

## Case Report

# Laparoscopic Surgery for the Transverse Colon Carcinoma Associated with Non-rotation Type Intestinal Malrotation

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### ABSTRACT

A 48-year-old man was referred to our hospital for surgical treatment of an advanced colon carcinoma that had been diagnosed with colonoscopy. Barium enema examination demonstrated the ascending colon running transversally in the mid-abdomen and an apple-core sign at the right side of the colon loop. Contrast-enhanced computed tomography of the abdomen showed the superior mesenteric vein to the left of the superior mesenteric artery, which is so-called superior mesenteric vein rotation sign. Therefore, intestinal malrotation was strongly suspected before surgery. The patient underwent laparoscopic surgery, at which nonrotation-type intestinal malrotation with colon carcinoma was diagnosed. Because the tumor was located at the oral side of the transverse colon, partial transverse colectomy was performed laparoscopically. Postoperative pathological examination revealed a well to moderately differentiated tubular adenocarcinoma that had invaded the subserosal layer without nodal involvement. Therefore, the TNM stage was IIa (T3, N0, M0). Nonrotation-type intestinal malrotation with concurrent transverse colon carcinoma is rare and is rarely treated which laparoscopic surgery. (Jikeikai Med J 2014 ; 61 : 87-92)

Key words : laparoscopic surgery, malrotation, transverse colon carcinoma

### INTRODUCTION

Malrotation of the midgut is a congenital anomaly of intestinal rotation and fixation, which usually presents in the first month of life<sup>1,2</sup>, is classified as nonrotation, malrotation, reversed malrotation, or paraduodenal hernia based on the type of faulty rotation<sup>3</sup>. Cases of malrotation associated with colon carcinoma in adults are so rare that our search of the literature yielded only 27 cases<sup>4-30</sup>. Here we report on a patient who underwent laparoscopic partial colectomy for transverse colon carcinoma associated with nonrotation-type intestinal malrotation.

### CASE PRESENTATION

A 48-year-old man visited a clinic because of shortness of breath ; while undergoing colonoscopy he was found to have colon carcinoma (Fig. 1). He was referred to our hospital for further examination and treatment. The family history was noncontributory. Except for hemoglobin of 8.1 g/dl, results of blood tests, including the carcinoembryonic antigen level, were within normal limits. Barium enema examination showed the ascending colon running transversally in the mid-abdomen and an apple-core sign at the right side of the colon loop (Fig. 2). Con-

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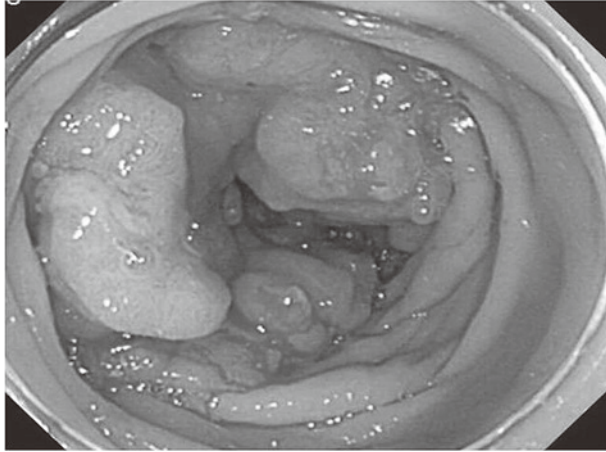


Fig. 1. Colonoscopy showed a type 2 tumor located 50 cm from the anal verge.

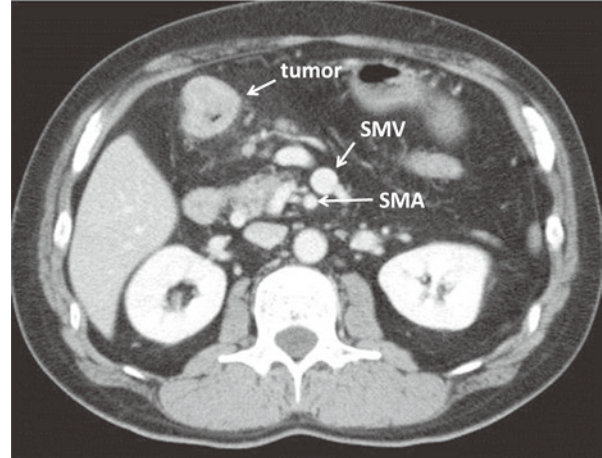


Fig. 3. The presence of the superior mesenteric vein to the left of the superior mesenteric artery is called the SMV rotation sign (contrast-enhanced CT of the abdomen).

