 acute presentations, 47 were of children with a history of symptoms suggestive of chronic or intermittent gastric volvulus, which we identify as acute-on-chronic volvulus. Forty (85%) of these presentations

**TABLE 3 Common Features of Acute and Chronic Gastric Volvulus in Children**

Sign or Symptom	Acute Volvulus, n (%)	Chronic Volvulus, n (%)
Nonbilious emesis	189 (75)	233 (71)
Epigastric distention	119 (47)	113 (34)
Abdominal pain	86 (34)	41 (12)
Acute respiratory distress	27 (11)	0 (0)
Cyanosis	24 (10)	3 (0.9)
Hematemesis	23 (9)	5 (1.5)
Apnea	21 (8)	5 (1.5)
Failure to thrive/growth retardation	16 (6)	100 (30)
GERD	0 (0)	40 (12)
Colic	0 (0)	32 (10)
Dyspnea	14 (6)	22 (7)

were of children aged  $\leq 12$  months. Forty-six were of the organoaxial type, and 42 were primary gastric volvulus (89%). Causes of secondary volvulus in this group were (1 case each) diaphragmatic eventration, HH, hypertrophic pyloric stenosis, previous CDH repair, and previous gastric pull-through for esophageal atresia. Although nonbilious emesis was the most common symptom (74%), apnea and cyanosis were seen more commonly in this population with acute-on-chronic volvulus (45%) than in the acute-volvulus group as a whole. Twenty-six (55%) of 47 children received surgical correction for gastric volvulus, with 12 receiving a laparoscopic gastropexy and 8 receiving an open gastropexy. There were no deaths in this group regardless of whether surgical correction was performed.

The majority of pediatric cases reported, 329 (57%) of 581 total cases, were of the chronic, recurrent, or intermittent type of gastric volvulus. There was a male predominance (55%) and a predilection for the very young: 235 (71%) of 329 patients were aged  $\leq 12$  months, 52 (16%) patients were 1 to 5 years old, 22 (7%) patients were 6 to 12 years old, and 17 (5%) patients were 13 to 18 years old. In 3 cases age was unknown.

In contrast to the acute presentation, 3 (74%) of every 4 cases of chronic gastric volvulus were of primary etiology. A vast majority (85%) of all chronic cases were organoaxial, whereas 10% of the cases were mesentero-axial and 3% were of the combined type. Four cases were of undetermined type. The most common associated anomalies included 13 HHs, 13 cases of wandering spleen, 10 CDHs, 10 diaphragmatic eventrations, and 8 PEHs.

Common presenting signs and symptoms of chronic volvulus are listed in Table 3. Nonbilious emesis was the most common presenting symptom. Feeding problems, or growth failure, was seen more prominently in chronic rather than acute volvulus cases. Other symptoms less commonly seen in acute cases included gastroesophageal reflux disease (GERD) and dyspnea.

A total of 44 (13%) children diagnosed with chronic gastric volvulus had radiologic evidence of GERD. Nineteen children were treated nonoperatively, with resolution of GERD symptoms reported in 11 cases.<sup>19</sup> No follow-up was reported in the remaining 8 cases.<sup>59</sup>

\*Refs 23, 75, 77, 78, 111, 118, 156, and 165.

Twenty-five children with chronic volvulus and GERD proceeded to surgical repair of their gastric volvulus, with 24 receiving anterior gastropexies (and 22 of those also receiving fundopexies) and 1 being treated with a gastrostomy tube.<sup>19,64,125</sup> Of these, 2 children developed recurrent GERD symptoms postoperatively, which required gastric fundoplication. No additional symptoms were noted for these 2 children.

It is compelling to review the divergent treatment patterns for children with chronic gastric volvulus around the world. A large percentage of children were treated nonoperatively, with wide variations including, for example, 8 (57%) of 14 children in Africa, 46 (57%) of 81 children in Europe, and 74 (36%) of 205 children in Asia who were treated successfully without surgery. It is surprising that only 2 (7%) of the 28 children reported in North America were managed nonoperatively. The single child with gastric volvulus reported from South America had surgery.

The reported cases of nonoperative management for chronic volvulus typically included positioning the infant on his or her right side or in the prone position, with the head elevated above the torso after feeding. This allowed for the dependent portion of the distended stomach to remain inferior to the lesser curvature, which reduces the tendency of the stomach to twist on itself.<sup>19,36,65,141</sup> The most common operative procedure performed to treat chronic gastric volvulus was gastropexy (150 [75%] of all operative cases). Nine laparoscopic gastropexies were included in the overall total.

The overall mortality rate for chronic gastric volvulus was 2.7% worldwide, including 0.8% mortality of those treated medically and 4% who suffered postoperative mortality. Of the 9 deaths, 6 may have been preventable with timely surgical intervention: 1 child developed septicemia and disseminated intravascular coagulopathy postoperatively after presenting for surgical repair with severe dehydration after months of intermittent emesis<sup>67</sup>; 4 postoperative deaths from sepsis were attributed to delayed diagnosis and malnutrition<sup>152</sup>; and the 1 medical mortality was a result of recurrent aspiration and subsequent pulmonary infection.<sup>182</sup>

Fourteen children presented with chronic volvulus after  $\geq 1$  gastric procedure, including 3 pyloromyotomies,<sup>30,126</sup> 4 Nissen fundoplications (including case 2 above),<sup>41,50</sup> 4 gastrostomy tubes (2 with Nissen fundoplications),<sup>14,50</sup> 3 gastropexies,<sup>54,119</sup> 1 omphalocele repair,<sup>41</sup> 1 gastric pull-through for esophageal atresia,<sup>44</sup> and 1 percutaneous endoscopic gastrostomy-tube placement.<sup>158</sup> All 14 children received corrective surgery, including 9 gastropexies.

