MALROTATION OF MIDGUT: ULTRASOUND FEATURES

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ABSTRACT

Ultrasound features of Malrotation of midgut with or without volvulus are described. The three signs are Inversion of Superior Mesenteric Vessels, Whirlpool sign, dilated proximal duodenum with course of distal duodenum to right instead of left. The findings in ten patients with surgical confirmation are described. Ultrasound is a useful Screening investigation in children presenting with vomiting.

Key Words: Malrotation of Midgut, Ultrasound, Inversion of Superior Mesenteric Vessels, Whirlpool sign.

The expanding role of Ultrasound (US) in the diagnosis of gastrointestinal disorders, particularly in infants and children, often makes US the first diagnostic approach for a variety of abdominal symptoms and signs. There are increasing reports of its use in malrotation of midgut. Malrotation of midgut is a congenital anomaly which has a varied presentation. It also presents in different age groups from newborn period to adolescence. Ultrasound features of malrotation with and without volvulus are already described. A series of 10 patients with malrotation is presented here.

MATERIALS & METHODS

Ten patients were diagnosed to have malrotation of midgut by Ultrasound during the period 1990 to 1998. Their age ranged from 12 days to 46 years. The clinical presentation was vomiting and three patients also had pain abdomen. During Sonography concentration was for inversion of the relationship of Superior Mesenteric Artery (SMA) and Superior Mesenteric Vein (SMV). The anatomic relationship between the SMA and SMV were evaluated with realtime Ultrasound. The equipments were initially ADR 4000 and then ATL Ultramark 4 and ATL HDI Ultramark 9 with 3.5 to 10MHz transducers. The SMA was identified at its origin on the anterior wall of the aorta. The SMV was identified by tracing it from the portal vein confluence. Both vessels were scanned as far caudally as technically possible. The vessels were considered to be inverted if the SMV was to the left of the left lateral margin of the SMA. When inversion was seen diagnosis of malrotation of midgut was made. In three patients presenting with pain, in addition to inversion of vessels the "whirlpool sign" was seen indicating volvulus.

Figure 1 Transverse Scan to Show the normal relationship of superior mesentric vessels-vein to right of artery.

Three patients underwent upper GI barium study which confirmed malrotation. All the patients were operated.

Results

Results are displayed in the table. At surgery all the ten patients were found to have malrotation of midgut with duodenal obstruction. The obstruction was due to Ladd's bands in six patients. Three patients who had whirlpool sign had volvulus in addition but there was no ischemia. The fourth patient who had pain in addition to vomiting but did not have whirlpool sign had volvulus at surgery. But There was an
interval of 4 days between Ultrasound examination and surgery. The presentation was acute in 7 patients and so were taken up for surgery without further investigations. Three patients of ages 8 years, 10 years and 46 years had intermittent symptoms and so had upper GI series confirming the malrotation. There was a great variation in the age of presentation from 12 days to 15 years with one patient at 46 years.

DISCUSSION

Malrotation of midgut reflects incomplete rotation and fixation of the midgut after it passes into the umbilical stalk and returns to the coelom. The usual broad mesenteric attachment from ligament of Treitz to the right lower quadrant is replaced by a short attachment around the SMA that permits volvulus. Peritoneal bands fix the high-riding caecum (Ladd bands)

![Figure 2](image)

Inversion of superior mesenteric vessels – the vein to left of artery.

and can be accompanied by more proximal bands between the duodenum and jejunum. These bands compress the duodenum or cause kinking of the duodenojejunal junction producing obstruction.

Ultrasound is emerging as a diagnostic tool to investigate children with vomiting, which is the usual presenting symptoms of midgut malrotation. The features of malrotation on US varies with the cause of vomiting, ie Ladd's bands, volvulus or kink of DJ junction. The hallmark of diagnosis is the inversion of the SMA and SMV which was seen in all the patients in this series and one report of 24 patients. In another study of 9 patients the relations between SMA and SMV was normal in two patients but there was malrotation at surgery. Normally the SMV is to the right of SMA (Fig 1). The vessels were considered to be inverted if the SMV was to the left of the lateral margin of SMA (Fig 2). The cause of the inversion of SM vessels in malrotation is unknown, although it has been assumed to be directly related in some fashion to the anomaly of intestinal rotation, volvulus or both.

