

## The Clinical Utility of SPECT/CT Hybrid Imaging on Bleeding Meckel's Diverticulum in Adults: A Case Report

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## 1. Abstract

Meckel's diverticulum is a common malformation of the gastrointestinal tract. Technetium-99m (<sup>99m</sup>Tc) pertechnetate planar scintigraphy is the procedure of choice to localize ectopic gastric mucosa. On the other hand, single photon emission computed tomography/computed tomography (SPECT/CT) imaging comes up with more precise landmarks and scintigraphic findings. We present a case where SPECT/CT provided accurate differential diagnosis and diagnosis of Meckel's diverticulum. A 23-year-old male patient with a history of hematochezia 5 years ago, was referred to our department. At that time, bleeding was attributed to active colitis. Recently the patient had a new episode of gastrointestinal hemorrhage and Meckel's diverticulum was highly suspected. <sup>99m</sup>Tc pertechnetate planar scintigraphy was performed in our department and revealed a subtle focal uptake of radioactivity in the right iliac fossa but involving an atypical location. Using SPECT/CT, the lesion was localized in the right hemiabdomen, within the pelvic region, next to the right margin of the urinary bladder. Imaging characteristics supported the diagnosis of either Meckel's or bladder diverticulum. SPECT/CT revealed the presence of air within the lesion of radiotracer uptake. This finding was suggestive of an outpouching of the bowel wall. The diagnosis of Meckel's diverticulum was highly likely. The lesion

was surgically removed, and the presence of ectopic gastric mucosa was histologically confirmed. If the clinical suspicion for Meckel's diverticulum is high and planar images have ambiguous or negative findings, SPECT/CT fusion imaging is the key method to obtain definite diagnosis.

## 2. Introduction

Meckel's diverticulum is the most common malformation of the gastrointestinal tract. It represents remnants of the omphalomesenteric ducts and it is usually located within 60-100 cm of the ileocecal valve [1, 2].

It is present in 1%-3% of the general population but only the minority of people will develop symptoms. Most symptomatic cases occur in early life, usually before the age of 2 years [1-3]. Although symptomatic Meckel's diverticulum is an uncommon entity during adulthood, it may give rise to bleeding, intestinal obstruction, inflammation, intussusception, and neoplasm [3, 4].

Multiple techniques have been used to detect Meckel's diverticulum; however, they are generally of limited value. Technetium-99m (<sup>99m</sup>Tc) pertechnetate scan is the procedure of choice, since more than 50% of symptomatic diverticula contain ectopic gastric mucosa [4, 5].

Planar scintigraphy has been widely used in the past. Meckel's diver-

ticulum is typically seen in the right lower quadrant as focal abdominal uptake of radioactivity that appears simultaneously with that in the stomach [2, 3].

Hybrid single photon emission computed tomography/computed tomography (SPECT/CT) allows merging of functional and anatomical information and it provides more precise landmarks and scintigraphic findings [5-7]. Although it is increasingly being used in clinical nuclear medicine, its application to Meckel's scan has not been well established yet.

We describe a case of an adult male patient with abdominal bleeding in whom SPECT/CT provided important anatomical and diagnostic information. Moreover, it was the key imaging modality allowing proper differential diagnosis, successful surgical treatment, and complete patient recovery thereafter.

### 3. Case Report

A 23-year-old male patient presented with black stools and several painless episodes of active intestinal bleeding was referred to our department for Meckel's scan.

He had a history of hematochezia 5 years ago. At that time, the bleeding stopped spontaneously, and he was diagnosed as having active colitis.

Recently the patient had a new episode of gastrointestinal hemorrhage. He was admitted to our institution for further evaluation. He

