Laparoscopic surgery for appendiceal cancer with intestinal malrotation in an adult: A case report

Hirokatsu Hayashi *, Mamoru Matsuhisa, Yusuke Murase, Hitoya Sano, Kimitosi Nishio, Iwao Kumazawa

Department of Surgery, JA Gifu Kouseiren Ibi Kosei Hospital, 2547-4 Miwa, Ibigawa-cho, Ibi-district, Gifu-Prefecture, 501-0696, Japan

**ABSTRACT**

**INTRODUCTION:** Intestinal malrotation is a congenital anatomical anomaly resulting from abnormal midgut rotation. Many cases occur during childhood and present with intestinal obstruction and midgut volvulus. Intestinal malrotation rarely occurs in adults and is found incidentally because it is asymptomatic. We herein report a case of intestinal malrotation, and colorectal cancer operated laparoscopically.

**PRESENTATION OF CASE:** A 78-year-old man presented to our Department of Surgical Gastroenterology with fecal occult blood. There were no abnormal findings in the physical examination. Colonoscopy revealed a type 3 tumor in the cecum. Contrast-enhanced computed tomography revealed that the tumor was located in the appendix along the midline of the abdomen. The small intestine and colon occupied the right and left sides of the abdominal cavity, respectively. The diagnosis was appendiceal cancer with nonrotation-type intestinal malrotation. A laparoscopy-assisted ileocecal resection was performed. During surgery, the right-side colon was not fixed to the retroperitoneum, and the right-side colon could be extracted out of the abdominal cavity through the umbilical wound with only adhesive dissection, and mesenteric and lymph node dissection can be performed outside the body. The postoperative course was uneventful.

**DISCUSSION:** Appendiceal cancer with intestinal malrotation is managed with laparoscopic surgery because this method is safe and minimally invasive.

**CONCLUSION:** The laparoscopic approach may be safer and less invasive than laparotomy, and extraperitoneal lymph node dissection is safe and reliable for patients with intestinal malrotation.

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1. Introduction

Intestinal malrotation is a congenital anatomical anomaly resulting from abnormal rotation of the midgut. It may often present in childhood with intestinal obstruction and midgut volvulus [1]. In adults, intestinal malrotation is rarely present and is found incidentally at the time of gastrointestinal examination or operation because it is asymptomatic [2].

We herein report a patient with intestinal malrotation and colorectal cancer who had undergone laparoscopic surgery. This work has been reported in line with the SCARE criteria [3].

**Abbreviations:** 3D, three-dimensional; CT, computed tomography; SMA, superior mesenteric artery.

* Corresponding author.
E-mail addresses: m050766bb@yahoo.co.jp (H. Hayashi), mamoru.matsuhisa@gmail.com (M. Matsuhisa), mukku01265569ponkikki@gmail.com (Y. Murase), hitoya.sano840nifty.com (H. Sano), ktnishio0607@yahoo.co.jp (K. Nishio), iwaokuma@mac.com (I. Kumazawa).

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The diagnosis was appendiceal cancer with non-rotation-type intestinal malrotation. We scheduled a laparoscopy-assisted ileocecal resection. Intraoperative examination revealed that the third and fourth parts of the duodenum descended vertically without the ligament of Treitz, and the small intestine was located on the right-side of the abdominal cavity. The ascending colon and cecum were not fixed with the retroperitoneum and were located along the midline of the abdomen. The ascending colon had adhesions with the greater omentum, transverse colon, and Ladd’s band (Figs. 3, 4, 5 and 6). After adhesive dissection, the ileocecal region was extracted out of the abdominal cavity through the umbilical wound and ileocecal resection with D2 lymph node dissection was performed outside the body. Histopathological examination revealed a mucinous adenocarcinoma of the appendix penetrating the muscularis propria with lymphatic and vascular invasion and metastatic involvement in 1 of the 6 dissected lymph nodes. According to the tumor-node-metastasis classification of malignant tumors, the diagnosis was Stage IIIa (T3N1aM0). Capecitabine (3000 mg/day) was administered as adjuvant chemotherapy, which was completed in only one course due to deterioration of renal function. The patient is still being followed up at our hospital, with no recurrence or distant
Fig. 3. Ladd’s band in front of the small intestine. Ileocecal region is located along the midline of the abdomen.

Fig. 4. The ascending colon has adhesions with the greater omentum, transverse colon, and Ladd’s band.

Fig. 5. The appendiceal cancer is located along the midline of the abdomen.

Fig. 6. Depiction of intraoperative findings of intestinal malrotation.

metastases observed using CT or blood tests at 18 months after surgery.

3. Discussion

Intestinal malrotation is a congenital abnormal rotation in the midgut. During embryologic development, the midgut rotates 270° counterclockwise around the SMA and fixes to the retroperitoneum [4]. Depending on the degree of rotation, intestinal malrotation is classified into four types: nonrotation (90° counterclockwise rotation), malrotation (180° counterclockwise rotation), reversed rotation (90° clockwise rotation), and paraduodenal hernia [5].

Intestinal malrotation is found in 0.01–0.02% of infants, and 80% of cases present with midgut volvulus or intestinal obstruction in the first few weeks of life [1]. In adults, most cases of intestinal malrotation, of which the nonrotation-type is the most frequent, are incidentally found at the time of digestive tract examination or operation because it remains asymptomatic [2,6].

