

# Spontaneous perforation and intraabdominal abscess due to Meckel's diverticulum revealed on SPECT/CT with 99m-technetium pertechnetate

## A case report

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### Abstract

**Rationale:** Meckel's diverticulum (MD) is common congenital abnormality of gastrointestinal tract, only about 6.4% of patients become symptomatic. A smaller minority develop potential fatal complications such as hemorrhage, perforation, abscess, and bowel obstruction.

**Patient concerns:** A 15-year-old boy with history of appendicitis was admitted due to worsening abdominal pain and nausea for 1 day. The physical examination showed the abdomen was soft, with the diffuse tenderness to palpation and voluntary guarding.

**Diagnosis:** Abdominal computed tomography showed a probable MD in the distal ileum. Single photon emission computed tomography/computed tomography (SPECT/CT) fusion imaging revealed the focal concentration at the right lower quadrant of abdomen region.

**Intervention:** After the initial management including antibiotic administration and intravenous fluid resuscitation, MD with perforation and localized suppurative peritonitis was confirmed in surgery. The patient underwent a diverticulectomy. Histological examination was confirmed as MD with focal heterotopic gastric tissue.

**Outcomes:** After surgery, the patient had uneventful recovery during 3 months follow-up.

**Lessons:** Spontaneous perforation and intraabdominal abscess due to MD is very rare. Accurate diagnosis of MD remains challenging as clinical symptoms from these complications occur nonspecifically. SPECT/CT fusion imaging is critical for prompt recognition and accurate diagnosis in the successful management of this rarely life-threatening complication.

**Abbreviations:** MD = Meckel's diverticulum, SPECT/CT = single photon emission computed tomography/computed tomography.

**Keywords:** abscess, meckel diverticulum, perforation, single photon emission computed tomography/computed tomography

## 1. Introduction

Meckel's diverticulum (MD) is a vestigial remnant of the omphalomesenteric, which fails to completely obliterate during the 5th to 8th week of gestation. Although most patients are asymptomatic, the lifetime risk of developing a complication is estimated at 6.4%.<sup>[1]</sup> The most common complication is

bleeding, obstruction in children and adults, respectively.<sup>[2]</sup> Perforation is found in 11% to 15% of the symptomatic patients.<sup>[3]</sup> 99m-Technetium pertechnetate scintigraphy has been widely used for noninvasive detection of MD as ectopic gastric mucosa in MD could take in and concentrate 99m-technetium pertechnetate. Whereas approximately 90% of MD manifests with bleeding due to contained gastric mucosa.<sup>[4]</sup> Single photon emission computed tomography/computed tomography (SPECT/CT) fusion imaging can give definition of scintigraphy findings and precise localization of lesion.<sup>[5]</sup> We report a case of spontaneous perforation and intraabdominal abscess due to MD revealed on SPECT/CT fusion imaging.

## 2. Case report

The study was approved by the Ethics Committee of the First Affiliated Hospital, College of Medicine, Zhejiang University. Informed consent for publication of case details was obtained from the parents of the patient. A 15-year-old Chinese boy was presented with worsening abdominal pain and nausea over the last 1 day and was admitted to the emergency department. He had unremarkable medical history with respect to malignant tumor, trauma, tuberculosis, and surgery, except for appendicitis treated by anti-inflammatory drugs when he was 8 years old. His vital signs were normal and afebrile. The physical examination showed the abdomen was soft, with diffuse tenderness to palpation and voluntary guarding. The other systems revealed no

