Perforated Gastrointestinal Stromal Tumor of the Meckel's Diverticulum: a Case Report and Review of Literature

Ishwar R. Hosamani¹ · Srinivas Kodaganur¹ · S. M. Chaukimath²

Received: 20 January 2016 / Accepted: 5 July 2016 / Published online: 20 July 2016
© Association of Surgeons of India 2016

Abstract Gastrointestinal stromal tumors (GISTs) are the most common mesenchymal tumors of the GI tract, they have a wide spectrum of clinical manifestations, and a small proportion of them present as an acute abdomen due to obstruction, perforation, or hemoperitoneum. We present a case of a perforated GIST of the Meckel's diverticulum and review the current literature on perforated GISTs. We ran a search on Pubmed and Google Scholar with the following terms “perforated GIST,” “perforated Meckel's diverticulum,” “GIST with peritonitis,” and “GIST in Meckel's diverticulum.” After selecting the relevant articles, we tabulated our results and analyzed the data. Out of the 45 cases, 32 (71.1 %) were male and 13 (28.8 %) were female. Out of the 45 reported cases, 41 (91.1 %) were from the small intestine, 2 (4.44 %) cases from the stomach, and 2 (4.44 %) from the small bowel. In 15 (33.33 %) cases, the site of perforation was the Meckel's diverticulum (MD). Forty-year-old male, presented with features of peritonitis localized to the right iliac fossa, was diagnosed as acute appendicitis and subjected to a diagnostic laparoscopy. Intraoperatively, a perforated Meckel's diverticulum was found, which on histopathological examination contained a low-grade GIST. Our literature search revealed that in reported cases of perforated GISTs, there is a slight male preponderance. Small bowel appears to

be the most common site for a perforated GIST, and a significant proportion (30.23 %) arise from the Meckel's diverticulum. And most importantly, the commonest tumor to cause perforation of a Meckel's diverticulum is a GIST.

Keywords Perforated GIST · Meckel's diverticulum · GIST with peritonitis · Diagnostic laparoscopy

Introduction

Gastrointestinal stromal tumors (GISTs) are rare tumors of the GI tract, and in most studies, their incidence is found to be less than 1 % [1]; however, they are the most common mesenchymal neoplasms that arise from the GI tract [2].

They have a wide spectrum of clinical manifestations, a third of them are asymptomatic and detected incidentally while investigating other pathologies. They most commonly present with symptoms of gastric discomfort or ulcer-like symptoms and upper GI bleed. Very rarely, they may present with features of an acute abdomen either due to obstruction, perforation, or hemoperitoneum [2].

To come to a diagnosis of GIST, it is essential to demonstrate the expression of the tyrosine kinase receptor KIT (CD 117 leukocyte antigen), almost 97 % of GISTs are positive for KIT, other markers that can be demonstrated immunohistochemically and are useful in KIT-negative GISTs are Ano-1, PDGFRA, CD 34, and protein kinase C theta [2].

The aims of this article were to review the available literature and present a rare case of a perforated GIST arising in a Meckel's diverticulum (MD) which was successfully managed by a laparoscopic-assisted approach.

✉ Srinivas Kodaganur
srinirocks89@gmail.com

¹ Department of General Surgery, Karnataka Institute of Medical Sciences, Hubli, Karnataka 580022, India

² Department of Pathology, Karnataka Institute of Medical Sciences, Hubli, Karnataka, India

Case Report

A 40-year-old male patient presented to the emergency department with complaints of pain abdomen for 1 day; on examination, there was tenderness and guarding in the right iliac fossa. A clinical diagnosis of acute appendicitis was made.

Ultrasound of the abdomen showed free fluid in the peritoneal cavity, and the appendix could not be visualized. Plain abdominal and chest radiographs were normal.

Patient was subjected to a diagnostic laparoscopic evaluation, which revealed multiple adherent bowel loops in the right iliac fossa mostly involving the terminal ileum. After carefully releasing the adhesions laparoscopically, a Meckel's diverticulum was identified at about 50 cm from the ileocecal junction, which appeared to be perforated.

