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**ABOUT COVER**

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# Intestinal obstruction in pregnancy with reverse rotation of the midgut: A case report

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## Abstract

### BACKGROUND

Reverse rotation of the midgut is a rare type of intestinal malrotation. Volvulus of the right colon or entire midgut, stenosis of the transverse colon and obstruction of the duodenojejunal junction are common complications of reverse rotation. In this study, we report the first case of intestinal obstruction associated with reverse rotation in pregnancy.

### CASE SUMMARY

A 31-year-old woman at 36<sup>+2</sup> wk gestation presented to the emergency department with progressive abdominal cramping, nausea and bilious vomiting. Abdominal ultrasound scanning showed dilatation of the bowel. Computed tomography scanning revealed features of reverse rotation of the midgut with intestinal volvulus. After consultation with the obstetrician, the pregnancy was terminated and exploratory abdominal surgery was performed. Intra-operatively, it was found that the mesentery of the colon and small intestine was insufficiently attached. The right colon and the small intestinal mesentery was twisted, and intestinal necrosis was observed. The duodenum and duodenojejunal junction were curved in front of the transverse colon, and the transverse colon passed through the tunnel behind the mesenteric root. Intestinal reverse rotation with volvulus was confirmed. The necrotic intestine was resected and small intestine mesenteric reconstruction was performed. The patient recovered after surgery. After leaving the hospital, the patient and her daughter remained well during an 8-month follow-up period.

### CONCLUSION

We report the diagnosis, treatment and etiology of a pregnant patient with intestinal obstruction due to reverse rotation of the midgut. For similar cases, appropriate diagnosis and treatment should be carried out according to the condition of the fetus and pregnant woman.

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**Core tip:** Reverse rotation of the midgut is the rarest type of intestinal malrotation, accounting for approximately 2%-4%. The most common feature is that the transverse colon lies behind the superior mesenteric artery and the duodenum is located in front of the superior mesenteric artery. In this study, we report the case of intestinal obstruction associated with reverse rotation of the midgut in pregnancy. Due to reverse rotation, the patient had insufficient attachment of the ascending colon and small bowel mesentery. As the uterus enlarged, the intestinal canal shifted, causing intestinal volvulus and obstruction. To our knowledge, this is the first report of a pregnant patient with reverse rotation of the midgut.

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## INTRODUCTION

Pregnancy complicated by intestinal obstruction is very rare, with an incidence of between approximately 1/5000 and 1/66000<sup>[1]</sup>. Intestinal volvulus is responsible for 25% of acute bowel obstructions in pregnant women. More importantly, intestinal obstruction complicating pregnancy results in maternal mortality of 6% and fetal mortality of 26%<sup>[2]</sup>.

Intestinal malrotation is a congenital malformation. Malrotation can be traced to a congenital anomaly of intestinal rotation in the early stages of embryonic development, with a failure of mesentery attachment to the retroperitoneal wall<sup>[3]</sup>. Most patients are diagnosed in the first year of life, it is rarely observed in adults<sup>[4,5]</sup> and is even rarer during pregnancy<sup>[6]</sup>. Reverse rotation of the midgut is a rare type of intestinal malrotation. The most common feature is that the transverse colon lies behind the superior mesenteric artery (SMA) and the duodenum is located in front of the SMA<sup>[7]</sup>. Volvulus of the right colon or entire midgut, stenosis of the transverse colon and obstruction of the duodenojejunal junction are common complications of reverse rotation.

In this report, we describe a pregnant patient with malrotation of the midgut, and describe the diagnosis, treatment and pathogenesis of this case. To our knowledge, this is the first case of malrotation of the midgut in pregnancy.

## CASE PRESENTATION

### Chief complaints

A 31-year-old woman at 36<sup>+</sup>2 wk gestation presented to the emergency department with progressive abdominal cramping, nausea and bilious vomiting.

### History of present illness

The patient's symptoms started the previous day. She denied fevers, diarrhea, hematochezia and melena. She was treated with intravenous fluids and antispasmodic and analgesic therapy in a local hospital. However, the patient's symptoms did not significantly improve.

### History of past illness

Gravidity 2, para 1-0-0-1. A history of left ovarian teratoma resection four years previously, and a new-onset right ovarian teratoma for seven mo.



**Physical examination**

Vital signs were stable. Temperature was 37.2°C, heart rate was 90 bpm, respiratory rate was 24 breaths per minute, and BP was 120/70 mmHg. Abdominal examination revealed tenderness of the bilateral abdomen and subxiphoid area, without rebound tenderness. Fundal height was consistent with gestational age.