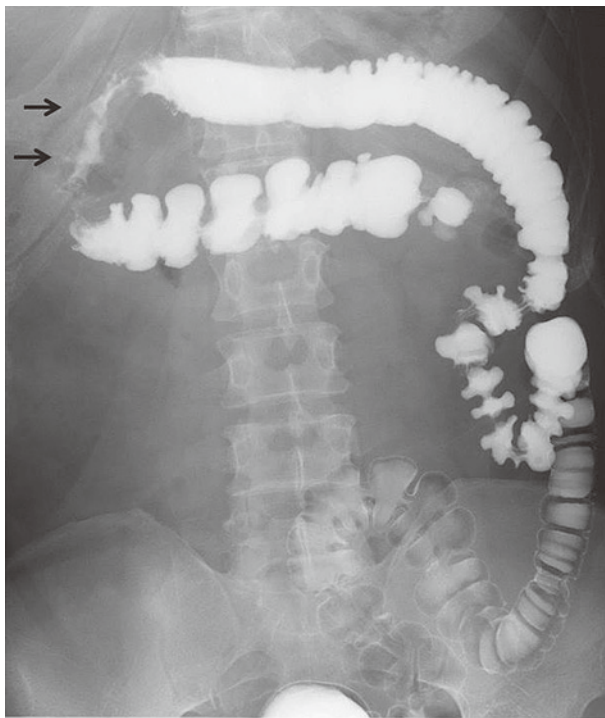


Fig. 2. Barium enema examination demonstrated the ascending colon running transversally in the mid-abdomen and an apple-core sign in the transverse colon (arrows).

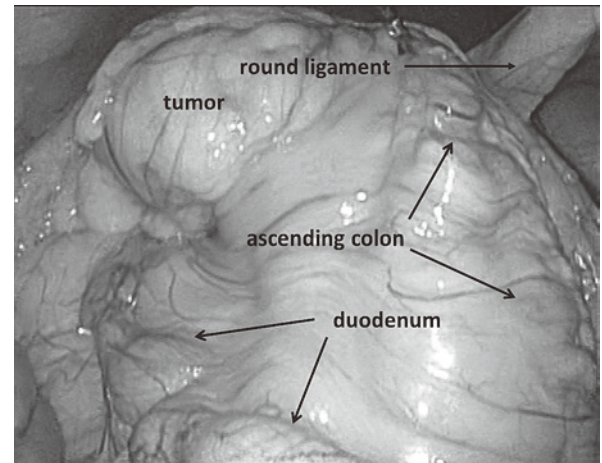
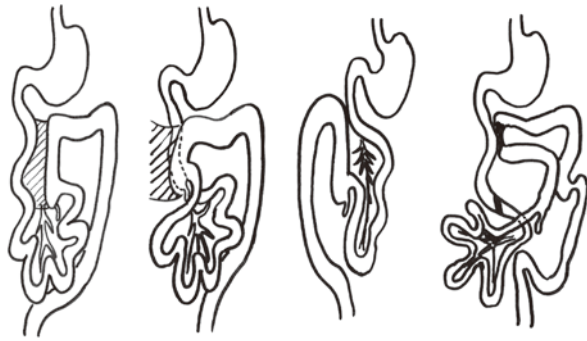


Fig. 4. The ascending colon and the transverse colon are located ventrally to the descending to horizontal portion of the duodenum.

trast-enhanced computed tomography (CT) of the abdomen showed the superior mesenteric vein (SMV) to be located to the left of the superior mesenteric artery (SMA), which is the so-called SMV rotation sign (Fig. 3). Therefore, intestinal malrotation was diagnosed.