It was decided by the senior operating surgeon to convert the laparoscopic procedure to an open exploratory laparotomy.

The port site incision at the umbilicus was extended and the adherent bowel loops delivered out. The involved part of the ileum containing the Meckel's diverticulum was resected, and an end-to-end ileo-ileal anastomosis was performed (Fig. 1). Peritoneal lavage was performed, and the abdominal cavity was closed in layers. The patient had an uneventful post operative recovery and was discharged on post op day 5.

Histopathological examination of the resected specimen (Fig. 1 and Fig. 2) showed a perforated Meckel's diverticulum with a gray white fleshy growth involving the entire length of the diverticulum; sections from this area revealed features suggestive of a GIST with mitotic count of 2/50 hpf (Fig. 3).

To confirm our diagnosis, immunohistochemical (IHC) examination was performed and the sample was found to be C-KIT positive.

Patient was started on adjuvant therapy with oral imatinib.

Fig. 1 Specimen showing segment of resected bowel

Fig. 2 Specimen showing resected bowel segment with bowel wall thickening and perforation

Methodology

We conducted an extensive search on PubMed and Google Scholar with the following terms “perforated GIST,” “perforated Meckel's diverticulum,” “GIST with peritonitis,” and “GIST in Meckel's diverticulum.” After selecting the relevant articles that described the occurrence of perforation of the GI tract associated with a GIST, we tabulated our results and analyzed the data; we calculated the percentages of the following:

- i) Total number of patient sex-wise
- ii) Organ-wise distribution of cases
- iii) Percentage of cases involving Meckel's diverticulum and the average age of the study population.

Fig. 3 High-power (×40) microphotograph showing features of a classical stromal tumor