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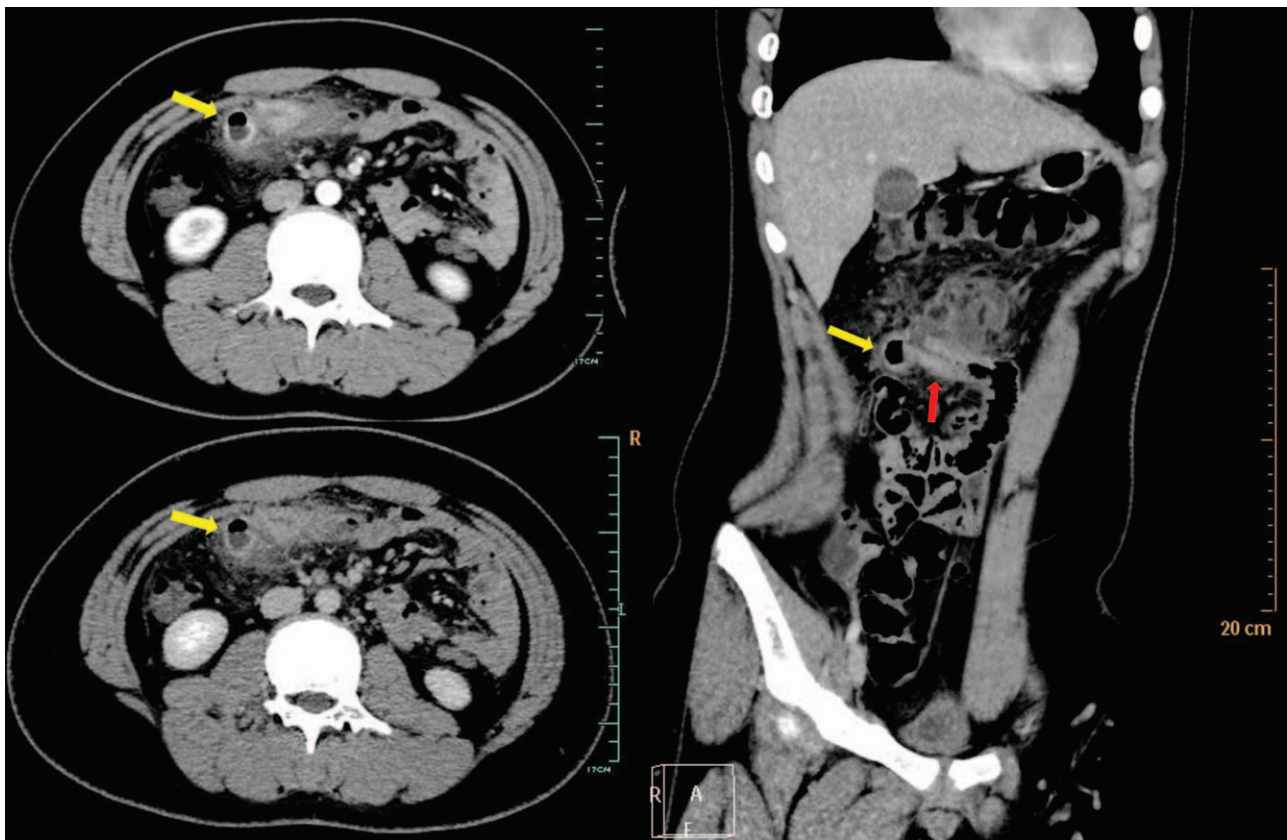
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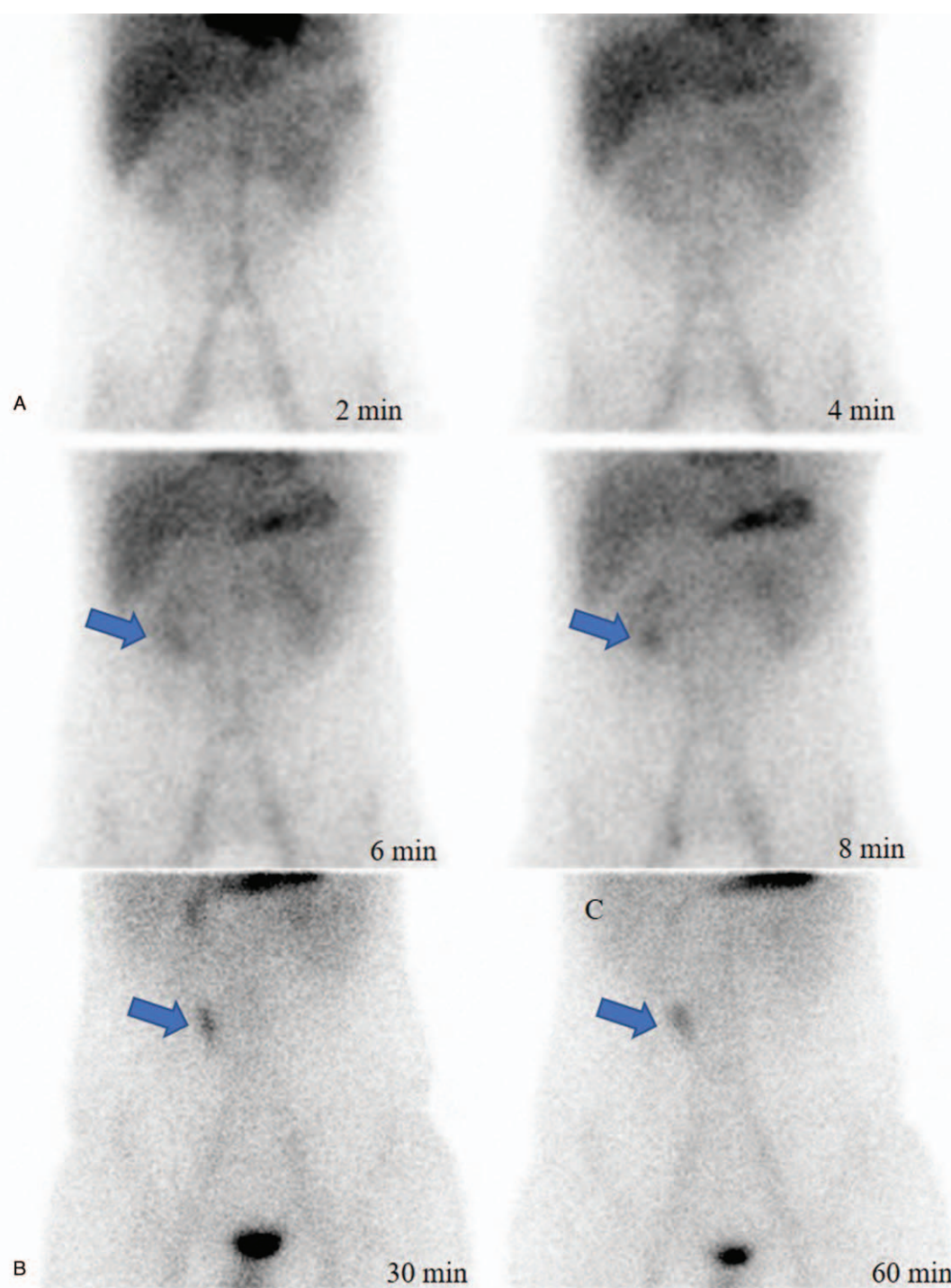