**Laboratory examinations**

Leukocytosis of  $14.21 \times 10^9/L$ , neutrophils of 90.0%, D-dimer of 6975 ng/mL, and FIB of 4.64 g/L were observed. The other laboratory examination results were unremarkable.

**Imaging examinations**

In the emergency department, abdominal ultrasound and gynecological ultrasound examination were performed. Abdominal ultrasound indicated the following: (1) Dilatation of the intestine in the abdominal cavity, with a small amount of peritoneal effusion; (2) No abnormalities were found in the gallbladder and urinary system; and (3) An enlarged appendix was not found. Gynecological ultrasound indicated the following: (1) Fetus was not deformed; and (2) Fetal heart rate was 160 bpm. According to her physical examination and ultrasound results, the patient was suspected to have intestinal obstruction. To determine the cause of intestinal obstruction, an abdominal computed tomography (CT) scan was carried out and the risks to the patient and her family were explained. The CT scan showed that the mesentery was twisted around the SMA resulting in a “whirlpool” sign. The dilated ascending colon had moved to the left abdomen. The transverse colon was located behind the SMA (Figure 1). The above findings suggested that the diagnosis was reverse rotation of the midgut with volvulus.

**FINAL DIAGNOSIS**

Pregnancy with volvulus and congenital reverse rotation of the midgut.

**TREATMENT**

Following consultation with the obstetrician, we decided to terminate the pregnancy and perform exploratory abdominal surgery. After cesarean section, the patient gave birth to a baby girl. The baby's Apgar score was 4 at 1 min. After rescue therapy, the Apgar score rose to 9. Right ovarian teratoma exfoliation was also performed.

During exploratory abdominal surgery, purulent ascites was detected in abdominal cavity. The colon and small intestine mesentery was insufficiently attached. The right colon and the entire small intestinal mesentery were twisted, and the intestinal canal showed ischemic changes. The ascending colon and cecum were mobile. Although we de-rotated the mesentery and covered the ischemic intestinal tract with warm saline gauze for half an hour, the ascending colon, cecum and 78 cm of the small intestine were necrotic (Figure 2A). Further exploration of the abdominal cavity revealed that the duodenum and the duodenum jejunum were curved in front of the transverse colon, and the transverse colon passed through the tunnel behind the mesenteric root (Figure 2B). The diagnosis of reverse rotation of the midgut with volvulus was confirmed. The necrotic intestine was resected and mesenteric reconstruction was performed. The patient was transferred to the ICU where she recovered.

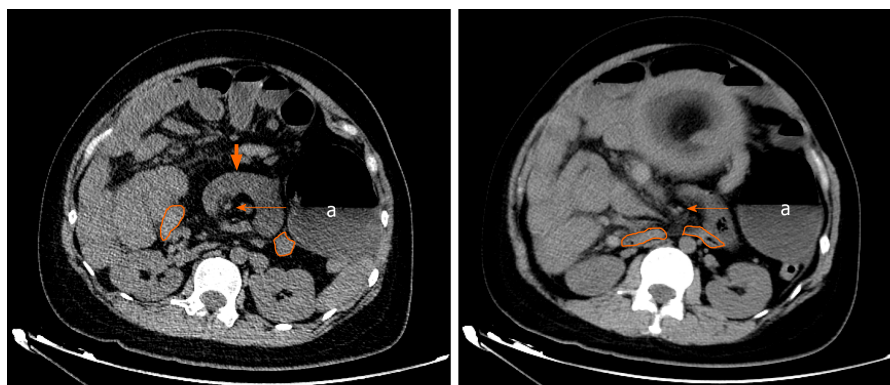
**OUTCOME AND FOLLOW-UP**

After leaving hospital, the mother and her daughter remained well during the 8-mo follow-up period.

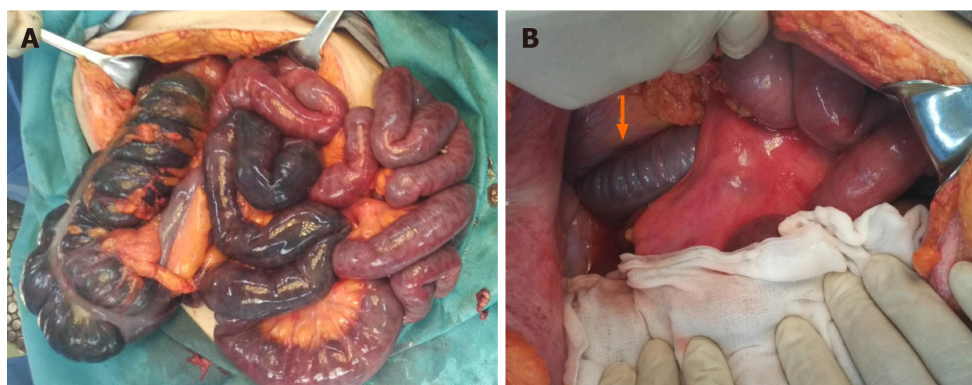
**DISCUSSION**

Reverse rotation of the midgut is the rarest type of intestinal malrotation, accounting for about 2%-4%<sup>[8]</sup>. The incidence in females is twice than in males<sup>[9]</sup>. In normal