Table 1 Results of our literature search—perforated GI stromal tumors

Si no	First author	Year	Age/sex	Location	Intraoperative findings	Mitotic counts	Size (cm)	Treatment	Follow-up (months)
1	Yamamoto et al. [11]	2003	32/M	Small bowel	Peritonitis	28/50	15	SBR + imatinib	Alive 24
2	Szentpalli et al. [12]	2004	70/M	Small bowel—Meckel's diverticulum	Peritonitis	Low mitotic index	1.5	SBR	Alive 36
3	Efremidou et al. [13]	2006	66/M	Ileum	Peritonitis	2/50	7 × 5 × 4	SBR + imatinib	Alive 44
4	Karagulle et al. [14]	2008	70/M	Jejunum	Abscess	NR	5	SBR	Alive 13
5	Hur et al. [15]	2008	70/M	Colonic/hepatic recurrence from a primary gastric GIST	Abscess	NR	NR	Percutaneous drainage with palliative chemotherapy with sunitinib	Alive after 2nd cycle of chemo with sunitinib
6	Versaci et al. [16]	2009	46/M	Jejunum	Peritonitis	5/50	12 × 7	SBR + imatinib	Alive 12
7	Taniguchi et al. [17]	2009	59/M	NR	Peritonitis	<5/50	7 × 5	SBR + imatinib	Alive 14
8	Licursi et al. [18]	2009	47/M	Jejunum	Peritonitis	<5/50	12.5 × 50	SBR	NR
9	Ku et al. [19]	2010	33/F	Jejunum	Peritonitis	NR	6.5 × 5 × 4	SBR	NR
10	Ozben et al. [20]	2010	65/M	Ileum	Peritonitis	NR	6.5 × 5 × 4	SBR + ileostomy	Dead POD 4
11	Dogrul et al. [21]	2011	86/F	Ileum—perforated Meckel's diverticulum	Peritonitis	High	8	SBR	Dead 2
12	Feng et al. [22]	2011	45/M	Jejunum	Peritonitis	<5/50	10 × 8	SBR + imatinib	NR
13	Paranyhiotis et al. [23]	2011	56/M	Jejunum	Peritonitis	<5/50	3	SBR + imatinib	Alive 48
14	Bhandarwar et al. [24]	2011	55/F	Jejunum	Peritonitis	<5/50	10 × 8	SBR	NR
15	Aslan et al. [25]	2012	50/F	Jejunum	Peritonitis	NR	13	SBR	NR
16	Memmi et al. [26]	2012	59/M	Jejunum	Peritonitis	7/50	12	SBR	NR
17	Choudhary [27]	2012	35/M	Jejunum	Peritonitis	>5/10	4.5 × 3.5 × 2.5	SBR	Alive 48
18	Sezer et al. [28]	2012	61/F	Jejunum	Peritonitis	9/50	5 × 2	SBR + imatinib	Alive 6
19	Roy et al. [29]	2012	46/M	Jejunum	Peritonitis	NR	3 × 2	SBR + imatinib	Alive 6
20	Shoji et al. [30]	2013	61/M	Jejunum	Peritonitis	0/50	9 × 7	SBR + imatinib	Alive 36
21	Beltran et al. [31]	2013	46/M	Ileum	Abscess	15/50	7.5 × 7	SBR + imatinib	NR
22	Mitura et al. [32]	2012	63/F	Meckel's diverticulum	Peritonitis	High malignant potential	14	SBR	Alive 6
23	Chou et al. [33]	2011	76/F	Meckel's diverticulum	Peritonitis	High	3.2	SBR	NR
24	Misawa et al. [34]	2014	70/M	Jejunum	Abscess	NR	9 × 9	SBR + imatinib	Alive 12
25	Sharma et al. [35]	2014	50/F	Ileum	Peritonitis	NR	10 × 8	SBR + imatinib	NR
26	Mansoor et al. [36]	2014	41/M	Multiple	Peritonitis	NR	NR	SBR + imatinib	NR
27	Alessiani et al. [1]	2014	82/M	Jejunum	Peritonitis	16/50	7 × 5	SBR + imatinib	Alive 6
28	Skipworth et al. [37]	2014	51/F	Stomach	Perforated mass	Low	5	Distal gastrectomy with roux-en-y GJ	Alive 6
29	Fernandez em et al. [38]	2013		Meckel's diverticulum	peritonitis	NR	NR	SBR + imatinib	NR
30	Woolf et al. [39]	20	59/M	Meckel's diverticulum	Peritonitis	low	NR	SBR	Alive
31	Hager et al. [40]	2004	75/M	Meckel's diverticulum	Peritonitis	NR	NR	NR	NR
32	Sozen et al. [41]	2012	62/F	Meckel's diverticulum	peritonitis	6/50	2.5 cm	SBR	NR
33	Nayak et al. [42]	2015	50/M	Meckel's diverticulum	peritonitis	NR	NR	SBR	NR
34	Kilic et al. [43]	2015	37/F	Meckel's diverticulum	Peritonitis	10/50	4.5 × 2.5 × 2.5	SBR + imatinib	NR
35	Caricato et al. [44]	2010	65/M	Meckel's diverticulum	Peritonitis	1/50	4.5 × 3.7.3.5	SBR	Alive 24

Table 1 (continued)

Sl no	First author	Year	Age/sex	Location	Intraoperative findings	Mitotic counts	Size (cm)	Treatment	Follow-up (months)
36	Fruhauf et al. [45]	2002	61/M	Meckel's diverticulum	Peritonitis	Poorly differentiated	NR	NR	NR
37	Goyal et al. [46]	2013	22/M	Meckel's diverticulum	peritonitis	<5/50	4.8 × 4.2 × 4.2	SBR	NR
38	Sreevathsa [47]	2012	60/F	Caecum	Obstruction and peritonitis	>5/50	15 × 20	Right hemicolectomy with imatinib	Alive 36
39	M.M. Lorenzo et al. [48]	2014	77/M	Stomach	Peritonitis	NR	NR	Gastric resection	NR
40	Kivileim [49]	2012	54/M	Ileum	Peritonitis	>5/50	7 × 5	SBR + ima	Alive 9
41	Kim et al. [50]	2013	32/M	Ileum	Peritonitis	>5/50	10.5 × 8 × 7	SBR + imatinib	Alive 10
42	Usha M et al. [51]	2014	52/M	Jejunum	Peritonitis	10/50	Multiple nodules	SBR + imatinib	NR
43	Present case	2015	40/M	Meckel's diverticulum	Peritonitis	2/50	3 × 1 × 1	SBR + imatinib	Alive 60
44	Ikemura et al. [53]	2015	82/M	Meckel's diverticulum	Peritonitis	NR	Diffuse involvement	SBR + imatinib	Alive 6
45	Omerza et al. [54]	2016	55/M	Meckel's diverticulum	Peritonitis	<5/50	3.5 × 8	SBR + imatinib	NR