**Figure 1.** Axial contrast-enhanced CT images reveal a thick-mucosa and increased enhancement of segmental ileum loop with air-fluid level (yellow arrows) and intraperitoneal abscess with diffuse infiltration of small bowel mesentery (A). Curved reconstruction shows an enhancing and thickened tubular structure (red arrow) corresponding to suspicious inflamed Meckel diverticulum with an associated phlegmon (B). CT=computed tomography.

abnormality. Laboratory investigations showed the following values: white blood cell count  $21.4 \times 10^9/L$  (Neut. 87.3%); red blood cell count,  $5.11 \times 10^{12}/L$ ; hemoglobin, 140 g/L; platelets,  $378 \times 10^9/L$ ; C-reactive protein, 10.0 mg/L. The other biochemical analysis was in normal range, including liver and renal function, electrolytes, urinalysis, tumor marker tests, antinuclear antibody, and tuberculosis screening test. A computed tomographic scan of the abdomen with intravenous contrast showed an irregular inflammatory lesion, considered to be an abdominal abscess caused by the thickening and perforation of the distal ileum (Fig. 1). The appendix was not inflamed. The  $^{99m}\text{Tc}$ -pertechnetate scintigraphy was performed after the intravenous injection of 370 MBq  $^{99m}\text{Tc}$ -pertechnetate. Dynamic images (2 min/frame) and delayed (30 min, 60 min) revealed the focal concentration under the liver at the right quadrant of abdomen region, which changes simultaneously with the concentration of  $^{99m}\text{Tc}$ -pertechnetate in stomach (Fig. 2). SPECT/CT fusion imaging showed that the focal concentration was located on the distal ileum, which was surrounded the inflammatory lesion (Fig. 3). Based on these findings of imaging, MD with perforation was diagnosed. After the initial management including antibiotic administration and intravenous fluid resuscitation, MD (5.5×2.5×2.0 cm) with perforation located in the ileum within 85 cm of the ileocecal valve and localized suppurative peritonitis, was noted by the laparoscope. Histological examination of the lesion was confirmed as MD with focal heterotopic gastric tissue (Fig. 4). The patient underwent surgical diverticulectomy and had uneventful recovery during 3 months follow-up.

