

Short Communication

Midgut clockwise whirlpool: A case report and review of Gray scale and Color Doppler ultrasonographic findings

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Abstract

Midgut volvulus is a cause of acute abdomen in neonates and infants. Learning to recognize the US findings of midgut volvulus is imperative, and it should always be considered in the differential diagnosis of abdominal pain in the pediatric population. For the neonate with the classic appearance of a whirlpool sign, additional imaging investigation is often unnecessary, and the surgeon should be alerted to plan for emergency surgery. Until now, the diagnosis of this condition has relied on upper gastrointestinal barium studies. We describe a case of midgut volvulus diagnosed on ultrasound after observing the “whirlpool sign.” This sign corresponds to a clockwise wrapping of the superior mesenteric vein and the mesentery around the superior mesenteric artery. Using ultrasound as an investigation modality when suspecting midgut volvulus in neonates and infants is also emphasized. Also, the advantages of US for this age group are apparent, since it can be performed at the bedside in intensive care units and lacks the adverse effects of ionizing radiation.

Keywords: Midgut; ultrasound; volvulus; “whirlpool sign”

1. Introduction

Midgut volvulus is a cause of acute abdomen in neonates and infants. Learning to recognize the US findings of midgut volvulus is imperative, and it should always be considered in the differential diagnosis of abdominal pain in the pediatric population. For the neonate with the classic appearance of a whirlpool sign, additional imaging investigation is often unnecessary, and the surgeon should be alerted to plan for emergency surgery. Until now, the diagnosis of this condition has relied on upper gastrointestinal barium studies.

2. Case Report

5 year old boy presented in a rural tertiary health centre in emergency hours with acute abdominal pain, bilious vomiting and generalized abdominal tenderness. The possibility of hypertrophic pyloric stenosis was kept. On ultrasonography the diagnosis of midgut volvulus was made.

Fig. 1: Transverse sonogram showing “whirl”-like pattern of small bowel loops in mid-abdomen.

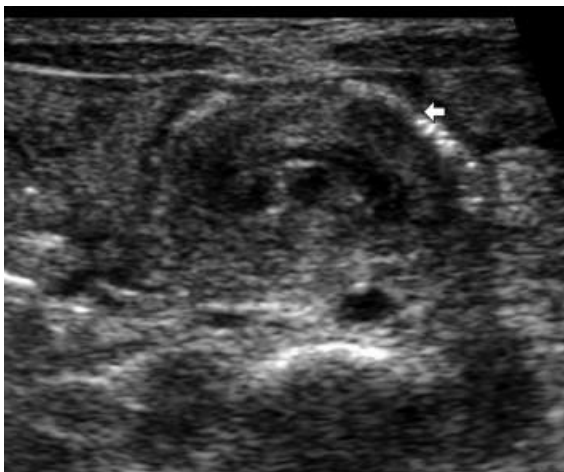
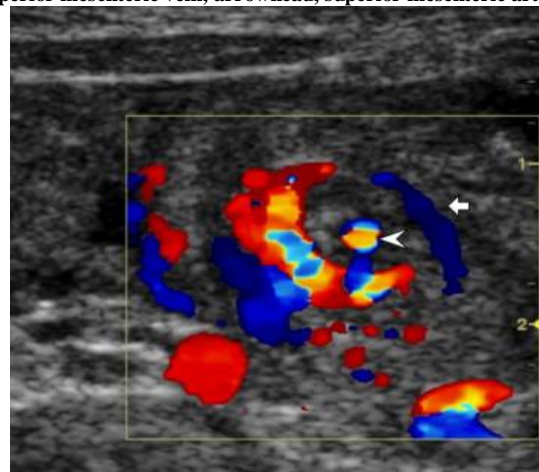


Fig. 2: Color Doppler ultrasound showing “whirlpool sign,” clockwise rotation of superior mesenteric vein, and small bowel around centrally placed superior mesenteric artery. Arrow, superior mesenteric vein; arrowhead, superior mesenteric artery.