SBR small bowel resection, NR not reported

Results

Out of the 45 cases, 32 (71.1 %) were male and 13 (28.8 %) were female. Out of the 45 reported cases, 41 (91.1 %) were from the small intestine, 2 (4.44 %) cases from the stomach, and 2 (4.44 %) from the small bowel. In 15 (33.33 %) cases, the site of perforation was the MD. Five (11.11 %) patients presented with a localized intraperitoneal abscess; the rest presented with peritonitis per se.

The average age of this study population was 55.72 ± 14.48 years.

Discussion

GISTs account for less than 1 % of all gastrointestinal malignancies, their most common location being the stomach [1, 2]; however, the occurrence of a perforation associated with a stromal tumor is more commonly seen in the small bowel [3]. Our own literature search revealed that out of 45 reported cases of perforation in a GIST, 41 occurred in the small intestine. The exact reason for this is not known; we hypothesize that it may be due to the thinner wall of the small intestine compared to the stomach or large bowel.

One third of the stromal tumors of the GI tract are asymptomatic and incidentally detected during investigative procedures; some of them may present with vague nonspecific gastrointestinal complaints such as early satiety, nausea, and vomiting and very few present in an acute setting [1]. Amongst those, which present in an acute setting, bleeding from the GI tract is the most common symptom [2]. The incidence of perforation associated with a GIST is quite low, with only 45 cases reported till date.

The association of GIST with MD is a known entity; it accounts for about 12 % of the tumors associated with MD [4]. Only 4–16 % of MD is symptomatic and is mostly due to ulceration and intussusception [5]. A Meckel's diverticulum causing perforation of the small intestine is an even more rarely reported entity. Perforation is usually caused by foreign objects such as a fish bone, or spontaneous perforation due to ulceration of the gastric mucosa present in the diverticulum [6, 7]. A perforation caused due to a tumor is almost unheard of.

Our literature search revealed that GISTs are the most common tumors responsible for perforation of a MD (Table 1). There are at present 15 well-reported cases of a perforated Meckel's diverticulum due to a GIST, compared to just one case report of a carcinoid tumor [8], two cases of leiomyosarcoma [9, 10], and one case of adenocarcinoma [52]. Amongst the location of perforated stromal tumors, MD accounts for a large proportion (30.33 %) of the cases.

This association between MD and GIST has not been previously described, even though the number of cases is quite less to come to any conclusion, there is a possibility that

stromal tumors of the MD are at a higher risk of perforation. Management of these patients is mostly surgical followed by adjuvant therapy with imatinib. As in our case, and as previously reported [38], these cases can be managed laparoscopically without any complications.

According to Johnsue's classification [1], tumor rupture has been assigned to the high-risk category and any patient presenting with a perforated GIST should receive imatinib irrespective of the mitotic count, as there is a possibility of tumor cells being disseminated into the peritoneal cavity after perforation. Perforated GISTs are usually associated with a good prognosis, unless there are other co-morbid factors in the patient.

Conclusion

Both MD and GIST are relatively rare entities, and their association is even more so. Our literature search has revealed that GISTs are the most common tumors responsible for perforation of a Meckel's diverticulum. And even amongst the sites of perforated stromal tumors, they form a significant chunk (35 %).

Even though it is hard to come to any conclusions with the data presented here, it is worthwhile for the practicing surgeon to keep this association in mind while dealing with a Meckel's diverticulum.

CD, cluster of differentiation; GI, gastrointestinal; GIST, gastrointestinal stromal tumor; KIT, receptor tyrosine kinase; MD, Meckel's diverticulum; PDGFRA, platelet-derived growth factor receptor alpha.

