Malrotation of the Intestine in Adult and Colorectal Cancer

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Abstract Malrotation of the gut is a congenital anomaly and usually presents in childhood. Rarely, it may present in adults. Patients may be asymptomatic, and malrotation is detected during investigations, operation or autopsy. It can cause longstanding abdominal symptoms like pain, dyspepsia or acute abdomen due to volvulus. In adults, malrotation is found with different gastrointestinal malignancies like gastric, hepatobiliary, pancreatic and, in particular, colorectal neoplasms. We are reporting a case of 60-year-old female presented with carcinoma caecum along with malrotation of the gut. It is the first case report from India. We also reviewed documented cases of malrotation associated with colorectal malignancies. A large number of cases have been reported in Japan as compared to rest of the world. Malrotation in adults is probably associated with gastrointestinal malignancies. Possible causes of this association can be genetic factors or gut changes like chronic inflammation. These associations need further study to consider intestinal malrotation as premalignant lesion which may be very important in follow-up of children with malrotation.

Keywords Intestinal malrotation · Colon cancer · Gastrointestinal cancer · Adult

Introduction

Intestinal malrotation is a congenital anomaly presenting in first few months of life usually with acute bowel obstruction and midgut volvulus. In adults, usually, it is asymptomatic and detected during investigations, operation or autopsy. Rarely, it may cause chronic abdominal pain, intestinal obstruction and even volvulus in adults [1–3]. This report describes a case of iron deficiency anaemia and dyspepsia which, on investigation, found to have carcinoma caecum with malrotation of the gut. This is the first reported case from India. Gastrointestinal malignancies, in particular colorectal malignancy, have been found in cases of malrotation presenting in adulthood. There can be some association between these two conditions. The cause of this association is uncertain. It can be genetic or gut changes due to malrotation. Further information regarding this association is important for follow-up of children with malrotation.

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Case Report

A 60-year-old lady presented to our Department of Surgical Gastroenterology with anaemia, abdominal pain, dyspepsia and constipation for more than 5 years. Her symptoms worsened in last 6 months, and she was hospitalised and had blood transfusion. But, her symptoms persisted and she gradually developed anorexia also.

Physical examination revealed anaemia and abdominal fullness with minimal tenderness. No lump was palpable.

Laboratory values showed Hb%—6 g%, a blood report suggestive of iron deficiency anaemia. Biochemical reports, abdominal USG and upper GI endoscopy were unremarkable. Colonoscopy showed ulceroproliferative growth in the ascending colon. Colonoscopic biopsy diagnosed adenocarcinoma. Contrast-enhanced computer tomography (CECT) of the abdomen showed distended and thick-walled distal small bowel, mesenteric lymphadenopathy without any mass.

Laparotomy showed intestinal malrotation with Ladd's bands and thickened distal ileum with mesenteric lymphadenopathy along with mass in the mobile caecum which was in midline (Fig. 1). Adhesionolysis with release of Ladd's bands, straightening of duodenojejunal junction and broadening of mesenteric base was done. After that, right hemicolectomy was done taking care of anomalous superior mesenteric vessels. Histopathology report was moderately differentiated infiltrating adenocarcinoma caecum with metastasis in 1 of 22 pericaecal lymph nodes (pT3N1Mx). Patient recovered well and having adjuvant chemotherapy—FOLFOX regimen.

Materials and Method

In relation to our case, we searched PubMed and Google Scholar with keywords like 'intestinal malrotation', 'malrotation of gut' and 'colon cancer' and 'rectal cancer'. The reported cases were reviewed. Though worldwide reported incidence is less, a large number of cases have been reported from Japan (Table 1). Till date, altogether, 60 cases have been reported in literature citing colorectal cancers developed in cases of malrotation of the gut. All are adults, age ranging from 22 to 88 years. Most of the cases (75 %) are between 50 and 80 years.

Fig. 1 Intestinal malrotation with mass in the caecum in the midline. Terminal ileum is distended and thickened

Gender distribution is found to be more or less equal to male/female=28:29. Associated situs inversus totalis (SIT) was noted in 12 cases (20 %). In two patients with SIT, there was a history of other malignancies: one had gastrectomy for carcinoma stomach 6 years ago and the other had operation for ovarian cancer 5 years ago. Synchronous carcinoma was noted in the stomach and rectum in one patient.