**Figure 1 Computed tomography findings.** Twisting of the mesentery around the superior mesenteric artery (thin arrow) giving a “whirlpool” sign (thick arrow). The dilated ascending colon (a) was moved to the left abdomen. The transverse colon (irregular circle) was located behind the superior mesenteric artery.



**Figure 2 Intra-operative findings.** A: The colon mesentery was insufficiently attached. The ascending colon, cecum and 78 cm of the small intestine were necrotic; B: The transverse colon (arrow) passed through the tunnel behind the mesenteric root.

rotation, the midgut usually rotates 90° counterclockwise and then 180° counterclockwise with the SMA as the axis. However, in reverse rotation, the midgut is rotated 90° counterclockwise and then 180° clockwise. Estrada and Gurd<sup>[7]</sup> divided reverse rotation of the midgut into two subtypes: retro-arterial type and pre-arterial type<sup>[7]</sup>. The most common is the retro-arterial type, in which the transverse colon is located behind the SMA and the duodenum is located in front of the artery, while the position of the ascending-descending colon in relation to the liver is normal. The pre-arterial type is relatively rare, that is, the relative positions of the duodenum, transverse colon and SMA are normal, but the position of the ascending-descending colon in relation to the liver is reversed (the ascending colon is left-sided and the descending colon is right-sided). Reverse rotation of the midgut often results in volvulus of the ascending colon or entire midgut due to insufficient attachment of the mesentery, which is one of the pathogenic mechanisms of intestinal obstruction caused by reverse rotation<sup>[9]</sup>. The pregnant woman in the present study, with reverse rotation of the midgut, had a retroperitoneal transverse colon and insufficient attachment of the ascending colon and small bowel mesentery. As the uterus enlarged, the intestinal canal shifted, causing intestinal volvulus and obstruction.

We performed a literature search of PubMed, based on the terms “pregnancy” and “volvulus”. The results showed that volvulus in pregnancy often occurs in the sigmoid colon, with more than 100 cases<sup>[10-12]</sup>. Volvulus in other sites of the gastrointestinal tract, such as the cecum<sup>[13-15]</sup>, small intestine<sup>[16,17]</sup> and stomach<sup>[18]</sup> have also been reported. In the search results, we did not find any reported cases of volvulus in pregnancy caused by reverse rotation. Nine cases of volvulus caused by other types of intestinal malrotation were found<sup>[2,19-26]</sup>. Among them, 5 cases had extensive midgut volvulus and intestinal necrosis<sup>[19,20,23,25,26]</sup>. We performed another literature search to identify other complications caused by intestinal malrotation. The search terms used were: “Malrotation” or “nonrotation” or “reverse rotation” and “pregnancy”. In addition to the previous volvulus cases, we also retrieved one case of internal hernia<sup>[27]</sup> and one case with only symptoms of intestinal obstruction<sup>[28]</sup> (Table 1). No cases of pregnancy