Authors' Contribution IRH and SK were involved in patient care and manuscript preparation, and CSM was the pathologist who reported the slides and provided the microphotographs.

Compliance with Ethical Standards

Informed Consent Informed consent was taken from the patient and his relatives according to the Declaration of Helsinki and its later amendments.

Conflict of Interest The authors declare that they have no conflict of interest.

References

- Alessiani M, Gianola M, Rossi S, et al. (2015) Peritonitis secondary to spontaneous perforation of a primary gastrointestinal stromal tumour of the small intestine: a case report and a literature review. *Int J Surg Case Rep* 6:58–62
- Miettinen M, Lasota J (2013) Gastrointestinal stromal tumors. *Gastroenterol Clin N Am* 42(2):399–415
- Chen HW, Lin TY (2012) Tumor abscess formation caused by *Morganella morganii* complicated with bacteremia in a patient with gastrointestinal stromal tumor. *Clin Res Hepatol Gastroenterol* 36(2):e29–e31
- Lorusso R, Forte A, Urbano V, Soda G, D'Urso A, Bosco MR, Mancini P, Bezzi M (2003) Small bowel stromal tumors in a "meckelian" location: about a clinical observation. *Ann Ital Chir* 74:707–711
- Sagar J, Kumar V, Shah DK (2006) Meckel's diverticulum: a systematic review. *J R Soc Med* 99:501–505
- Cotirlet A, Anghel R, Tincu E, Rau S, Motoc I, Popa E (2013) Perforation of Meckel's diverticulum by foreign body, a rare complication. *Chirurgia (Bucur)* 108(3):411–413
- Hortezky K (1956) Perforated peptic ulcer in Meckel's diverticulum. *Wien Klin Wochenschr* 68(4):66–67 German
- Nordsten M, Bryniz S (1986) Carcinoid of Meckel's diverticulum. Report of two cases with perforation, in one with concomitant foreign body. *Acta Chir Scand* 152:551–553
- Nishibe M, Nishibe T, Yamashita T, Kaji M, Fukuhara I, Yasuda K (2001) Perforated leiomyosarcoma of Meckel's diverticulum: report of a case. *Surg Today* 31(2):163–165
- Sheth M, Rosenberg V, Kim U (1978) Perforated leiomyosarcoma of Meckel's diverticulum: a case report and review of literature. *Mt Sinai J Med* 45(3):322–328
- Yamamoto S, Kubo S, Shuto T (2003) Treatment with STI571, a tyrosine kinase inhibitor, for gastrointestinal stromal tumor with peritoneal dissemination and multiple liver metastases. *J Gastroenterol* 38:896–899
- Szentpáli K, Palotás A, Wolfárd A, et al. (2004) A gastrointestinal stromal tumour presenting in a perforated Meckel's diverticulum. *Can J Surg* 47:70
- Efremidou EI, Liratzopoulos N, Papageorgiou MS, Romanidis K, Manolas KJ, Minopoulos GJ (2006) Perforated G.I.S.T. of the small intestine as a rare cause of acute abdomen: surgical treatment and adjuvant therapy. Case report. *J Gastrointestin Liver Dis* 15:297–299
- Karagülle E, Türk E, Yildirim E, Göktürk HS, Kiyici H, Moray G (2008) Multifocal intestinal stromal tumors with jejunal perforation and intra-abdominal abscess: report of a case. *Türk J Gastroenterol* 19:264–267
- Hur H, Park AR, Jee SB, et al. (2008) Perforation of the colon by invading recurrent gastrointestinal stromal tumors during sunitinib treatment. *World J Gastroenterol* 14:6,096–6,099
- Versaci A, Macri A, Grosso M (2009) Acute abdomen for perforated gastrointestinal stromal tumor (GIST). A case report. *Ann Ital Chir* 80:69–73
- Taniguchi M, Fukuda M, Kobayashi H, Kawata A (2009) A case of gastrointestinal stromal tumor (GIST) of the small intestine presenting with perforative peritonitis. *J Abdom Emerg Med* 29:931–935
- Licursi M, Bonsignore A, Fiumara F (2009) Gastrointestinal stromal tumors (GISTs): personal experience on three cases of the tumors of the small intestine complicated and emergency surgically treated. *G Chir* 30:276–285
- MC K, Tsai CM, Tyan YS (2010) Multiple gastrointestinal stromal tumors in a patient with type I neurofibromatosis presenting with tumor rupture and peritonitis. *Clin Imaging* 34:57–59
- Özben V, Çarkman S, Atasoy D, Doğusoy G, Eyüboğlu E (2010) A case of gastrointestinal stromal tumor presenting with small bowel perforation and internal hernia. *Türk J Gastroenterol* 21:470–471
- Dogrul AB, Kilic YA, Onurdag F, et al. (2010) A gastrointestinal stromal tumor in Meckel diverticulum in an 86-year-old patient. *Am J Med Sci* 340:156–157
- Feng F, Chen F, Chen Y, Liu J (2011) A rare perforated gastrointestinal stromal tumor in the jejunum: a case report. *Türk J Gastroenterol* 22:208–212
- Paramythiotis D, Panidis S, Papadopoulos V, Panagiotou D, Panteliadou P, Michalopoulos A (2011) Perforated gastrointestinal

