# Intestinal Malrotation in a Patient with Gastric Cancer during Laparoscopic Total Gastrectomy: A Case Report

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AIM: Intestinal malrotation (IM) represents a rare congenital anomaly in adults, although it is more common during infancy. This condition originates during embryonic development due to incomplete rotation of the midgut around the superior mesenteric vessels. The primary aim of this case study is to emphasize the importance of surgeon awareness and recognition of this congenital anomaly during laparoscopic gastric surgery to avoid serious complications.

CASE PRESENTATION: A 45-year-old male presented to the clinic with a complaint of vague epigastric pain for two months. The patient underwent a comprehensive clinical evaluation, including laboratory tests, endoscopic examination, and radiological imaging. The diagnostic workup revealed early-stage gastric cancer. Incidentally, radiological studies also demonstrated a congenital non-rotation of the small bowel. Given the patient's congenital anatomical anomaly, a laparoscopic total gastrectomy was performed employing a reversed C-shaped Roux-En-Y limb reconstruction. Postoperative recovery was uneventful, and the patient was discharged in stable condition.

RESULTS: The patient was doing well at the 2-year follow-up, there were no complications related to the form of anastomosis, and the pathological result was comparable to that of patients with non-rotating small bowls.

CONCLUSIONS: Intestinal malrotation is an uncommon asymptomatic congenital abnormality in adults. During laparoscopic gastric surgery, the surgeon should identify this anomaly to optimize surgical approaches, particularly during anastomosis formation. Accurate identification and appropriate management of intestinal malrotation are crucial to mitigate potential postoperative complications, including twisting, obstruction, tension, and anastomosis leak.

**Keywords:** intestinal malrotation (IM); gastric carcinoma; Roux-en-Y reconstruction; laparoscopic total gastrectomy

## Introduction

Intestinal malrotation (IM) is a rare congenital midgut anomaly arising from incomplete rotation of the small bowel around the superior mesenteric vessels during embryonic development. This condition predominantly affects infants, with an incidence of 1 in 6000, and 90% of cases are diagnosed within the first year of life [1]. In contrast, IM is extremely uncommon in adults, with an estimated incidence ranging from 0.00001% to 0.19% [2]. Adult presentations of IM are usually asymptomatic [3]. During laparoscopic abdominal surgery in patients with congenital anomalies, a comprehensive understanding of the anatomical variation is crucial for developing appropriate surgical strategies and minimizing potential complications [4]. This case report documents an unusual instance of asymptomatic IM observed during a laparoscopic distal gastrectomy for gastric carcinoma.

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## Case Presentation

A 45-year-old male had a two-month history of nonspecific epigastric abdominal pain. Physical examination of the abdomen revealed it to be soft, and lax, with no tenderness or masses. Laboratory investigations, including tumor markers, were normal. To elucidate the etiology of the patient's symptoms, an esophagogastroduodenoscopy (EGD) was performed. The EGD showed a polypoid mass, approximately 2.0 cm in diameter, located in the proximal region of the stomach between the fundus and the body. Subsequent histopathological examination of the mass revealed a moderately differentiated adenocarcinoma of gastric origin.

A preoperative staging workup was conducted, utilizing the TNM 7th edition classification system. The results indicated no metastases, leading to a clinical stage of cT1b N0 M0, corresponding to cStage I (Fig. 1A) [5]. Incidentally, abdominal computed tomography (CT) imaging revealed a non-rotation small bowel (Fig. 1B). Following a thorough evaluation of the preoperative assessments, a multidisciplinary tumor board recommended surgical intervention. The proposed procedure entailed a laparoscopic total gastrectomy with D1+ lymphadenectomy and Roux-en-Y reconstruction, adhering to standard techniques for this cancer stage, irrespective of the observed anatomical anomaly.