Records of presentation found in 45 cases are given in Table 2. The commonest presentation is bleeding or anaemia (55 %).

Preoperative diagnosis of malrotation with colorectal cancer could be established by CT scan in 25 cases (42 %) and by barium X-rays in 12 cases (20 %). But, even after investigations, malrotation was not detected before operation in 15 cases (25 %). The site of malignancies is given in Table 3, and the majority of the cases (58 %) are found in the right colon.

Discussion

Malrotation of the gut is a congenital anomaly. By fifth intrauterine week, vascular pedicle develops in the developing gut. The midgut supplied by superior mesenteric vessel elongates faster than the rest of the gut and herniates out of small intraabdominal coelom. The staged return of midgut within abdominal cavity involves rotation and fixation which can be anomalous in different stages leading to malrotation of the gut. The classification of different rotational anomalies and their clinical significance are given in Table 4 [2].

Incidence of intestinal malrotation is unknown. Estimation by autopsy study indicates that it may be as high as 1 % of the population. About 90 % of cases present within the first year of life of which 80 % are diagnosed in the neonatal period. Intestinal malrotation presents in infants or children with midgut volvulus or intestinal obstruction. In adults, it was assumed to be asymptomatic often being diagnosed at the time of laparotomy for other causes or at autopsy.

But, recently studies have shown that, in adults, malrotation can cause chronic symptoms like intermittent abdominal pain, dyspepsia, nausea, vomiting and abdominal bloating in 80 % of cases [3].

Preoperative diagnosis of malrotation is preferably done by CT scan than barium X-rays. CT scan of the abdomen done for other reasons may diagnose malrotation. Also, other vascular and hepatobiliary anatomic anomalies associated with intestinal malrotation can be diagnosed by CT scan.

Interestingly, malrotation of the gut in adults was found to be associated with different gastrointestinal neoplasm

Table 1 Reported cases of colorectal cancers in adult malrotation of the intestine

Worldwide									
Citations	Age	Sex	Location of malignancy	Malrotation pattern	Associated anomaly	Presentation	Malrotation diagnosed		
Bruna J Czech, 1970 [7]			Unknown						
Gilbert HW et al. UK, 1990 [1]	55	M	Descending colon	Type IIIA		Obstruction	Perioperative		
Torregiani WC Canada, 2001 [8]	86	F	Caecum	Reverse rotation		Abdominal mass	CT scan		
Q J Greene, USA, 2007 [9]	78	M	Ascending colon	Non-rotation	SIT		CT scan		
Ren P T, Lu B C China, 2009 [6]	45	M	Ascending colon	Type IIIA		Abdominal mass	Perioperative		
Antonio Brillantino, Italy, 2009 [10]	34	M	Ascending colon	Non-rotation		Abdominal mass, weight loss	Perioperative		
Michalopoulos A Greece, 2010 [11]	76		Ascending colon	Reverse rotation					
Petrou A Greece, 2010 [12]	59	M	Mucinous adenocarcinoma appendix	Non-rotation	SIT	Acute appendicitis	CT scan		
Hye Jim Kim, Korea, 2011 [13]	63	M	Ascending colon	Non-rotation	SIT	Obstruction	CT scan		
Huh J W, Korea, 2010 [14]	41	F	Rectum	Non-rotation	SIT	Bleeding per rectum	CT scan		
Michael Donaire, USA, 2013 [15]	52	M	Ascending colon	Non-rotation		Anaemia, weight loss	CT scan		
Ray D, India, 2013	60	F	Caecum	Non-rotation		Anaemia	Perioperative		
Japanese experience									
No	year	sex	Location of malignancy	malrotation pattern	Associated anomaly	Presentation	Malrotation diagnosed		
1	2013	M	Caecum	Unknown			Perioperative		
2	2013	M	Transverse colon	Non-rotation	SIT. Had gastrectomy for CA stomach 6 years ago.	GI bleeding	CT scan		
3	2012	M	Caecum	Reversed rotation		Occult bleeding	CT scan		
4	2012	M	Transverse colon	Non-rotation		Occult bleeding	CT scan		
5	2012	F	Rectosigmoid	Reversed rotation		Anaemia	CT scan		
6	2012	F	Sigmoid	Non-rotation					
7	2011	M	Caecum	Reversed rotation		Pain, weight loss, anaemia	CT scan		
8	2011	F	Ascending colon	Non-rotation		GI bleeding	CT scan		
9	2010	F	Transverse colon	Non-rotation					
10	2010	F	Caecum	Non-rotation		Obstruction	Perioperative		
11	2009	M	Ascending colon	Unknown		Anaemia	CT scan		
12	2009	M	Transverse colon	Malrotation		Obstruction	CT scan		
13	2009	M	Ascending colon	Non-rotation					
14	2009	F	Sigmoid colon	Non-rotation		Anaemia	CT scan		
15	2008	F	Rectum	Non-rotation			Perioperative		