- stromal tumor of the small intestine: a case report presenting with peritonitis. *J Curr Surg* 1:44–46
24. Bhandarwar AH, Borisa AD, Kori C, Vora S, Kasat G (2011) Giant jejunal gastrointestinal stromal tumor presenting as acute abdomen. *Bombay Hosp J* 53:463–467
 25. Aslan F, Alper E, Cantürk F (2012) Gastrointestinal stromal tumor perforation in a case with neurofibromatosis presenting with abdominal pain. *Turk J Gastroenterol* 23:83–84
 26. Memmi N, Cipe G, Bektasoglu H (2012) Perforated gastrointestinal stromal tumor in the jejunum: a rare cause of acute abdomen. *Oncol Lett* 4:1244–1246
 27. Choudhary G, Koushal G, Bhoirwal S (2012) Jejunal gastrointestinal stromal tumor causing perforation peritonitis in a young male: a case report. *Int J Surg* 2:8
 28. Sezer A, Sagioglu T, Ozpuyan F, Erdogan B, Tastekin E (2012) A ruptured gastrointestinal stromal tumor of jejunum causing acute abdomen. *J Clin Anal Med* 3:341–343
 29. Roy SD, Khan D, De KK, De U (2012) Spontaneous perforation of jejunal gastrointestinal stromal tumor (gist): case report and review of literature. *World J Emergency Surg* 7:37
 30. Shoji M, Yoshimitsu Y, Maeda T, Sakuma H, Nakai M, Ueda H (2013) Perforated gastrointestinal stromal tumor (GIST) in a true jejunal diverticulum in adulthood: report of a case. *Surg Today* 20
 31. Beltrán MA, Tapia RA, Cortés VJ (2013) Multiple primary gastrointestinal stromal tumors presenting in jejunum and ileum. *Indian J Surg* 75(Suppl. 1):S227–S229
 32. Mitura K, Blicharz P, Roman'czuk M (2012) Perforated GIST of Meckel's diverticulum. *Pol Przegl Chir* 84:258–261
 33. Misawa S, Takeda M, Sakamoto H, Kirii Y, Ota H, Takagi H (2014) Spontaneous rupture of a giant gastrointestinal stromal tumor of the jejunum: a case report and literature review. *World J Surg Oncol* 12:153
 34. Chou YH, CC T, Huang CC, Hsieh MS (2011) A clinically-occult gastrointestinal stromal tumor in a Meckel's diverticulum presenting as hollow organ perforation. *Chang Gung Med J* 34(6 Suppl):56–61
 35. Sharma MBK, Barad AK, Padu K, Singh KS, Singh Th SC (2014) Spontaneous perforation as a first presentation of ileal gastrointestinal stromal tumour (GIST) with synchronous breast sarcoma. *J Clin Diagn Res* 8:–ND7–9
 36. Mansoor E (2014) Multifocal small bowel stromal tumors presenting with peritonitis in a HIV positive patient. *Int J Surg Rep* 5:243–245
 37. Skipworth JR, Fanshawe AE, West MJ, Al-Bahrani A (2014) Perforation as a rare presentation of gastric gastrointestinal stromal tumors: a case report and review of the literature. *Ann R Coll Surg Engl* 96:96E–100E
 38. López-Tomassetti Fernández EM, Hernández Hernández JR, Nuñez Jorge V (2013) Perforated gastrointestinal stromal tumor in Meckel's diverticulum treated laparoscopically. *Asian J Endosc Surg* 6(2):126–129