### 3. Discussion

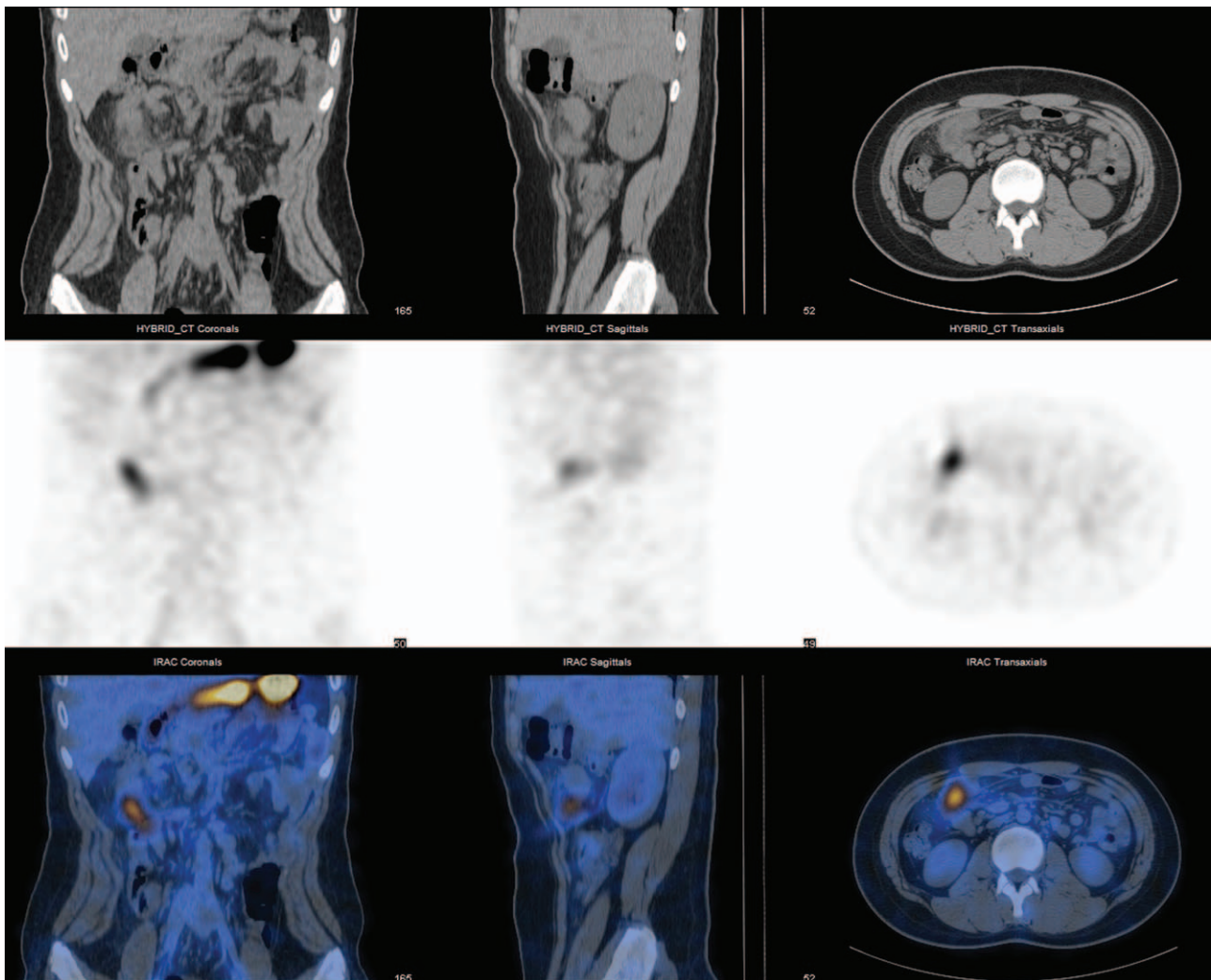
MD was first described in 1809 and the most common dysgenesis of the small intestine, which is caused by incomplete obliteration of the vitelline duct.<sup>[1,2]</sup> MD occurs in 2% of the population, which are often found in children and less present in adults. The average distance of the MD from the ileocecal valve is 67 cm in adults.<sup>[6]</sup> Most patients with MD are asymptomatic and are incidentally discovered intraoperatively.<sup>[7]</sup> The risk of lifetime complication is 4% to 6%, including bowel obstruction and intussusception (50.2%), diverticulitis (12.7%), hemorrhage (11.8%), perforation (7.3%), and neoplasm (3.2%).<sup>[6]</sup> Accurate diagnosis of MD is notably difficult in symptomatic patients as the clinical presentation is unspecific and mimics many other abdominal diseases. Multiple imaging modalities, including plain film, ultrasound and CT, are challenging as it shows non-specific changes and is difficult to differentiate between MD and a loop of bowel, thus limiting its detection.<sup>[8]</sup> However,  $^{99m}\text{Tc}$ -pertechnetate scintigraphy can provide an important clue to diagnose MD as heterotopic gastric mucosa is present in 50% to 60% of all MD, which  $^{99m}\text{Tc}$ -pertechnetate is taken up by the heterotopic gastric mucosa in MD.<sup>[9,10]</sup> Although the sensitivity of scintigraphy is 85% to 54%, it is highly specific (95%).<sup>[11,12]</sup> The sensitivity of scintigraphy also can be improved by use of  $\text{H}_2$  antagonists or glucagon.<sup>[12]</sup> SPECT/CT fusion imaging can provide valuable anatomical and functional information, which allow precise efficient localization of activity at an abnormal anatomic structure. It can avoid false negative or false positive associated with a traditional Meckel's scan.<sup>[13-16]</sup>