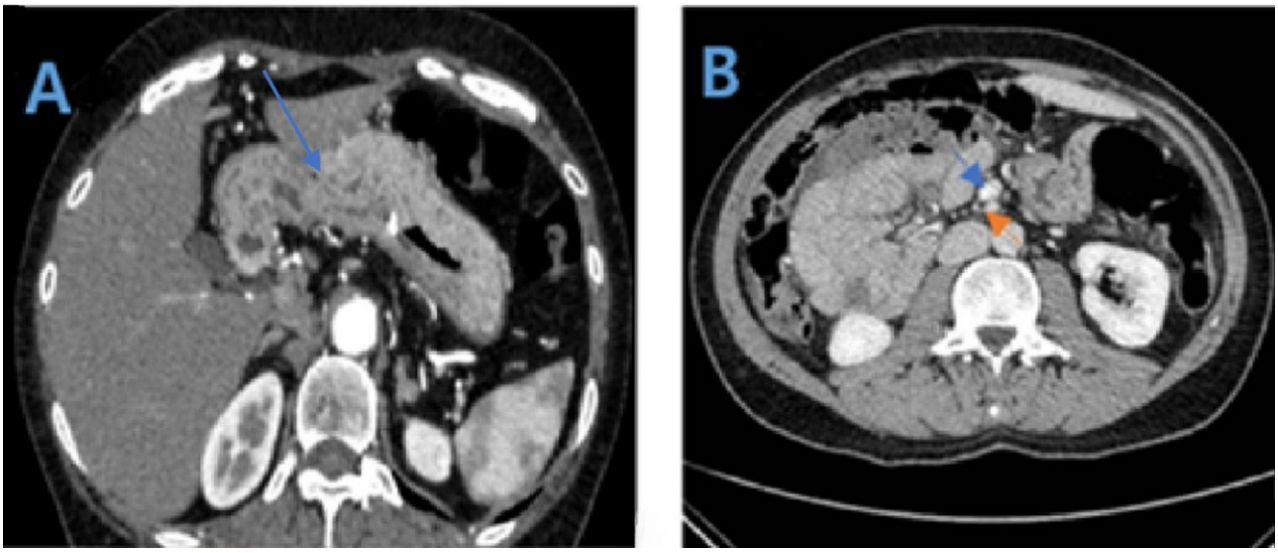


**Fig. 1. Preoperative computed tomography (CT)-scan.** (A) Gastric cancer is located in the posterior wall of the mid-body and has no lymph node metastasis (blue arrow). (B) Small bowel located on the right side of the abdomen. The superior mesenteric vein (orange arrow) is located on the left side of the superior mesenteric artery (blue arrow).

