Meckel's diverticulum in infants and children; technetium-99m pertechnetate scintigraphy and clinical findings

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Abstract

Meckel's diverticulum (MD) is the most common congenital gastrointestinal anomaly. About 50% of diverticulae contain ectopic gastric mucosa. Gastric mucosal secretions can cause peptic ulceration resulting in pain, bleeding and perforation. Technetium-99m (^{99m}Tc) pertechnetate scintigraphy is helpful in diagnosing ectopic gastric mucosa. *We have conducted a* retrospective analysis of scintigraphic data of 107 pediatric patients, 28 females and 79 males, their age ranging from 5 days to 11 years who referred to us for a query diagnosis of MD. *Our results* have shown that the most frequent presenting symptom was bleeding per rectum. Twenty-one cases of the 107 were positive for functioning gastric tissue indicating MD (19.62%). Maximum clustering of positive cases was at the age group of 1-2 years (11 cases i.e. 52.38%). The site of the ectopic activity was mainly at the umbilical quatrum in 11 cases (52.4%). Two patients were lost to follow-up and hence surgery could not be performed. The remaining 19 cases were subjected to surgical intervention and 16 were found to be positive for MD. The scintiscan was true positive in 84.2%. Our findings were in agreement with those of other authors. *In conclusion,* in pediatric patients ^{99m}Tc-pertechnetate scintigraphy is by 84.2% true positive for gastric mucosa, indicating MD.

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Introduction

Meckel's diverticulum (MD) is an embryological remnant appearing after the incomplete closure of the omphalomesenteric duct, most commonly located in the distal ileum. It occurs in 1%-3% of the general population [1], but only 25%-40% of the cases are symptomatic [2]. Almost 10%-60% of these diverticulae contain ectopic mucosa, most common being gastric mucosa. Ectopic gastric mucosa may give rise to potential parietal cell production of gastric acid and pepsin and subsequently result in mucosal damage and bleeding. Less commonly, there may be perforation, obstruction, and occasionally pain [3]. Bleeding, as well as other complications of MD are much more common in early life; more than 50 % of the complications of MD occur by the age of 2 yr [3]. In order to avoid frequent bleeding and blood loss, it is important to early diagnose MD. ^{99m}Tc-pertechnetate scintigraphy is helpful in diagnosing the presence of ectopic gastric mucosa, because it contrasts against the relatively low background radioactivity of the abdomen or of the chest [4-9]. The aim of this study was to assess the utility of ^{99m}Tc-pertechnetate scintigraphy in the diagnostic workup of the pediatric patient with gastrointestinal (GI) bleeding and a suspected MD.

Patients and methods

We conducted a retrospective study of the scintigraphic data of patients referred to us in order to diagnose the presence of functioning ectopic gastric mucosa. A total of 107 (28 female and 79 male) patients' data were evaluated. The age of our patients ranged from 5 days to 11 years. The data were collected over a period of 5 years. Painless lower gastrointestinal bleeding was the most common symptom with which the patients presented. Melena and abdominal pain were the other major presenting symptoms. Diagnostic GI endoscopy-lower gastrointestinal endoscopy-(LGIE) in 2 and upper gastrointestinal endoscopy-(UGIE) in 3 was performed in 5 patients before being referred for scintigraphy and was normal in all these cases. Colonoscopy was performed in 1 patient prior to scintigraphy and revealed hyperemia of the colon.