Table 1 (continued)

16	Sumiya Yamamoto [25]	2007	63	F	Ascending colon	Non-rotation	SIT	GI bleeding	CT scan
17	Takao Kyouzawa [4]	2007	84	M	Descending colon	Non-rotation	Known SIT. Had	GI bleeding	CT scan
18	Yushi Fujiwara [26]	2007	53	F	Ascending colon	Non-rotation	ovariectomy for CA ovary 5years ago. SIT		CT scan
19	Takehide Sasaki [4]	2006	71	M	Transverse colon	Non-rotation			Barium enteroclysis CT scan
20	Yasuyuki Mitani [4]	2006	76	F	Transverse colon	Para duodenal hernia		Obstruction	CT scan
21	Oku Takaomi [27]	2005	56	M	Ascending colon	Non-rotation	Liver SOL		CT scan
22	Shigeo Fujita [28]	2004	55	F	Sigmoid colon	Non-rotation		Asymptomatic	Barium enema
23	Uchida H [29]	2004							
24	Keisei Sasaki [30]	2003	71	F	Caecum	Non-rotation			Perioperative
25	Takeshi Nagase [31]	2003	60	M	Ascending colon	Non-rotation	Situs inversus	Occult bleeding	CT scan
26	Takanori Goi [32]	2003	72	F	Ascending colon	Non-rotation	SIT	Abdominal mass	CT scan
27	Kaneko Tadashi [33]	2002	52	M	Sigmoid colon	Non-rotation	Situs inversus	Anaemia	CT scan
28	Sato Harunobu [34]	2001	76	F	Appendix	Non-rotation		Acute appendicitis	Perioperative
29	Iwamura T [35]	2001	71	F	Rectum	Non-rotation	SIT, synchronous carcinoma stomach	bleeding	CT scan
30	Nobuhisa Akamatsu [4]	2000	81	F	Sigmoid colon	Non-rotation	Situs inversus		Barium enema
31	Masaya Tamura [36]	1999	55	M	Caecum	Non-rotation		Pain, dyspepsia	CT scan
32	Katsuyuki Kumieda [37]	1998	57	F	Rectum	Non-rotation		Bleeding per rectum	Barium enema
33	Katsuyuki Kumieda [37]	1998	62	F	Rectum	Non-rotation		Bleeding per rectum	Barium enema
34	Tomio Ogawa [4]	1997	69	F	Transverse colon	Unknown			Perioperative
35	Yasuhide Sounaka [4]	1997	22	M	Ascending colon	Non-rotation			
36	Seta [37]	1996	68	M	Ascending colon	Non-rotation			
37	Shiomi [37]	1996	82	M	Rectum	Non-rotation			
38	Kazuhiko Yokota [37]	1995	66	M	Rectum	Non-rotation			
39	Naoki Hashimoto [37]	1995	65	F	Appendix	Malrotation			
40	Isogai [37]	1995	77	F	Caecum	Non-rotation		Abdominal mass	Barium X-ray
41	Hiroo Ooshita [37]	1993	68	M	Rectum	Non-rotation		Bleeding per rectum	Barium X-ray
42	Hayashi [37]	1993	72	F	Caecum	Non-rotation		Obstruction	Barium X-ray
43	Yoshikata [37]	1992	72	F	Sigmoid colon	Non-rotation		GI bleeding	Perioperative
44	Yokoyama [37]	1990	62	F	Ascending colon	Non-rotation		Abdominal mass	Perioperative
45	Shimanuki [37]	1988	73	M	Caecum	Non-rotation		Obstruction	Barium X-ray
46	Umaki [37]	1974	43	M	Colon	Non-rotation		GI bleeding	Barium X-ray
47	Hiratsuka [37]	1974	47	F	Caecum	Non-rotation		Abdominal mass	Perioperative
48	Hiratsuka [37]	1971	52	F	Colon	Non-rotation			Perioperative