The patient underwent laparoscopic surgery with 5 ports for advanced colon carcinoma. Laparoscopic exami-

nation demonstrated that the third and fourth parts of the duodenum descended vertically without the ligament of Treitz and that the jejunum and ileum were located on the right. The colon from the transverse colon to the ascending colon was located ventrally to the second and third parts of the duodenum (Fig. 4, 5). The ascending colon ran transversally in the abdominal cavity, and the hepatic flexure of the colon was not found. Nonrotation-type intestinal malrotation with colon carcinoma was diagnosed. Because the tumor was located at the oral side of the transverse colon, partial transverse colectomy was performed laparoscopically. The transverse colon and the ascending colon were adherent to each other. However, both had a



Nonrotation Malrotation Reversed rotation Our case  
 Fig. 5. Variations of intestinal malrotation and the operative findings of our case

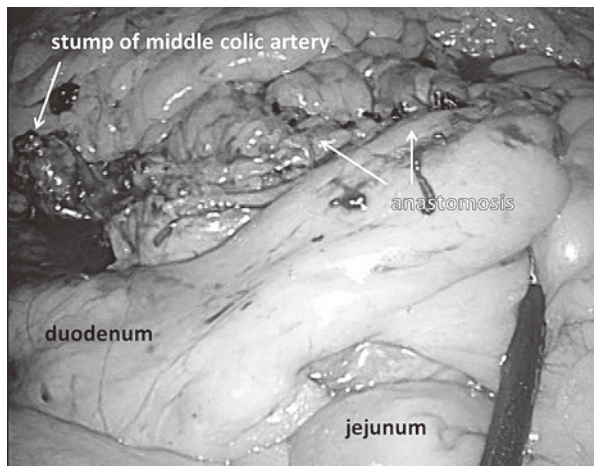


Fig. 6. After reconstruction, the ligament of Treitz could not be clearly identified.

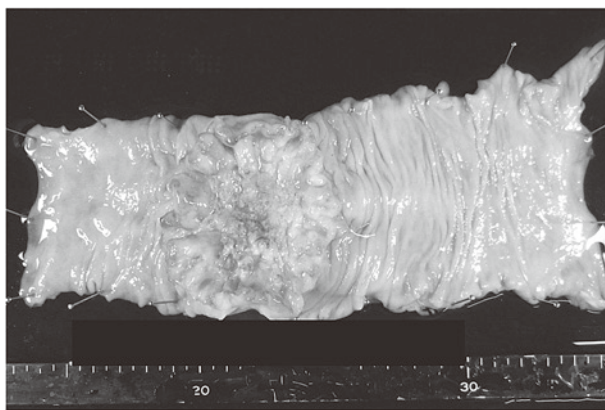


Fig. 7. Macroscopic findings of the resected specimen

mesocolon. A functional end-to-end anastomosis was performed between the transverse colon and the ascending colon with linear staplers. The ligament of Treitz could not

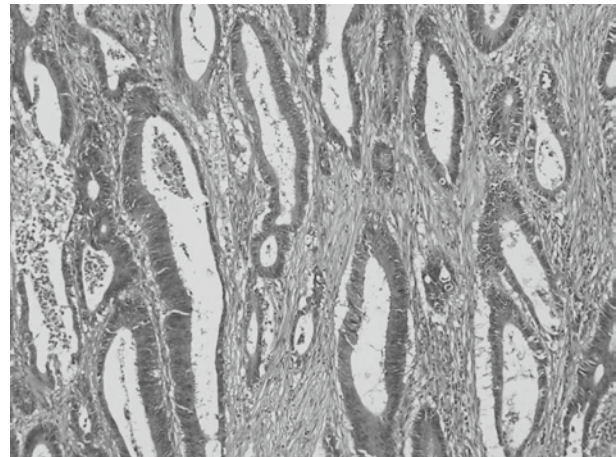


Fig. 8. Pathological examination revealed well to moderately differentiated adenocarcinoma of the transverse colon that had invaded the subserosal layer (hematoxylin and eosin  $\times 100$ ).

be clearly identified (Fig. 6). The tumor was 70 mm in diameter, pathological examination revealed a well to moderately differentiated tubular adenocarcinoma (Fig. 7), and the carcinoma had invaded the subserosal layer (T3) (Fig. 8).

Six lymph nodes were harvested, but none showed metastasis. Therefore, the TNM stage was IIa (T3, N0, M0). The postoperative course was uneventful, and the patient was discharged 10 days after surgery.

