

Intestinal Nonrotation

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A woman in her twenties presented to a general practitioner with upper-abdominal pain. An ultrasound performed in the clinic revealed gallstones. Subsequently, she sought care at a private hospital, where a computed tomography (CT) scan confirmed those gallstones. Incidentally, the scan also demonstrated small bilateral pleural effusions and a congenital bowel anomaly. After her recovery, she was referred to the hospital, and an abdominal radiograph was obtained (**Figure 1**).

What is the diagnosis?

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Answer: Intestinal nonrotation

The abdominal radiograph demonstrated that the colon was located centrally and on the left side of the abdomen, consistent with intestinal nonrotation (**Figure 2a**). In contrast, a normal radiograph (**Figure 2b**) shows the colon beginning in the right flank (ascending colon), coursing across the upper abdomen (hepatic flexure and transverse colon), reaching the left upper quadrant (splenic flexure), descending along the left flank, and entering the pelvis as the sigmoid colon and rectum, enclosing the small bowel. The CT scan had incidentally identified this congenital anomaly, which was likely unrelated to her presenting symptoms. The patient remained asymptomatic following recovery, with no recurrence of symptoms.

Intestinal nonrotation is a congenital variant within the spectrum of intestinal rotational anomalies broadly termed as malrotation - intestinal nonrotation, incomplete rotation, reverse rotation and anomalous fixation of the mesentery.¹ It arises when the embryonic midgut fails to complete the standard sequence of counterclockwise rotation during the foetal period.^{1,2}

The midgut develops between the 5th and 12th weeks of foetal development (**Figure 3**). In the first stage, around the 6th week, the midgut rapidly elongates and outgrows the abdominal cavity and herniates

through the umbilical ring as a U-shaped portion into the umbilical cord with the vitelline duct as its apex. The cephalic or cranial limb gives rise to the distal duodenum through to the ileum, while the caudal limb forms the distal ileum to the distal two-thirds of the transverse colon.²

During herniation, the midgut rotates 90° counterclockwise around its axis, the superior mesenteric artery (SMA). In the second stage (approximately weeks 10–12), the intestinal loops return to the abdominal cavity. As they retract, they undergo an additional 180° counterclockwise rotation, completing a total of 270° rotation.¹ In normal anatomy, this positions the small intestine centrally, surrounded by the colon (**Figure 3a**). Any deviation from this process will result in congenital anomalies.^{1,2} In nonrotation, disruption occurs during the second stage with the failure of the 180° counterclockwise rotation to occur. Consequently, the small bowel remains fixed on the right, and the colon on the left of the abdomen of the SMA (**Figure 3b**).

Intestinal nonrotation can be associated with various intra-abdominal anomalies, including pancreatic malformations (e.g., dorsal pancreatic agenesis), biliary system (e.g., gallbladder agenesis), and gastrointestinal tract malformations (e.g., duodenal atresia).^{1,3}

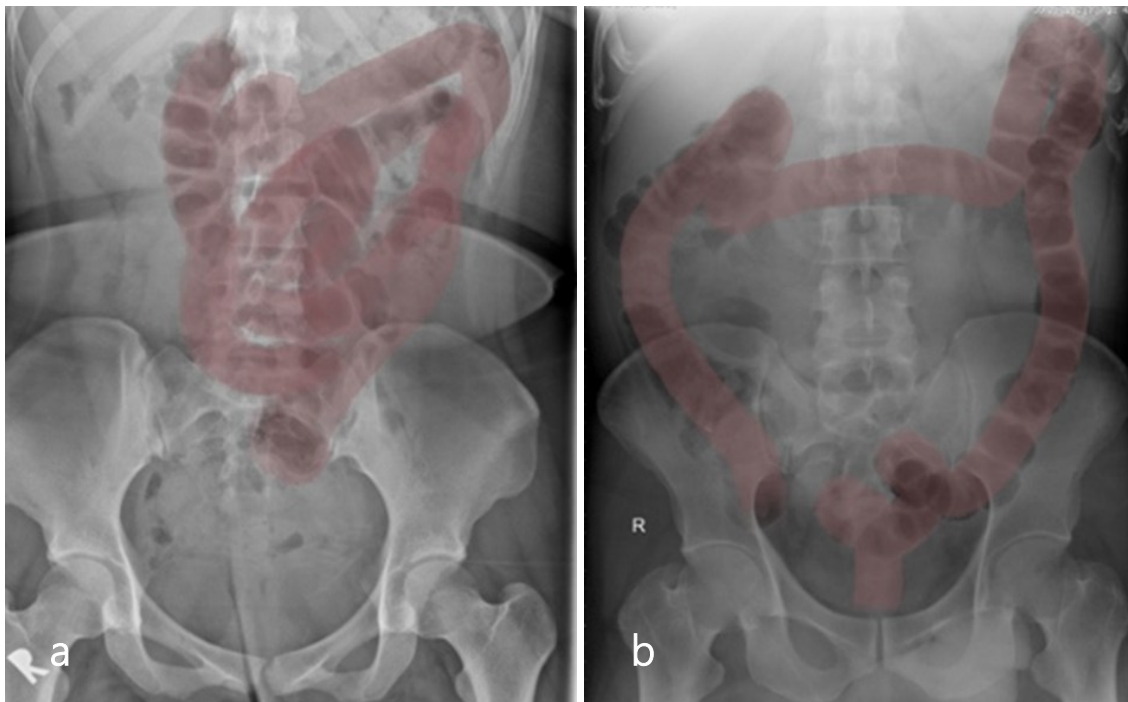


Figure 2: a) Abdominal radiograph comparing intestinal nonrotation and b) a normal colon highlighted in colour. (Annotations by Tan CCY).