## DISCUSSION

Gastric volvulus may present as an acute, life-threatening event that carries significant mortality if not recognized and treated in a timely fashion. Cole and Dickinson<sup>53</sup> reported an overall mortality rate of 65% in case reports of children with acute gastric volvulus before 1950. Prompt diagnosis is facilitated by awareness and recognition of common patterns of presentation: sudden

onset of persistent, nonbilious emesis, frequently accompanied by epigastric pain and distention and less commonly by respiratory distress, cyanosis, or hematemesis. A plain radiograph of the chest may show a widely distended stomach at or above the level of the diaphragm, lying in either a horizontal (organoaxial) or vertical (mesenteroaxial) plane.

Confirmation of the diagnosis is obtained via a UGI contrast study, followed by surgical treatment with either open or laparoscopic techniques. Although the procedure of choice may vary depending on associated pathologic findings, care must be taken to adequately repair any diaphragmatic defect found: Stephenson and Hopkins<sup>161</sup> reported the recurrence of acute gastric volvulus in 1 child despite adequate, wide-based anterior gastropexy that, however, left the diaphragmatic eventration unrepaired.

Although several authors have concluded that acute volvulus is treated adequately by repairing any associated defects with simple reduction of the stomach,<sup>49</sup> some authors have questioned this approach. Two reported cases exist of recurrent primary volvulus in children after simple reduction<sup>42,184</sup>; another child experienced recurrent secondary volvulus with repaired CDH after an initial treatment using simple reduction<sup>53</sup>; and there has been 1 reported case of recurrent volvulus through a large HH after Nissen fundoplication without anterior gastric fixation.<sup>162</sup> However, recurrent gastric volvulus has not been reported in most acute cases (56 of 60 [93%]) treated with gastric reduction alone.

Two cases of recurrent primary volvulus after anterior gastropexy in adults have been reported.<sup>98,185</sup> Gastric volvulus has also been reported in children after gastropexy for other indications, including dextrogastric,<sup>119</sup> gastric torsion,<sup>54</sup> and PEH.<sup>54</sup> As noted above, gastric volvulus has also occurred after gastrostomy-tube placement by open, laparoscopic, and endoscopic techniques.

Given these reports, it is difficult to state conclusively that anterior gastric fixation is required for repair of secondary volvulus once the associated defect has been repaired effectively; however, anterior gastric fixation should be performed for cases of primary gastric volvulus not amenable to medical therapy. Overall, 317 (55%) of 581 pediatric cases have been treated with anterior fixation with either gastropexy or gastrostomy-tube placement. There is no evidence that an antireflux procedure is necessary at the time of volvulus repair, whether for primary or secondary gastric volvulus.

A mild association between GERD and chronic primary gastric volvulus has been reported.<sup>58,59,128</sup> Although no documented cases of GERD were reported in children with acute gastric volvulus, 44 (13%) of 329 children with chronic volvulus had radiologic evidence of GERD at the time of the volvulus diagnosis. Initial treatment for each of these children was directed toward correction of the volvulus only. In each case, GERD symptoms resolved once the volvulus was reduced. In only 2 of those 44 cases was a subsequent antireflux procedure necessary. Patients should be evaluated for GERD if symptoms persist after correction of the volvulus.

Chronic gastric volvulus presents as persistent or re-

current nonbilious emesis with epigastric distention and feeding intolerance. Abdominal pain, colic, and respiratory symptoms may also be present but are much less common. In Africa, Asia, and Europe, treatment is primarily medical, involving prone or right-lateral positioning in infants after feedings. In the Americas, treatment is primarily surgical. Overall, 40% of infants with chronic volvulus have been treated successfully without surgical intervention. Chronic gastric volvulus is more commonly reported outside the Americas, which may indicate a more common usage of UGI studies for diagnosis in infants with persistent emesis or feeding intolerance in Asia, Africa, and Europe. Similar symptoms found in infants in the Americas are more likely to be attributed to GERD; perhaps the symptoms caused by undiagnosed chronic gastric volvulus or torsion may, in many cases, be treated adequately with nonsurgical antireflux therapy.

For more thorough and accurate comparisons among continents, evidence of complete gastric obstruction, even if intermittent, should be gathered before the diagnosis of gastric volvulus is made. In addition, it is important to remember that 1 (12.5%) in 8 children with chronic gastric volvulus developed acute symptoms, with 28 (60%) of 47 ultimately requiring life-saving resuscitation. It is possible that many recently reported cases of chronic secondary volvulus are detected before the development of acute symptoms and, therefore, should be treated proactively with surgery before symptoms have a chance to become acute.

The mortality rate for acute gastric volvulus in children is more than twice that of chronic gastric volvulus and seems to be unchanged regardless of whether the child requires life-saving resuscitation at the time of presentation. More than two thirds of the deaths reported from either acute or chronic gastric volvulus seem to be attributable to delays in reasonable and appropriate surgical intervention.

## CONCLUSIONS

Gastric volvulus is a distinct clinical condition that may present in both acute and chronic forms, each with distinctive patterns of presentation. Surgical intervention is necessary for the acute presentation as well as for volvulus secondary to pathology of adjacent organs. We recommend operative treatment of documented primary chronic gastric volvulus. On the basis of reports from outside the United States, watchful waiting may be acceptable, to some extent, in cases that are difficult to document. However, waiting and watching must be tempered by rapid surgical response to avoid life-threatening complications in a disease proven to be correctable through surgery. Gastric volvulus is not the rare condition it was once thought to be; as Youssef et al<sup>186</sup> stated more than 20 years ago, "perhaps this entity is more common than generally thought." It does require a heightened sense of awareness by pediatric providers to avoid delays in appropriate therapy and minimize the risk of gastric ischemia and perforation, which can lead to death.

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