SIT situs inversus totalis, GI gastrointestinal

Table 2 Presentation (*n*=45)

Gastrointestinal bleeding	14
Anaemia	8
Intestinal obstruction	7
Abdominal mass	7
Occult bleeding	3
Weight loss	3
Acute appendicitis	2
Pain/dyspepsia	1

of the stomach, gallbladder, pancreas and colorectal. The literatures in English were searched through PubMed and Google Scholar, while those in Japanese language were accessed through J-East and other databases. We noticed high incidence of gastrointestinal or hepatobiliary malignancies with malrotation in Japan compared to only few cases documented worldwide. The incidence of SIT is also high in Japan. Eleven cases of colorectal cancers associated with malrotation of the intestine were reported worldwide till date, but 48 cases have been reported in Japan. In a series in 2013, Sakaguchi T et al. presented 30 cases of colorectal cancers [4].

Is malrotation of the intestine a predisposing factor for colorectal malignancy? Genetic factors suggested for intestinal malrotation are as follows:

1. Due to mutation of genes controlling left to right patterning of the dorsal mesentery, of the intestine itself and of other abdominal organs.
2. Due to mutation in the forkhead box transcription factor (FOXF1), a key gene in the development of dorsal mesentery.
3. There are cases of intestinal malrotation which are likely genetic, but chromosomal locus and gene mutation are not yet identified [5].

But, genetic factors, so far identified predisposing colorectal malignancies, particularly in gastrointestinal polyposis syndromes, like mutation in APC gene, *p53*, *K-ras* genes, germline MMR mutations in HNPCC, germline SMAD4 mutations, etc., are different.

We also searched for long-term follow-up of malrotation of the intestine detected or operated in childhood. We could not find any report of developing colorectal malignancy later in

Table 3 Site of malignancies (*n*=57)

Right colon including caecum and appendix	33
Transverse colon	7
Left colon including sigmoid colon	8
Rectum	9

Table 4 Classification of malrotation of the intestine and clinical significance

Embryonal stage	Type of malrotation	Clinical effect
I Midgut length on superior mesenteric vessels; no rotation	IA Non-rotation	Midgut volvulus
II Withdrawal of duodenum followed by its rotation and fixation	IIA Non-rotation of duodenum: colon rotates normally IIB Reverse rotation of duodenum: and colon IIC Reverse rotation of duodenum: colon rotated normally	Duodenal obstruction by bands Transverse colon obstruction by superior mesenteric vessels Paraduodenal hernia
III Withdrawal of right colon followed by its rotation and fixation	IIIA Normal rotation of duodenum: colon not rotated IIIB Incomplete fixation of hepatic flexure IIIC Incomplete attachment of caecum and its mesentery IIID Internal hernias near the ligament of Treitz	Midgut volvulus Intermittent duodenal obstruction by “Ladd’s bands” Volvulus of caecum Internal hernias

life of the children known to have malrotation of the gut only. There are reports of developing malignancies in patients known to have malrotation of the intestine as a part of situs inversus. Hypotheses like malrotation of the gut may cause chronic bowel obstruction which leads to inflammation and carcinogenesis have been proposed [6]. Whether change in composition of bile due to altered enterohepatic circulation leads to colon cancers remains to be investigated.

Surgeons have different opinions regarding the benefits of surgical correction for malrotation found in adults.

Recently, there has been more awareness of malrotation of the gut in adults causing abdominal symptoms and surgical correction is favoured in patients with chronic symptoms or diagnosed incidentally [3]. Laparoscopic operation also can be safely accomplished.

Conclusion

Malrotation of the intestine, though commonly a paediatric problem, can present in adults with chronic abdominal

symptoms. Associations with different gastrointestinal and hepatobiliary malignancies have been reported. Whether this association is due to background genetic predisposition or due to gut-related abnormalities needs to be investigated. Long-term follow-up of children diagnosed to have malrotation can help to understand that whether malrotation should be considered as premalignant or not. Also, the role of operative correction of malrotation even in asymptomatic adults should be evaluated.

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