### DISCUSSION

During embryologic development, the midgut rotates 270 degrees counterclockwise around the SMA and fixes to the retroperitoneum<sup>31</sup>. Intestinal malrotation is an anomaly of this rotation, and most cases are found incidentally at the time of digestive tract examination or surgery. Cases associated with colon carcinoma in adults are rare<sup>4-30</sup>. In only 7 of these cases was the laparoscopic approach used because of its safety and reliability<sup>15,19,23,25,28-30</sup>. In the present case, we performed laparoscopic partial colectomy for transverse colon carcinoma in an adult patient with nonrotation-type intestinal malrotation, which is 1 of 4 types of malrotation<sup>3</sup>.

Multidetector-row CT (MDCT) is useful for establishing a preoperative diagnosis in patients with diseases resulting from abnormal anatomy and for planning laparoscopic surgery<sup>23</sup>. Our patient was found to have intestinal malrotation after undergoing barium enema examination



Table 1. Reported cases of intestinal malrotation with colon carcinoma

Author (Reference number)	Reported year	Age	Sex	Location	Classification	Approach
Shimaunki (4)	1988	73	M	Cecum	Nonrotation	Open
Yokota (5)	1995	66	M	Rectum	Nonrotation	Open
Kunieda (6)	1998	53	F	Rectum	Nonrotation	Open
Kunieda	1998	62	F	Rectum	Nonrotation	Open
Tamura (7)	1999	55	M	Cecum	Nonrotation	Open
Torreqqiani (8)	2001	86	F	Cecum	Unknown	Unknown
Sato (9)	2001	76	F	Appendix	Nonrotation	Open
Kaneko (10)	2002	52	M	Sigmoid	Nonrotation	Open
Nagase (11)	2003	60	M	Ascending	Nonrotation	Open
Sasaki (12)	2003	71	F	Ascending	Malrotation	Open
Uchida (13)	2004	57	M	Transverse	Nonrotation	Open
Oku (14)	2005	56	M	Ascending	Nonrotation	×
Yamamoto (15)	2007	63	F	Ascending	Nonrotation	Laparo
Brilliantino (16)	2009	34	M	Cecum	Unknown	Open
Nakasone (17)	2009	71	F	Sigmoid	Nonrotation	Open
Itatani (18)	2009	61	M	Transverse	Malrotation	Open
Takahashi (19)	2009	84	M	Ascending	Nonrotation	Laparo
RenPei-tu (20)	2009	45	M	Ascending	Nonrotation	Open
Michalopoulos (21)	2010	76	M	Ascending	Malrotation	Open
Kokubo (22)	2011	73	M	Cecum	Reversed rotation	Open
Morimoto (23)	2012	57	M	Cecum	Reversed rotation	Laparo
Sekizawa (24)	2012	56	F	Rectum	Reversed rotation	Open
Tokai (25)	2012	79	M	Transverse	Nonrotation	Laparo
Donaire (26)	2013	52	M	Ascending	Nonrotation	Laparo → Open
Maeda (27)	2013	48	M	Transverse	Nonrotation	Open
Sakauchi (28)	2013	78	M	Cecum	Unknown	Laparo
Hirano (29)	2013	82	F	Transverse	Reversed rotation	Laparo
Hirano (30)	2013	68	F	Ascending	Malrotation	Laparo
Our case	2014	48	M	Transverse	Nonrotation	Laparo

and contrast-enhanced CT of the abdomen before surgery, and the precise diagnosis was established with laparoscopic evaluation.

Because the tumor in the present case was located at the oral side of the transverse colon, partial transverse colectomy was performed laparoscopically. The tumor was supplied by the middle colic artery, which was found in the mesocolon of the transverse colon loop. Because dissection of the middle colic artery was possible, right hemicolectomy was not necessary.

In nonrotation-type intestinal malrotation, functional end-to-end anastomosis between the transverse colon and the ascending colon can easily be performed with linear staplers because the transverse colon and the ascending colon run parallel to each other.

Previously reported cases of intestinal malrotation

with colon carcinoma are summarized in Table 1. The patients had an average age of 63.5 years, and 19 were male. The 26 cases in which the type of intestinal rotation was reported were as follows: nonrotation type, 18 cases (69.2%); malrotation type, 4 cases (15.4%); and reversed rotation type, 4 cases (15.4%). The location of tumors was ascending colon, 9 cases; cecum, 7 cases; transverse colon, 6 cases; rectum, 4 cases; sigmoid colon, 2 cases; and the appendix, 1 case.