When there is volvulus the "Whirlpool" sign is seen. This sign is produced by the wrapping of the gut and the SM vessels around the short mesentery which acts as the axis. In an axial section it appears as a round mass of concentric layers with a brightly echogenic central axis formed by multiple wrapping of the mesentery (Fig 3).

![Figure 3](image)

Transverse scan below the pancreas shows the round mass of concentric layers and the echogenic centre.

With color flow mapping the paired SMA and SMV is seen on either side of the axis within the mass (Fig 4).

With color box on the mass if the transducer is moved down, the classical whirlpool is seen. The paired SM vessels are seen to go around the echogenic axis in the centre many times depending on the number of turns of the volvulus. As volvulus becomes increasingly tight, the venous return
is impeded and the bowel becomes edematous and enlarged which can be seen on US as described by Leonidas et al. Further twisting causes arterial blockage and gangrene.

Another US sign described is dilated fluid filled proximal duodenum, an abnormal course of distal duodenum to the right instead of left and beaklike appearance of the site of obstruction. This was seen in one of our patients (Fig 5) who presented at the age of 46 with history of intermittent symptoms of pain and vomiting.

In conclusion, there are three different appearances on US in midgut malrotation depending on the cause of symptoms. The hallmark is the inversion of SM vessels which is seen in almost all patients of malrotation. This sign is enough to diagnosis malrotation. If the obstruction is due to Ladd bands a dilated proximal duodenum and abnormal course of distal duodenum with beak like ending is seen. If there is volvulus the "Whirlpool" sign is seen. The convenience, lack of ionising radiation and noninvasive nature of sonography make it an appealing modality for use in diagnosing midgut malrotation particularly since the symptoms are nonspecific.
<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex / Age</th>
<th>Clinical Findings</th>
<th>Sonographic Findings</th>
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<th>Surgical Findings</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>M/46 y</td>
<td>Intermittent attacks of vomiting and abdominal pain</td>
<td>Inversion of vessels. Dilated proximal duodenum, abnormal course of distal duodenum with beak end</td>
<td>Malrotation with cork screw appearance of distal duodenum and proximal jejunum</td>
<td>Malrotation with Ladd bands</td>
</tr>
<tr>
<td>2.</td>
<td>M/8 y</td>
<td>Intermittent vomiting</td>
<td>Inversion of superior mesenteric vessels</td>
<td>Malrotation</td>
<td>Malrotation with Ladd Bands</td>
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<td>3.</td>
<td>M/6 y</td>
<td>Pain and vomiting - 1 day</td>
<td>Inversion of superior mesenteric vessels “Whirlpool” sign</td>
<td>Not done</td>
<td>Malrotation with volvulus</td>
</tr>
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<td>4.</td>
<td>M/1 m</td>
<td>Vomiting 2 days</td>
<td>Inversion of superior mesenteric vessels. Dilated duodenum</td>
<td>Not done</td>
<td>Malrotation with Ladd Bands</td>
</tr>
<tr>
<td>5.</td>
<td>M/2 y</td>
<td>Recurrent pain and vomiting</td>
<td>Inversion of superior mesenteric vessels</td>
<td>Not done</td>
<td>Malrotation with volvulus *</td>
</tr>
<tr>
<td>6.</td>
<td>F/12 d</td>
<td>Vomiting</td>
<td>Inversion of superior mesenteric vessels</td>
<td>Not done</td>
<td>Malrotation with Ladd Bands</td>
</tr>
<tr>
<td>7.</td>
<td>M/2 m</td>
<td>Vomiting</td>
<td>Inversion of superior mesenteric vessels</td>
<td>Not done</td>
<td>Malrotation with Ladd Bands</td>
</tr>
<tr>
<td>8.</td>
<td>M/15 y</td>
<td>Pain and vomiting 4 days</td>
<td>Inversion of superior mesenteric vessels “Whirlpool” sign”</td>
<td>Not done</td>
<td>Malrotation with volvulus</td>
</tr>
<tr>
<td>9.</td>
<td>M/3 m</td>
<td>Vomiting</td>
<td>Inversion of superior mesenteric vessels “Whirlpool” sign</td>
<td>Not done</td>
<td>Malrotation with volvulus</td>
</tr>
<tr>
<td>10.</td>
<td>F/10 y</td>
<td>Rec. Vomiting</td>
<td>Inversion of superior mesenteric vessels</td>
<td>Malrotation</td>
<td>Malrotation</td>
</tr>
</tbody>
</table>

* Surgery was done 4 days after US examination.
REFERENCES