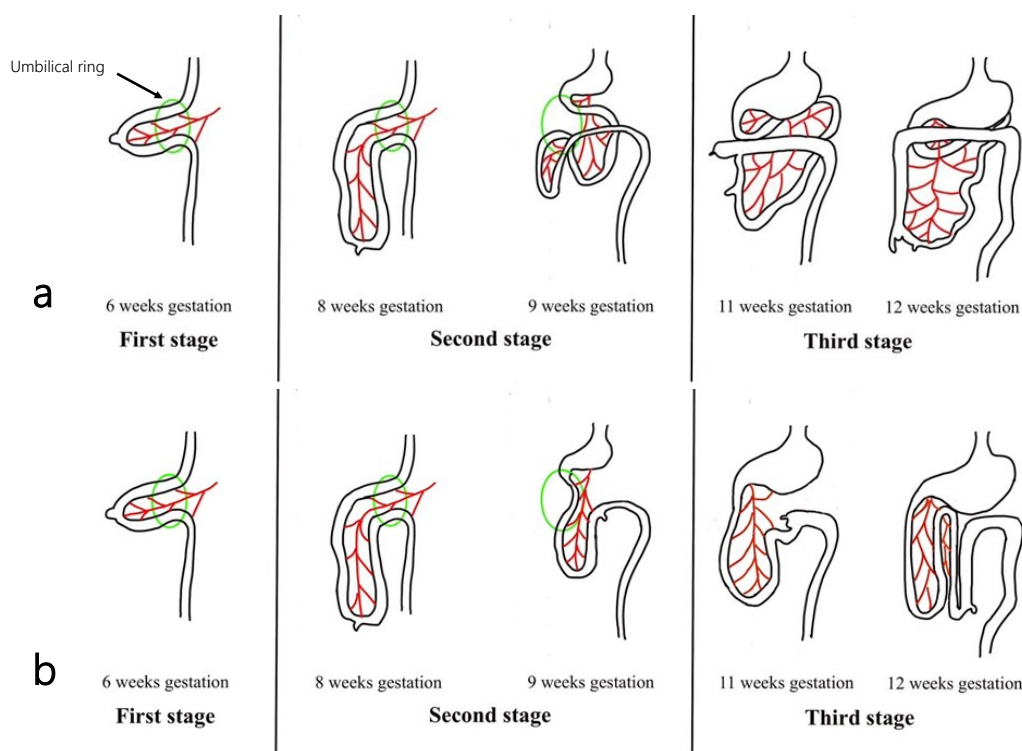


Figure 3: Developmental stages of the gastrointestinal tract – a) normal and b) nonrotation (Illustrations by Tan CCY).

Intestinal nonrotation can remain asymptomatic or present with acute or with chronic symptoms. In acute presentations, patients may develop acute bowel obstruction, or volvulus, which may lead to bowel ischaemia and necrosis.^{1,4} In chronic symptoms, patients may experience intermittent bowel symptoms of intermittent volvulus or obstruction.⁴ However, many individuals with this congenital anomaly remain asymptomatic throughout their lives. A significant concern is the potential for misdiagnosis or delayed diagnosis due to atypical presentations. For instance, appendicitis may present with left-sided abdominal pain, mimicking other conditions and complicating diagnosis.⁵ Additionally, the abnormal positioning of the colon can pose challenges during procedures like colonoscopy.⁶

Intestinal nonrotation is generally considered less clinically significant than intestinal malrotation. Malrotation occurs due to the failure of the small bowel to complete the 180° counterclockwise rotation during the second and third stages of development. The most common anomalies include the cecum located in the right upper quadrant and the ascending colon in the transverse colon position (Figure 3a - 11th week). Malrotation often presents with more acute symptoms and is associated with a higher risk of complications such as

midgut volvulus due to the smaller mesenteric base and the Ladd's band. In contrast, nonrotation is typically less symptomatic and may be discovered incidentally. However, both conditions can present with similar clinical features, making accurate diagnosis crucial for appropriate management. However, diagnosis can be challenging. Patient presenting with symptomatic pattern; only emergency laparotomy can provide the correct diagnosis. In the chronic situation, barium studies of the upper and lower gastrointestinal tract reveal varying degrees of midgut malrotation and confirm the nonrotation.⁴

Abbreviations

CT	Computed tomography
SMA	Superior mesenteric artery

Declarations

Conflict of interests

The authors declare no conflict of interests.

Patient Consent

Patient consent has been obtained.

Acknowledgement

None

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