The surgical approach, which was described for 28 cases, was open surgery in 18 cases and laparoscopic surgery in 9 cases (1 case of which was converted to open surgery). Of all colorectal cancers, more than 70% are in the sigmoid colon or rectum, but of colorectal cancer associated with intestinal malrotation only 20.7% are found there. In other words, 79.3% of colorectal cancers in cases of malro-

tation are located from the appendix to the transverse colon. Therefore, the anatomic malposition of the colon appears to be correlated with the development of colon carcinoma.

Authors have no conflict of interest.

## REFERENCES

- Torres AM, Ziegler MM. Malrotation of the intestine. *World J Surg.* 1993 ; 17 : 326-31.
- Durkin ET1, Lund DP, Shaaban AF, Schurr MJ, Weber SM. Age-related differences in diagnosis and morbidity of intestinal malrotation. *J Am Coll Surg.* 2008 ; 206 : 658-63.
- Wang CA, Welch CE. Anomalies of intestinal rotation in adolescents and adults. *Surgery.* 1963 ; 54 : 839-55.
- Shimanuki K, Chiba A, Itabashi K, Togashi K, Asano H, Hamada O. A case of carcinoma of the cecum associated with non-rotation of the midgut in the adult (in Japanese). *Nihon Rinsho Geka Gakkai Zasshi.* 1988 ; 49 : 2357-62.
- Yokota K, Sakamoto N, Hosino H, Tanaka Y, Hukunari N, Tanaka K, et al. A case of cecal volvulus due to a rectal cancer with midgut nonrotation in an adult (in Japanese). *Nihon Rinsho Geka Gakkai Zasshi.* 1995 ; 56 : 1898-902.
- Kunieda K, Kawai M, Sano B, Watanabe A, Takemura S, Saji S, et al. Two cases of intestinal malrotation following rectal carcinoma (in Japanese). *Nihon Shokakigeka Gakkai Zasshi.* 1998 ; 31 : 1136-40.
- Tamura M, Kimoto H, Murata S. Intestinal malrotation in an adult following carcinoma of the cecum (in Japanese). *Nihon Rinsho Geka Gakkai Zasshi.* 1999 ; 60 : 2964-9.
- Torreggiani WC, Thornton F, Lyburn I, Brenner C, Lee MJ. Malrotation of the bowel resulting in a left-sided caecal carcinoma presenting as a palpable intrahernial mass. *Australas Radiol.* 2001 ; 45 : 362-4.
- Sato H, Fujisaki M, Takahashi T, Maruta M, Maeda K, Kuroda M. Mucinous cystadenocarcinoma in the appendix in a patient with nonrotation : report of a case. *Surg Today.* 2001 ; 31 : 1012-5.
- Kaneko T, Sawada S, Sumi Y, Murase K, Yoshida N, Matsuyama T, et al. A case of the sigmoid colon carcinoma with total situs inversus and intestinal malrotation (in Japanese). *Nihon Shokakigeka Gakkai Zasshi.* 2002 ; 35 : 556-60.
- Nagase T, Adachi I, Yoshino Y, Morita K, Murakami N, Yamada T. A case of ascending colon cancer with total situs inverses and intestinal malrotation (in Japanese). *Nihon Rinsho Geka Gakkai Zasshi.* 2003 ; 64 : 1773-6.
- Sasaki Y, Wada T, Moritani M, Mizumura Y, Yamamoto K, Tsuchida A, et al. A case of intestinal malrotation with ascending colon carcinoma (in Japanese). *Nihon Gekakei Rengo Gakkaishi.* 2003 ; 28 : 920-3.
- Uchida H, Kawamura YJ, Takegami K, Matsuda K, Watanabe T, Masaki T, et al. Colon cancer complicated by vascular and intestinal anomaly. *Hepatogastroenterology.* 2004 ; 51(55) : 156-8.
- Oku T, Wada Y, Umeda I, Waga E, Fujita M, Nagamachi Y, et al. A case of ascending colon cancer combined with malrotation of the intestine (in Japanese). *Gan no Rinsho.* 2005 ; 51 : 399-404.