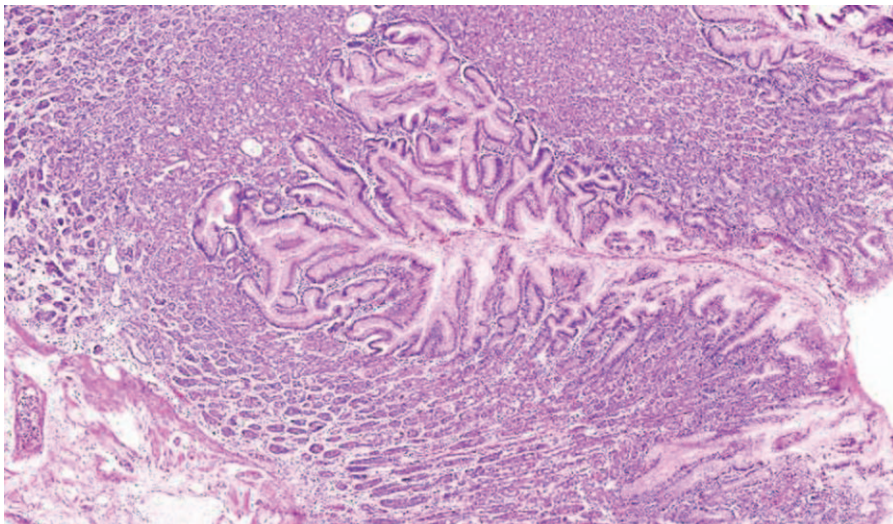
**Figure 2.** 99m-technetium pertechnetate scintigraphy show a subtle focus of activity within the right hemiabdomen (arrow) in dynamic images (A 2 min/frame). Delayed imaging (B 30 min, C 60 min) reveal a focal concentration of the right hemiabdomen, which changes simultaneously with the concentration of 99m-technetium pertechnetate in stomach.