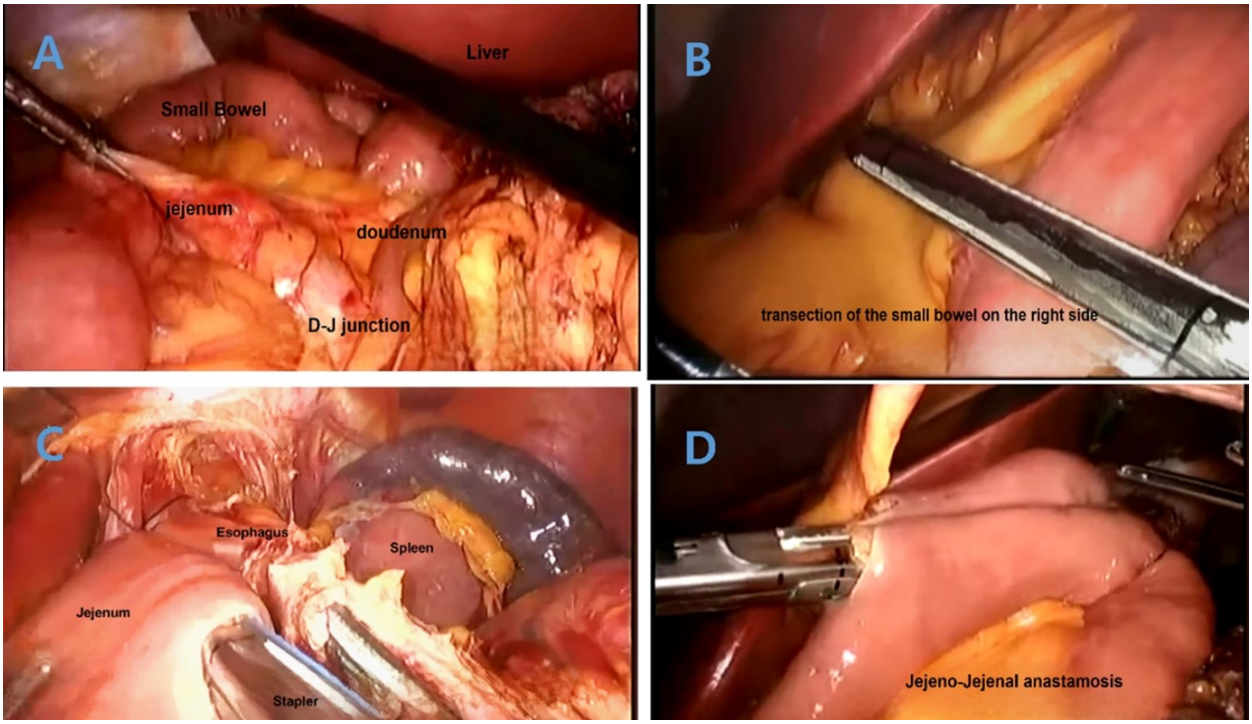


**Fig. 2. Internal malrotation from an operative approach.** (A) There was no right-side colon at the hepatic flexure, and the duodenum did not rotate to the left side of the body. There was a small intestine on the right side of the abdomen. (B) The small bowel was located on the right side of the abdomen, and the bowel transection in the right side instead of the left-sided abdomen. (C) During esophageal jejunal anastomosis, the jejunum on the right side and esophagus on the left side are opposite to usual anastomosis. (D) The jejunojejunal anastomosis is located on the right side of the abdomen instead of the left. D-J, doudeno-jejunal.

Informed consent for the surgery was obtained from the patient. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki and received approval from the Institutional Review Board of Saud University Hospital, KSA (IRB number 2-2023-0152).

## Results

The surgical procedure started with an open technique, involving the insertion of a 10 mm supraumbilical port under direct visualization. A diagnostic laparoscopy was performed, revealing no evidence of metastasis. Subsequently,

a laparoscopic total gastrectomy with D1+ lymphadenectomy was performed as a standard step [6, 7, 8]. Following a total gastrectomy, the surgeon encountered difficulty in localizing the jejunum or the ligament of Treitz on the left side, which is located underneath the transverse colon on the left side. Moreover, the small intestine was situated in the right abdomen with a fully mobilized duodenum devoid of a duodeno-jejunum loop. The right-sided colon had been fully mobilized to the left side of the abdomen (Fig. 2A). A linear white stapler device was used to identify and transect the correct jejunal side of the small bowel, taking into account the non-rotational nature of the bowel (Fig. 2B). The surgeon mobilized the Roux limb from the right side of the abdomen, deviating from the conventional approach, which is typically left-sided. The Roux limb was measured to be approximately 45 cm distal to the doudeno-jejunal (D-J) flexure. Upon dividing the Roux limb, the surgeon was required to mobilize the limb in a reversed C-shaped manner due to unusual anatomy to avoid the risks of limb torsion, obstruction, tension, inappropriate anastomosis, and potential leakage. A linear stapler side-to-side anastomosis was employed to perform both the esophagogastrostomy and jejunal anastomosis (Fig. 2C) [9]. After reconstruction, the procedure of establishing a Roux limb for gastrojejunostomy was straightforward and safe. In addition, a jejunojejunal anastomosis was carried out in the right upper quadrant (Fig. 2D). Consequently, we carefully sutured the small bowel mesentery and retroperitoneum covering the pancreas to close the defect behind the Roux limb. As in normal circumstances, the mesenteric defect at the jejunojejunal anastomosis was also closed. A thorough inspection was carried out to ensure the absence of any additional peritoneal defects. Non-rotation (90°) was the type of malrotation in the current patient. After receiving treatment at our hospital, this patient was discharged home without complications and recovered smoothly. Follow-up examinations over a year revealed no adverse events or cancer relapse.