- Yamamoto J, Fuchino Y, Ohishi J, Harimura T, Iawanaga S, Shirotsaki H, et al. A laparoscopic right hemicolectomy performed on a patient with ascending colon cancer accompanied by adult intestinal malrotation (in Japanese). *Nihon Shokakigeka Gakkai Zasshi.* 2007 ; 40 : 1960-5.
- Brillantino A, Marano L, Schettino M, Torelli F, Izzo G, Cosenza A, et al. Report of a rare case of colon cancer complicated by anomalies of intestinal rotation and fixation : a case report. *Cases J.* 2009 ; 2 : 6555.
- Nakasone Y, Nishijima I, Ikehara Y, Ikemura R, Miyagi K, Inami K. A case of sigmoid colon cancer in a patient with intestinal malrotation associated with abnormal run and blood supply area of the inferior mesenteric artery (in Japanese). *Nihon Rinsho Geka Gakkai Zasshi.* 2009 ; 70 : 1118-21.
- Itatani Y, Kawamoto K, Kaneshiro M, Ito T, Ogasawara K. A case of transverse colon cancer with intestinal malrotation (in Japanese). *Nihon Rinsho Geka Gakkai Zasshi.* 2009 ; 70 : 3066-9.
- Takahashi H, Ueshima S, Akamatsu H, Tori M, Omori K, Nakahara M. Ascending colon cancer, with intestinal malrotation, resected by laparoscopy-assisted colectomy (in Japanese). *Nihon Naishikyo Geka Gakkai Zasshi.* 2009 ; 14 : 675-9.
- Ren PT, Lu BC. Intestinal malrotation associated with colon cancer in an adult : report of a case. *Surg Today.* 2009 ; 39 : 624-7.
- Michalopoulos A, Papadopoulos V, Paramythiotis D, Papavramidis T, Douros V, Netta S, et al. Colonic cancer in a patient with intestinal malrotation : a case report. *Tech Coloproctol.* 2010 ; 14 Suppl 1 : S65-6.
- Kokubo K, Hyashi M, Iida Y, Tochii K, Fujita S, Imoto S, et al. A case of ceum carcinoma with intestinal reversed malrotation (in Japanese). *Nihon Gekakei Rengo Gakkaishi.* 2011 ; 36 : 965-70.
- Morimoto M, Horie H, Kumano H, Lefor A, Utano K, Yasuda Y. Reversed intestinal malrotation with concurrent cecal carcinoma. *Asian J Endosco Surg.* 2012 ; 5 : 149-51.
- Sekizawa K, Shida D, Matsuda M, Matsuoka Y, Miyamoto S, Inoue S. A case of rectosigmoid cancer with reversed intestinal malrotation (in Japanese). *Nihon Rinsho Geka Gakkai Zasshi.* 2012 ; 73 : 1185-9.
- Tokai H, Mesda S, Nagata Y. A case of transverse colon cancer with intestinal malrotation resected by laparoscopy-assisted colectomy (in Japanese). *Nihon Rinsho Geka Gakkai Zasshi.* 2012 ; 73 : 1497-501.
- Donaire M, Mariadason J, Stephens D, Pillarisetty S, Wallack MK. Carcinoma of the colon in an adult with intestinal malrotation. *Case Rep Surg.* 2013 ; 2013 : 525081.
- Maeda C, Hidaka E, Uchida T, Omoto T, Ishida F, Kudo S. A

- case of transverse colon cancer with adult intestinal malrotation (in Japanese). *Nihon Rinsho Geka Gakkai Zasshi*. 2013 ; 74 : 3103-7.
28. Sakaguchi T, Tokuhara K, Iwamoto S, Ueyama Y, Yoshida K, Okuno M, et al. A case of colon cancer accompanied with adult malrotation of intestinal treated by laparoscopic surgery (in Japanese). *Nippon Daicho Komonbyo Gakkai Zasshi*. 2013 ; 66 : 105-9.
  29. Hirano Y, Hattori M, Fujita M, Nishida Y, Douden K, Hashizume Y. The transverse colon cancer with the reversed rotation of the midgut treated with single incision laparoscopic colectomy. *Indian J Surg*. 2013 ; 75(Suppl 1) : 195-8.
  30. Hirano Y, Hattori M, Yagi D, Maeda K, Douden K, Hashizume Y. Laparoscopic surgery for the ascending colon cancer associated with malrotation of the midgut. *Indian J Surg*. 2013 ; 75(Suppl 1) : 71-3.
  31. Amaral L, Quintanilha R, Bernardo L, Eloi T, Bento F, Santos V. Intestinal malrotation in the elderly. *Am Surg*. 2009 ; 75 : 631-3.