Scintigraphy was performed in all patients after at least 4 hours fasting. Depending upon the body weight of the patient, an intravenous injection of 37-148 MBq of the radiotracer was administered. Perchlorate and drugs having an effect on the gastrointestinal tract were not given before the test. Barium studies and proctoscopy were postponed for at least 2-3 days after the study. Sequential images of the anterior abdomen were acquired with the patient in the supine position, using a large field of view gamma camera coupled with a low energy high resolution collimator. The images were acquired in 128 x 128 matrix, with a frame rate of 60 sec per frame for 30 min. Additional static images were acquired in lateral and posterior views at the end of the dynamic acquisition in a 256 x 256 matrix. Two experienced nuclear medicine physicians interpreted all images. A prominent hyperactive area appearing simultaneously with that in the stomach, usually between 10 and 20 min after the injection, persisting throughout the study and increasing in intensity parallel to the intensity of the stomach, was considered as positive for MD. Any accumulation of radioactivity that could not be ascribed to an organ was characterized as abnormal and attributed to the presence of ectopic gastric mucosa.

Results

Twenty-one cases, 5 female and 16 male, were positive for functioning ectopic gastric mucosa in the abdomen, indicating MD. The site of the ectopic activity was at the umbilical quadrant in 11 cases, right iliac fossa in 4 cases, right lumbar in 2 cases, hypogastrium in 2 cases, right hypochondrium in 1 case and left lumbar region in 1 case. The position of the reported MD on scintigraphy has been depicted in Figure 1. Two patients did not report for a follow-up and surgery. The remaining 19 cases were subsequently subjected to surgical intervention and in 16 cases MD was identified. MD was not found at laparotomy in 2 cases; instead these patients had colonic perforation. In another case a mesenteric duplicate cyst was demonstrated. Histopathological examination of the surgical specimens showed MD with ectopic gastric mucosa in all 16/19 cases (true positive: 84.2 %). Three of these 16 cases showed accompanying diverticulitis while one of these specimens showed also pancreatic mucosa. Details of all patients with positive findings on scintigraphy are depicted in Table 1. Our results show that at the ages of 5 days to 1 year, of 1-2 years and of 3-12 years, occurrence of MD is 16.7%, 28%, and 14%, respectively. The main clinical presentation

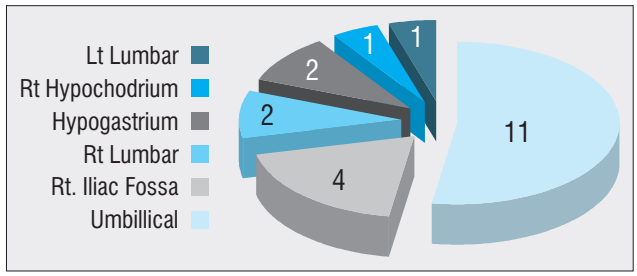

Figure 1. Position of Mechel's diverticulum as detected on scintigraphy.

Table 1. *Data of patients found positive for Meckel's diverticulum on scintigraphy.*

Sr. No.	Age	Sex	Symptom	Endoscopic Findings	Site of MD on Scintigraphy	Surgical Findings
1	7 m	M	Bleeding PR	N.D.	Umbilical	MD
2	8 m	M	Bleeding PR	N.D.	Umbilical	MD
3	9 m	M	Bleeding PR	LGIE-Normal	Umbilical	Lost to follow up
4	1	M	Bleeding PR	N.D.	Right lumbar	Colonic perforation
5	1	F	Bleeding PR	N.D.	Right iliac fossa	MD
6	1	F	Bleeding PR	N.D.	Right iliac fossa	MD
7	1	M	Bleeding PR	N.D.	Umbilical	Lost to follow up
8	1	M	Bleeding PR	N.D.	Umbilical	MD
9	1	M	Bleeding PR	N.D.	Right iliac fossa	MD
10	2	F	Bleeding PR	N.D.	Right lumbar	MD
11	2	M	Melena	LGIE-Normal	Hypogastrium	MD
12	2	M	Bleeding PR	N.D.	Umbilical	MD with Pancreatic mucosa
13	2	M	Bleeding PR	N.D.	Right iliac fossa	MD with diverticulitis
14	2	M	Melena	N.D.	Umbilical	MD
15	3	M	Melena, Pain-abdomen	N.D.	Hypogastrium	MD
16	5	M	Bleeding PR	UGIE-Normal	Umbilical	MD with diverticulitis
17	6	M	Bleeding PR	UGIE-Normal	Umbilical	MD
18	6	M	Bleeding PR	Colonoscopy-Hyperemia of colon	Right Hypochondrium	Colonic perforation
19	8	M	Bleeding PR, Pain-abdomen	UGIE-Normal	Umbilical	Duplication cyst
20	11	F	Melena	N.D.	Left lumbar	MD
21	12	F	Pain-abdomen	N.D.	Umbilical	MD