## Discussion

The gastrointestinal system is divided into the foregut, midgut, and hindgut. During embryonic abdominal development, they rotate around the superior mesenteric arteries in a counterclockwise direction of 270 degrees [8]. The duodeno-jejunal loop, which comprises the ligament of Treitz, is anchored on the left side of the midline following this rotation. Incomplete rotation of the embryonic midgut results in intestinal malrotation, a congenital anomaly typically manifested in early childhood [9]. Tonouchi *et al*. [10] divided IM into four categories: para duodenal hernia, malrotation with 180° rotation, non-rotation with incomplete 90° rotation, and reversed rotation.

The incidence of diagnosed IM in adults ranges from 0.2% to 1.0%. While IM primarily manifests as an intestinal obstruction in infancy [11, 12], its presentation in adults is often asymptomatic or associated with partial bowel obstruction, superior mesenteric artery syndrome, internal hernia, or intestinal volvulus [13, 14]. For symptomatic infants diagnosed with IM, the elective Ladd's procedure remains the gold standard treatment [15]. The increasing use of advanced radiological imaging techniques has led to a rise in the diagnosis of this anomaly in adults, often as an incidental finding during the evaluation or treatment of other abdominal conditions such as cancer, acute cholecystitis, or appendicitis [16].

In the past, the primary procedure for stomach cancer surgery was open laparotomy. However, over the last two decades, minimally invasive techniques for treating gastric cancer, such as robotic and laparoscopic gastrectomy, have rapidly evolved. With the increasing use of laparoscopic modalities in managing abdominal pathologies, it is imperative for surgeons to understand the malrotation for proper surgical techniques and avoid surgical complications [17]. In esophageal jejunal anastomosis, adequate vascular perfusion and tension-free anastomosis are critical factors. The smallest esophageal stump separation can be achieved while preserving the anastomosis's blood supply by using a circular stapler and a hand-sewn anastomosis. However, proximal tumor location presents significant challenges for extracorporeal anvil placement. Additionally, anatomical factors such as thoracic type and body mass index (BMI) may also impact the anastomosis procedure. The ability of the linear stapler to generate anastomotic stomas exceeding 30 mm in diameter could be beneficial for reducing anastomotic stenosis [18].

In the current case, intestinal non-rotation was incidentally discovered through CT scan and diagnostic laparoscopy. Preoperatively, the patient was asymptomatic regarding his disease and the incidental findings. During the surgery, the surgeon should recognize and implement the appropriate reconstruction method following gastric resection in a patient with malrotation. The surgical option of Roux limb reconstruction after total gastrectomy is a C-shaped bowel limb because of the Treitz ligament located on the left side of the abdomen. This anastomosis is similar to previously published similar cases. However, the misunderstanding of the proper reconstruction in a patient with intestinal malrotation during laparoscopic surgery may lead to significant postoperative complications including bowel obstruction, malabsorption, and internal herniation.

## Conclusions

Intestinal malrotation is a rare congenital anomaly that often remains asymptomatic in adults. Surgeons should recognize anomalies during laparoscopic abdominal surgery to implement proper surgical techniques and strategies. Through the laparoscopic total gastrectomy, reconstructing the Esophago-jejunal anastomosis in a reversed C-shaped manner is advised in cases of current bowel malrotation to avoid serious complications.

## Availability of Data and Materials

The datasets used or analyzed during the current study are available from the corresponding author upon reasonable request.

## Author Contributions

NA: design the research study, analyze the data, and write and revise the manuscript. The author read and approved the final manuscript. The author has participated sufficiently in the work and agreed to be accountable for all aspects of the work.

## Ethics Approval and Consent to Participate

The study was conducted by the Declaration of Helsinki and approved by the Institutional Review Board of Saud University Hospital, KSA (IRB number 2-2023-0152). Patient consent was obtained for this study.

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## Conflict of Interest

The author declares no conflict of interest.

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