Table 1 Literature review of pregnancy and intestinal malrotation

| Year | Author  | Age (yr) | Gestational age          | Imaging examination                  | Maternal complications                                      | Treatment                                   | Maternal and fetal prognosis                           |
|------|---|----------|--------------------------|--------------------------------------|---|---|--|
| 1998 | Ventura-Braswell <i>et al</i> <sup>[19]</sup> | 22       | 37 WA                    | NA                                   | Midgut volvulus + Intestinal necrosis                       | Termination of pregnancy + Surgery          | Maternal recovery, Fetal survival and no malformations |
| 2010 | Gaikwad <i>et al</i> <sup>[20]</sup>          | 27       | 33 WA                    | CT                                   | Midgut volvulus + Extensive bowel necrosis                  | Loss of surgical opportunity                | Maternal death, Fetal death                            |
| 2011 | Siwatch <i>et al</i> <sup>[21]</sup>          | 23       | 20 WA                    | CT, Upper gastrointestinal endoscopy | Midgut volvulus   | Maintained pregnancy + conservative therapy | Maternal recovery, Fetal survival and no malformations |
| 2013 | Sharma <i>et al</i> <sup>[2]</sup>            | 28       | 9 WA                     | US                                   | Transverse colon volvulus                                   | Maintained pregnancy + surgery              | Maternal recovery, Fetal survival and no malformations |
| 2013 | Kouki <i>et al</i> <sup>[22]</sup>            | 34       | 14 WA                    | US, MRI                              | Midgut volvulus   | NA  | NA   |
| 2014 | Hwang <i>et al</i> <sup>[23]</sup>            | 22       | 38 <sup>+2</sup> WA      | NA                                   | Midgut volvulus + ascending colon necrosis                  | Termination of pregnancy + surgery          | Maternal death, Fetal survival and no malformations    |
| 2016 | Joyeux <i>et al</i> <sup>[27]</sup>           | 33       | 32 WA                    | CT                                   | Internal hernia   | Termination of pregnancy + surgery          | Maternal recovery, Fetal survival and no malformations |
| 2017 | Yin <i>et al</i> <sup>[28]</sup>              | 23       | 9 WA-22 <sup>+4</sup> WA | MRI                                  | Intestinal obstruction                                      | Maintained pregnancy + conservative therapy | Maternal recovery, Fetal survival and no malformations |
| 2017 | Antunes <i>et al</i> <sup>[25]</sup>          | 38       | 27 WA                    | MRI                                  | Midgut volvulus   | Maintained pregnancy + surgery              | Maternal recovery, Fetal survival and no malformations |
| 2017 | Esterson <i>et al</i> <sup>[24]</sup>         | 28       | NA                       | US, MRI, CT                          | Small bowel volvulus + superior mesenteric artery occlusion | Maintained pregnancy + surgery              | Maternal recovery, Fetal survival and no malformations |
| 2020 | Chong <i>et al</i> <sup>[26]</sup>            | 27       | 32 WA                    | NA                                   | Midgut volvulus + intestinal necrosis                       | Termination of pregnancy + surgery          | Maternal recovery, Fetal death                         |

CT: Computed tomography; US: Ultrasound; MRI: Magnetic resonance imaging; NA: Not available.

with reverse rotation were identified.

Pregnancy with intestinal malrotation is relatively rare. However, once intestinal ischemia occurs, it can endanger the life of the mother and infant. Therefore, rapid diagnosis and treatment of these patients is particularly important. Some non-radiation examinations such as magnetic resonance imaging (MRI) and ultrasound are often chosen in these patients. However, the information obtained from ultrasound and MRI is often limited, and patients are often unable to cooperate with MRI due to the long time needed for this examination. CT is the best way to determine intestinal lesions, but CT is not chosen in pregnancy due to radiation exposure. Some studies have indicated that the fetal dose exceeds 100 mGy, which can significantly increase the risk of central nervous system damage, malformations and cancer<sup>[29,30]</sup>. However, the radiation dose with X-ray and CT is often less than 100 mGy<sup>[30]</sup>. Therefore, for pregnant women with suspected intestinal ischemia or perforation, low-dose CT can be performed, after excluding other factors (such as cholecystitis, appendicitis, urinary system and obstetric factors). For patients with mild symptoms, MRI or ultrasound examination can be selected. In the present case, the patient had severe abdominal colic, nausea, and vomiting. After routine antispasmodic and analgesic treatment, her symptoms were not relieved and white blood cells were elevated. These findings are highly suspicious of intestinal volvulus. When ultrasound does not detect lesions or the cause of the obstruction, CT can be performed.

Pregnant patients with intestinal malrotation usually attend the doctor due to symptoms of intestinal obstruction. Therefore, the treatment is the same as that for intestinal obstruction. For patients with mild intestinal obstruction without intestinal ischemia and sepsis, symptomatic relief and supportive treatment can be actively given, such as gastrointestinal decompression, parenteral nutrition, antispasmodic drugs, *etc*<sup>[21,28]</sup>. In patients who have developed serious complications, emergency surgery is required. Before 28 wk gestation, we should try to solve the obstruction

while maintaining the pregnancy. After 32 wk gestation, digestive surgery must be performed after an emergency cesarean section. Between 28 and 32 wk gestation, it should be determined whether to terminate the pregnancy according to fetal development and the condition of the pregnant woman. In this case, intestinal volvulus was confirmed by CT examination, and this patient was 36 wk gestation. Following the obstetrician's evaluation, the pregnancy was terminated.

## CONCLUSION

Reverse rotation of the midgut is a relatively rare congenital intestinal malrotation. We introduce the first pregnant patient with reverse rotation of the midgut, and revealed the pathogenesis of this condition. In similar cases, appropriate diagnosis and treatment is essential according to the gestational age and condition of the fetus and the condition of the pregnant woman.

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