3. Discussion

The whirlpool sign is found on transverse abdominal sonograms of newborns and young infants. This swirling, whirlpool like shape is created when the superior mesenteric vein (SMV) and the mesentery wrap around the superior mesenteric artery (SMA) in a clockwise direction (Fig 1), which indicates midgut volvulus. Visualization is enhanced by the vascular signal at color Doppler flow US^{1,2} (Fig 2). The intestinal tract and the mesenteric vessels become twisted, resulting in secondary venous engorgement. The SMV and its tributaries wrap around the SMA in a clockwise direction as a result of the volvulus.

Shimanuki *et al*³ found that the whirlpool sign consists of a side-by-side arrangement of vessels with opposing flow directions, indicating that the whirlpool contains not only the SMV and its tributaries but also branches of the SMA.

As the embryologic process of normal counterclockwise rotation is completed, the midgut (which is the portion of the bowel supplied by the SMA) becomes fixed and stabilized in its final position by the mesentery and peritoneum. The normal mesentery has a broad base, which extends from the left upper quadrant at the duodenojejunal junction (ligament of Treitz) to the cecum in the right lower quadrant. Midgut malrotation refers to a spectrum of congenital intestinal anomalies of position resulting from a nonrotation or an incomplete counterclockwise rotation of the primitive intestinal loop around the axis of the SMA during fetal development. The failure to complete rotation results in an abnormal base of the mesentery, which can predispose the neonate to volvulus of the midgut (the subsequent twisting of the bowel around the SMA), which may or may not cause bowel obstruction. This volvulus is responsible for the whirlpool-like appearance on cross-sectional images⁴⁻⁷. The direction of the volvulus should be clockwise, since Shimanuki *et al* noted counterclockwise whirlpool in patients with enteritis³.

Midgut volvulus is a life-threatening emergency that can occur in the intestinal tract of a neonate. If not promptly diagnosed and treated, it leads to death or a lifelong dependence on total parenteral nutrition in survivors with short bowel syndrome. Although usually seen in the neonatal period, it may also occur later in life. Bile-stained emesis and occasional bloody stools are the main presenting clinical indicators and require a rapid imaging investigation^{2,4}.

The whirlpool sign can aid diagnosis of midgut volvulus when seen on cross-sectional images, including those produced with computed tomography. Findings on abdominal radiographs are due to obstruction of the duodenum and/or bowel ischemia. Key signs of midgut volvulus include a jejunal bowel pattern on the right and variable degrees of duodenal obstruction due to peritoneal bands or a volvulus. The right lower quadrant may appear empty, since the malpositioned cecum often lies within the left hemi abdomen^{2,4}.

An important consequence of malrotation is malfixation of the intestines. Malfixation is inferred from malpositioning of the duodenojejunal junction or the cecum. Barium enema studies have fallen out of favor as the preferred diagnostic modality for malrotation, since the cecum may be positioned normally in as many as 20% of patients with malrotation⁴. In general, the diagnosis of this potentially fatal disorder is made by means of upper gastrointestinal (GI) series documenting the position of the duodenojejunal flexure. The location of the duodenojejunal flexure is an accurate indicator of malrotation and is classically depicted with the upper GI examination. The normal position of the duodenojejunal flexure is to the left of the pedicles of the spine and to the level of the duodenal bulb on an anteroposterior view of a well-positioned patient. Virtually all patients with malrotation will have a duodenojejunal flexure to the right of or below the normal position. In 1992, Dufour *et al* examined over 300 patients with ultrasonography. Finding the superior mesenteric vein (SMV) to the left of the SMA was highly suggestive of malrotation, while an anterior SMV was questionable⁸.

Learning to recognize the US findings of midgut volvulus is imperative, and it should always be considered in the differential diagnosis of abdominal pain in the pediatric population⁷. For the neonate with the classic appearance of a whirlpool sign, additional imaging investigation is often unnecessary, and the surgeon should be alerted to plan for emergency surgery. At some institutions, diagnosis of volvulus with US alone indicates the need for surgery, whereas at other institutions require confirmation with an upper GI series^{2,7}.

In summary, the whirlpool sign is an indicator of midgut volvulus on transverse US studies and enables the imaging diagnosis.

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