 39. Woolf R et al. (2009) A gastrointestinal stromal tumour presenting incidentally with haemorrhage and perforation associated with a Meckel's diverticulum: a case report. *J Med Case Rep* 3(2):1–5
 40. Hager M et al. (2005) Perforated Meckel's diverticulum presenting as a gastrointestinal stromal tumor: a case report. *J Gastrointest Surg* 9(6):809–811
 41. Sozen S, Tuna O (2012) A rare case of perforated Meckel's diverticulum presenting as a gastrointestinal stromal tumor. *Arch Iran Med* 15(5):325–327
 42. Nayak B, Dash RR, Mallik BN (2015) Perforated Meckel's diverticulum as a result of gastrointestinal stromal tumor presenting as acute abdomen: a rare case report. *Oncol Gastroenterol Hepatol Rep* 4(1):26
 43. Kiliç MÖ, Şen M, Turkan A, Yildirim Ü, Bozer M, Koketener AA (2015) Rare case of perforated gastrointestinal stromal tumour in a Meckel's diverticulum. *N J Med* 32:105–107
 44. Caricato M, Mangiameli G, Miecadei F (2010) A rare case of complicated Meckel's diverticulum. *Case Rep Images* 81(6):449–451
 45. Frühauf, Garcia, Rosso (2002) Stromal tumor in a perforated Meckel's diverticulum: a case report. *Swiss Surg* 8(6):273–276
 46. Goyal R, Chaudhary NK (2013) Gastrointestinal stromal tumour of Meckel's diverticulum causing perforation and peritonitis: a case report. *Indian J Surg* 75(1):171–173
 47. Sreevathsa MR (2012) Caecal gastrointestinal stromal tumor with perforation and obstruction. *Indian J Surg Oncol* 3(4):311–313
 48. Lorenzo MM, Castro LD, Moreiras MIP, Vales JC, Buján JAC (2014) Emergency atypical resection for perforated gastric gist. *Open J Gastroenterol* 4(03):118
 49. Kivilcim T, Altintoprak F, Onuray F, Beyaz SG, Yildirim M, Dilek ON (2013) Acute abdomen syndrome caused by a perforated gastrointestinal stromal tumor—a case report. *J Cancer Res Updat* 2(1):10–13
 50. Kim SY, Kim JH, Park DS, Jang GS, Hong EY, An JS, Park CK (2013) A case of perforated gastrointestinal stromal tumor in the jejunum as a rare cause of acute abdomen. *Int Res* 11(2):134–136
 51. U M, Kumar V, RA R, Kamath S (2014) Perforated GIST in jejunum—a rare cause of abdominal cocoon. *J Clin Diagn Res* 8(3):132–133
 52. Lesquereux-Martínez L, Macías-García F, Beiras-Sarasquete C, Martínez-Castro JJ, Paulos-Gómez AM, Beiras-Torrado A, Bustamante-Montalvo M (2011) Adenocarcinoma arising in Meckel's diverticulum: a case report and literature review. *Gastroenterol Hepatol* 34(3):137–140 (article in spanish)
 53. Ikemura M, Kunita A, Miwa Y, Jimbo K, Mori K, Seto Y, Fukayama M (2015) Gut wall replacing type of gastrointestinal stromal tumor presenting as a perforation of the ileal diverticulum. *Pathol Res Pract* 211(11):892–895
 54. Omerza CR, Bouman AK, Bulinski PPA (2016) Rare case of a gastrointestinal stromal tumor (GIST) presenting as a perforated Meckel's diverticulum. *J Gastrointest Cancer*