LGIE: Lower gastrointestinal endoscopy, UGIE: Upper gastrointestinal endoscopy, PR: Per rectal
N.D.: Non diagnostic, MD: Meckel's diverticulum, M: Male, F: Female

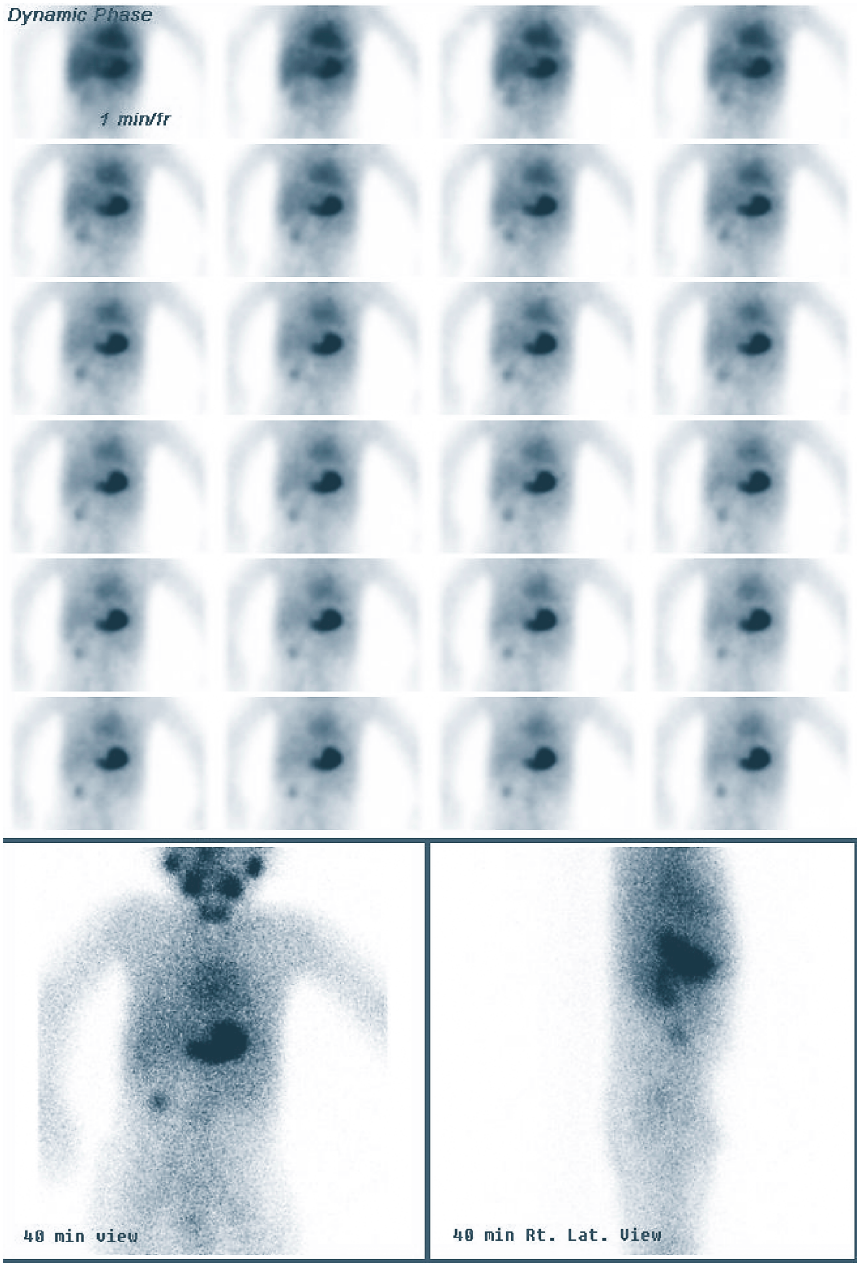

Figure 2. Scintiscan of a patient showing ectopic functioning gastric mucosa (Meckel's diverticulum) in the right lumbar region.

was painless lower gastrointestinal bleeding, melena and abdominal pain in 71.42%, 19% and 19%, respectively, with overlap of symptoms in some patients. Cases found to be negative for MD on scintigraphy were not subjected to surgery and were managed conservatively. A case of MD detected by scintigraphy is depicted in Figure 2.

Discussion

The clinical suspicion of bleeding ectopic gastric mucosa in a MD is the principal indication of pertechnetate abdominal imaging, since this condition is nearly always missed by radiology methods, including angiography [10-13]. Abdominal imaging with pertechnetate has become an established procedure in children and adults. MD are much more common in early life, more than 50% of the cases occur by the age of 2 years [3]. In our study, all patients were under the age of 12 years while 66.67% of the positive studies were under the age of 2 years and 52.38% were between 1-2 years. All children presented with painless intermittent lower gastrointestinal bleeding and after excluding other common conditions were referred for scintigraphy. The most common location of the ectopic gastric mucosa in our data is the umbilical area which coincides to the findings reported earlier [9].

Scintigraphy is a common procedure to diagnose heterotopic gastric mucosa as it is easy, non invasive and possibly the most accurate among all non invasive methods [9]. Drugs and hormones have been reported to influence the localization of pertechnetate in the gastric mucosa [9, 14, 15]. Pharmacological augmentation procedures were not used in any of our patients. Others have reported an accuracy of about 90% [6-7], especially in children. In adults however, the sensitivity of the scintigraphic procedure is only 63%. Sensitivity depends on the size