Intestinal malrotation diagnosed in adulthood is rare, and the recent method of diagnosis is CT [7]. Intestinal malrotation is associated with specific radiological findings. The duodenum has a vertical path that does not cross the midline, and the small intestine is located on the right side of the abdominal cavity. The colon is located on the left-side of the abdominal cavity, and vessels of the right-side colon bifurcate from the left-side of the superior mesenteric vessel. The superior mesenteric vein (SMV) is located on the left-side of the SMA, which is termed the SMV rotation sign [8].

Reports have indicated that in complications of right-side colon cancer, chronic intestinal obstruction caused by anatomical disorders of the colon leads to inflammation and carcinogenesis [9]. Literature search revealed intestinal malrotation with colon cancer in 55 cases from 1974 to 2018 in Japan, and only 11 other cases have been reported worldwide [10–13]. A total of 37 cases of right-side colon cancer, including the appendix, cecum, ascending colon, and transverse colon, have been reported. A total of 19 cases of left-side colon cancer, including the descending colon, sigmoid colon, and rectum, have been reported.

With respect to the surgical approach for intestinal malrotation with right-sided colon cancer, 31 cases of laparotomy and 16 cases of laparoscopic surgery have been performed (Table 1). In the last 10 years, the use of laparoscopic surgery has been increasing. The advantages of laparoscopic surgery include its ability to provide information about the entire abdominal cavity. This allows a variety of approaches to be performed without the need for a large skin incision. However, at the time of surgery, anatomical abnormalities of vessels and adhesions are problematic. 3D-CT angiography is a useful modality to understand anatomical abnormalities of vessels and to plan reliable lymph node dissection. Adhesions between the intestinal tracts and peripheral organizations are often present and require dissection. However, in many cases, the fixation of the right-side colon to the retroperitoneum is weak. Thus, the colon can be extracted out of the abdominal cavity through the umbilical wound.
Table 1 Review of literature of intestinal malrotation with right-side colon cancer treated by laparoscopic surgery.

| Author | Year | Location | Type | Malrotation diagnosed | Staging | Mesenteric lymph node dissection |
|--------|------|----------|------|-----------------------|---------|----------------------------------|
| Yamamoto | 2007 | Ascending colon | nonrotation | CT scan, enema | MP,N0,M0,StageII | outside body D3 |
| Takahashi | 2009 | Ascending colon | nonrotation | CT scan | SS,N0,M0,StageII | inside body D2 |
| Tokai | 2012 | Transverse colon | nonrotation | CT scan, enema | M,N0,M0,Stage0 | outside body D2 |
| Nakatani | 2013 | Cecum | nonrotation | operation | SS,N0,M0,StageII | outside body D1 |
| Hirano | 2013 | Transverse colon | reversal rotation malrotation | CT scan, enema | SM,N0,M0,Stage | outside body D2 |
| Hirano | 2013 | Ascending colon | nonrotation | CT scan, enema | M,N0,M0,Stage0 | outside body D2 |
| Sakaguchi | 2013 | Cecum | nonrotation | operation | SS,N0,M0,StageII | inside body D1 |
| Takahashi | 2013 | Ascending colon | malrotation | CT scan, enema | SS,N1,M0,StageII | outside body D3 |
| Enomoto | 2104 | Transverse colon | nonrotation | CT scan | SS,N0,M0,StageII | inside body D3 |
| Kuroda | 2014 | Transverse colon | nonrotation | CT scan | SE,N1,M0,StageII | inside body D3 |
| Morioka | 2015 | Cecum | nonrotation | CT scan | SS,N0,M0,StageII | inside body D3 |
| Kuwahara | 2015 | Transverse colon | nonrotation | CT scan | SS,N0,M0,StageII | inside body D3 |
| Motoki | 2016 | Ascending colon | nonrotation | operation | MP,N0,M0,Stage | outside body D2 |
| Nakatani | 2017 | Cecum | malrotation | operation | M,N0,M0,Stage0 | outside body D1 |
| Takahashi | 2017 | Ascending colon | malrotation | operation | SM,N0,M0,Stage | inside body D3 |
| Kiya | 2017 | Cecum | malrotation | CT scan | MP,N0,M0,Stage | inside body D3 |
| Hayashi | 2017 | Cecum | nonrotation | CT scan, enema | SS,N1,M0,StageII | outside body D2 |

with only adhesive dissection, and mesenteric and lymph node dissection can be performed outside the body. In fact, extracorporeal dissection was performed in 9 cases.

The learning point in this case is that laparoscopic surgery should be considered as the first choice for patients with intestinal malrotation because it is minimally invasive and allows for a variety of approaches. In addition, extracorporeal mesenteric and lymph node dissection should be performed because of the ease of adhesion dissection.

4. Conclusion

We believe that the laparoscopic approach is safer and less invasive than laparotomy. We also believe that extracorporeal lymph node dissection is a safe and reliable method for patients with intestinal malrotation.

Declaration of Competing Interest

The authors report no declarations of interest.

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Ethical approval

This report was reviewed and approved by the Institutional Review Board of JAGPU Koseiren Ibi Kosei Hospital.

Consent

Informed consent was obtained from the patient for publication of this case report.

Author contribution

Hirokatsu Hayashi: Data Acquisition, Data Interpret and writing of the manuscript. Mamoru Matsuhashi: management of case. Yusuke Murase: management of case. Hitoya Sano: management of case. Kimitosi Nishio: Supervision, review and editing. Iwao Kumazawa: Supervision, review, editing, and final approval of the version to be submitted.

Registration of research studies

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