However, it can only aid to detect the ectopic gastric mucosa in MD. Negative scan result does not completely exclude the diagnosis of MD as some patients with MD have no gastric mucosa or gastric mucosa in MD will be reducing with age.<sup>[17]</sup> In our case, the perforation loop of ileum was confirmed by enhanced and thickened tubular structure with surrounded inflammatory lesion on contrast-enhanced CT and confirmed by surgery. SPECT/CT fusion imaging help to be accurate in

diagnosis of ectopic gastric mucosa in MD. The perforation of MD is rare and mimics the other acute abdomen disease. Spontaneous perforation of MD is usually secondary to peptic ulcer, ischemia, or diverticulitis.<sup>[18]</sup> Some literature also reported that it can be induced by enterolith, trauma and foreign body, including fish bone, chicken bone, peanut, and batteries.<sup>[19-25]</sup> In our case, no enterolith and foreign body was found, the acidic secretions of ectopic gastric mucosa may be responsible for the



**Figure 3.** SPECT/CT fusion imaging obtained with  $^{99m}\text{Tc}$ -pertechnetate (top row: CT, middle row: SPECT, bottom row: fused SPECT/CT). Imaging demonstrate a focal concentration localized anatomically to the tubular structure in the right abdomen, which it is in the front of the right kidney. SPECT/CT = single photon emission computed tomography/computed tomography.



**Figure 4.** Hematoxylin and eosin analysis (magnification,  $\times 40$ ) of histological specimen revealed ectopic gastric type mucosa in Meckel's diverticulum.

progression of ulceration, which led to consequence of perforation and abscess. In symptomatic patients, especially when there is intestinal ischemia or perforation in MD, surgical resection is recommended. The postoperative mortality rate is less 1% and the particularly good prognosis in patients with MD.<sup>[26,27]</sup>

#### 4. Conclusion

Spontaneous perforation and intraabdominal abscess due to MD is very rare. Preoperative radiological diagnosis of MD remains challenging as imaging shows non-specific changes. SPECT/CT fusion imaging play a crucial role as it can detect the ectopic gastric mucosa in MD and provide precise localization of the lesion. We report this rare case, in the hope that it may remind the physician; SPECT/CT fusion imaging can help diagnosis when MD is a differential consideration and prevent potentially life-threatening complications that may occur.

#### Author contributions

Conceptualization: Jun Yang

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Writing- original draft: Yangjun Zhu

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Conceptualization: Jun Yang.

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Supervision: Jun Yang.

Writing – original draft: Yangjun Zhu.

Writing – review & editing: Yangjun Zhu, Jun Yang.