of active gastric mucosa in Meckel's diverticulum. This is why the sensitivity of this test is better in children than in adults [16]. The overall accuracy in our study was 84.2 % which is in corroboration with most of the published studies [7, 9, 17]. The false positive findings that we had in our studies have all been described in the literature [6, 7, 18]. Acquiring images in oblique or lateral or posterior projections can clear the ambiguity associated with common false positives such as renal or ureteric activity. In certain conditions, accumulation of the radiotracer has been described to rapidly fade away with time [18]. SPET and recently, combined with axial tomography SPET/CT are being used as additional modalities especially in equivocal cases [19, 20]. In spite of the high accuracy of the SPET scanning procedure in children, some studies suggest that due to its low negative predictive value it has little role in influencing clinical decision [8]. Although a histological diagnosis of ectopic gastric mucosa is based upon the finding of parietal cells, these may be histologically absent but, nevertheless, the pertechnetate study can be positive, if mucoid surface cells are present. Parietal cells do not specifically accumulate ^{99m}Tc-pertechnetate so they are not essential for imaging purposes [21]. Le-

sions with an increased blood pool, such as arteriovenous malformations, hemangiomas, and other tumors, although they do not accumulate pertechnetate, may show up in the scintiscan but they appear early and then fade, whereas gastric mucosa generally becomes more prominent with time.

In conclusion, at the ages of 5 days to 1 year, of 1-2 years and of 3-12 years, we have performed 18, 39 and 50 scintiscans and we have diagnosed: 3, 11 and 7 cases of MD respectively, an occurrence of MD of 16.7%, 28%, and 14%, respectively. The main clinical sign was painless lower gastrointestinal bleeding, melena and the main symptoms was abdominal pain in 71.42%, 19% and 19%, respectively, with overlap of symptoms in some patients.

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