#### References

- [1] Soltero MJ, Bill AH. The natural history of Meckel's diverticulum and its relation to incidental removal. A study of 202 cases of diseased Meckel's diverticulum found in King County, Washington, over a fifteen year period. *Am J Surg* 1976;132:168–73.
- [2] Park JJ, Wolff BG, Tollefson MK, et al. Meckel diverticulum: the mayo clinic experience with 1476 patients (1950–2002). *Ann Surg* 2005;241:529–33.
- [3] Kotha VK, Khandelwal A, Saboo SS, et al. Radiologist's perspective for the Meckel's diverticulum and its complications. *Br J Radiol* 2014; 87:20130743.
- [4] Elsayes KM, Menias CO, Harvin HJ, et al. Imaging manifestations of Meckel's diverticulum. *Am J Roentgenol* 2007;189:81–8.
- [5] Even-Sapir E, Keidar Z, Bar-Shalom R. Hybrid imaging (SPECT/CT and PET/CT)-improving the diagnostic accuracy of functional/metabolic and anatomic imaging. *Semin Nucl Med* 2009;39:264–75.
- [6] Yamaguchi M, Takeuchi S, Awazu S. Meckel diverticulum. Investigation of 600 patients in the Japanese literature. *Am J Surg* 1978;136: 247–9.
- [7] Sharma RK, Jain VK. Emergency surgery for Meckel's diverticulum. *World J Emerg Surg* 2008;13:27.
- [8] Ding Y, Zhou Y, Ji Z, et al. Laparoscopic management of perforated Meckel's diverticulum in adults. *Int J Med Sci* 2012;9:243–7.
- [9] Chandramohan K, Agarwal M, Guriar G, et al. Gastrointestinal stromal tumour in Meckel's diverticulum. *World J Surg Oncol* 2007;12:50.
- [10] Ghahremani GG. Radiology of Meckel's diverticulum. *Crit Rev Diagn Imagin* 1986;26:1–43.
- [11] Ford PV, Bartold SP, Fink-Bennett DM, et al. Procedure guideline for gastrointestinal bleeding and Meckel's diverticulum scintigraphy. *J Nucl Med* 1999;40:1226–32.
- [12] Sfakianakis GN, Conway JJ. Detection of ectopic gastric mucosa in Meckel's diverticulum and in other aberrations by scintigraphy. 1. pathophysiology and 10-year clinical experience. *J Nucl Med* 1981; 22:647–54.
- [13] Dillman JR, Wong KK, Brown RKJ. Utility of SPECT/CT with Meckel's scintigraphy. *J Ann Nucl Med* 2009;23:813–5.
- [14] Xie Q, Ma Q, Ji B, et al. Incremental value of SPECT/CT in detection of Meckel's diverticulum in a 10-year-old child. *SpringerPlus* 2016;5:1270.
- [15] Papatianassiou D, Liehn JC, Meneroux B, et al. SPECT-CT of Meckel diverticulum. *Clin Nucl Med* 2007;32:218–20.
- [16] Connolly LP, Treves ST, Bozorgi F, et al. Meckel's diverticulum: demonstration of heterotopic gastric mucosa with technetium-99m-perchnetate SPECT. *J Nucl Med* 1998;39:1458–60.
- [17] Cserni G. Gastric pathology in Meckel's diverticulum. Review of cases resected between 1965 and 1995. *Am J Clin Pathol* 1996;106:782–5.
- [18] Kusumoto H, Yoshida M, Takahashi I, et al. Complications and diagnosis of Meckel's diverticulum in 776 patients. *Am J Surg* 1992; 164:382–3.
- [19] Tummers WS, van der Vorst JR, Swank DJ. Traumatic rupture of a Meckel's diverticulum due to blunt abdominal trauma in a soccer game: a case report. *Int J Surg Case Rep* 2016;19:8–10.
- [20] Fonseca Sosa FK. Meckel's diverticulum perforated by a fishbone. An unusual presentation. *Rev Esp Enferm Dig* 2017;109:394–5.
- [21] Daniele L, Elliott D, Wong MS, et al. Perforation of Meckel's diverticulum by an intact fish bone: a case report and literature review. *ANZ J Surg* 2017;87:206–7.
- [22] Chae HD. Perforation of Meckel's diverticulum by a chicken bone; preoperatively presenting as bowel perforation. *J Korean Surg Soc* 2011;80:234–7.
- [23] Karaman A, Karaman I, Erdogan D, et al. Perforation of Meckel's diverticulum by a button battery: report of a case. *Surg Today* 2007; 37:1115–6.
- [24] Su CH, Lee JY, Chang YT. Perforation of Meckel's diverticulum by a peanut presenting as a mesentery abscess. *Iran J Pediatr* 2013;23:223–5.
- [25] Aamery A, Al-Shehhi R, Malik K, et al. Perforation of Meckel's diverticulum with a foreign body mimicking acute appendicitis: a rare complication. *J Pak Med Assoc* 2017;67:942–4.
- [26] Ruscher KA, Fisher JN, Hughes CD, et al. National trends in the surgical management of Meckel's diverticulum. *J Pediatr Surg* 2011;46:893–6.
- [27] Yahchouchy EK, Marano AF, Etienne JC, et al. Meckel's diverticulum. *J Am Coll Surg* 2001;192:658–62.