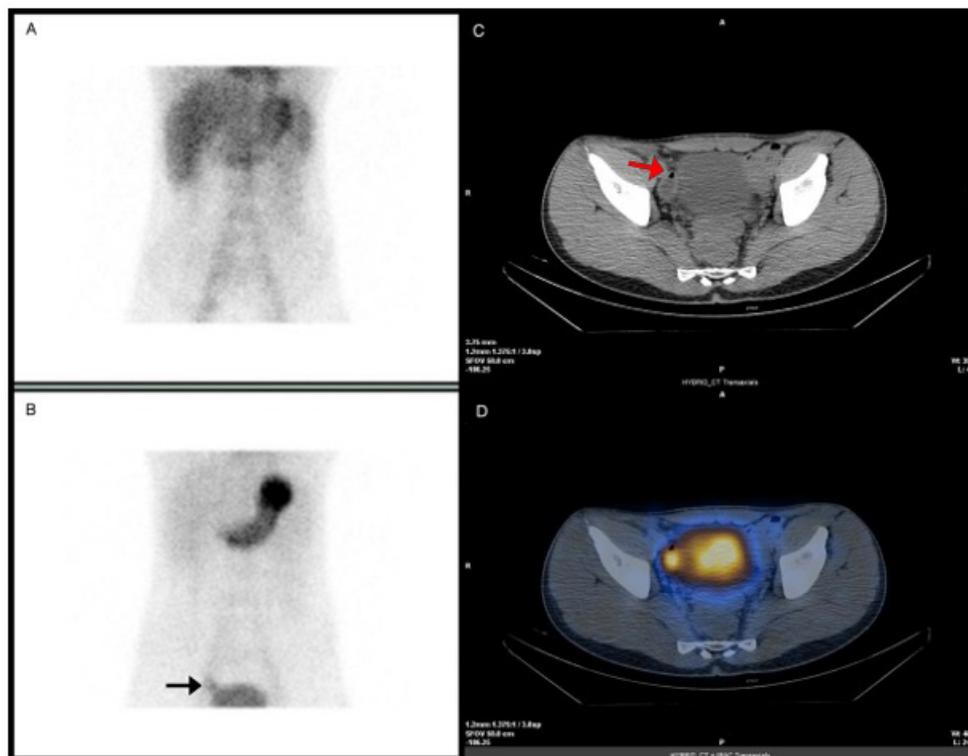
had serum hemoglobin concentration of 9.2 g/dl and abdominal tenderness on physical examination. Abdominal ultrasound, gastroscopy and colonoscopy revealed no active bleeding.

$^{99m}\text{Tc}$  pertechnetate scintigraphy was performed to rule out or confirm the presence of Meckel's diverticulum. Sequential planar images revealed a subtle focal uptake of radioactivity in the right iliac fossa but involving an atypical location. SPECT/CT 16 slices hybrid imaging was acquired (GE Healthcare Medical System, Discovery NM/CT 670) immediately following the planar acquisition. The lesion was in the right hemiabdomen, within the pelvic region, next to the right margin of the urinary bladder.

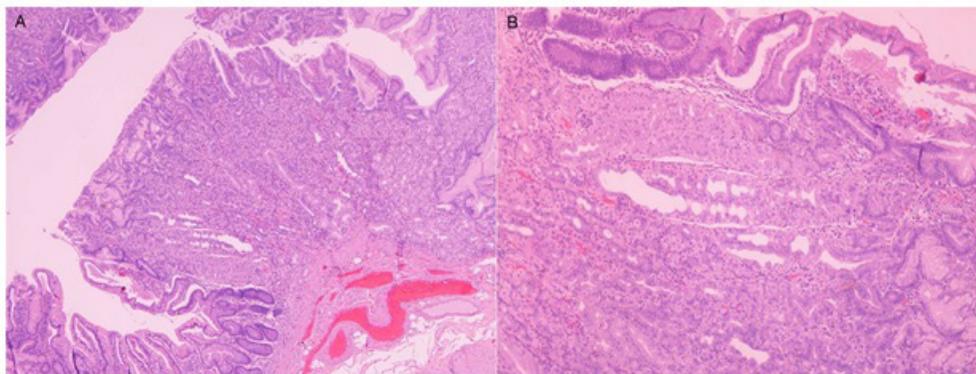
Imaging characteristics supported the diagnosis of either Meckel's or bladder diverticulum. Although the focal concentration was prominent before that in the urinary bladder and the patient was young, bladder diverticulum could not be excluded.

SPECT/CT was the key method for the differential diagnosis, since the low-dose CT revealed the presence of air within the lesion of radiotracer uptake (Figure 1). This was suggestive of an abnormal bulging pouch of the bowel, not the bladder, and consistent with Meckel's diverticulum.

The lesion was laparoscopically removed the following day. Histological examination of the resected specimen confirmed the diagnosis of Meckel's diverticulum with ectopic gastric and duodenal mucosa (Figure 2).



**Figure 1:** Technetium-99m ( $^{99m}\text{Tc}$ ) pertechnetate scintigraphy of the Meckel's diverticulum. A) 5 min and B) 20 min anterior planar views following the intravenous administration of 185 MBq (5 mCi) of the radiotracer. Images revealed focal accumulation in the right iliac fossa, next to the urinary bladder (black arrow). C) Axial CT and D) SPECT/CT hybrid images revealed the exact anatomical localization of the focal uptake, within the pelvic region, next to the right margin of the urinary bladder. Moreover, they demonstrated the presence of air within the lesion of radiotracer uptake (red arrow). This finding was suggestive of an abnormal outpouching of the bowel, not the urinary bladder.



**Figure 2.** Histopathology of the Meckel's diverticulum (hematoxylin-eosin). A) Ectopic gastric mucosa and normal small intestine mucosa (H. Ex40). B) Ectopic gastric mucosa and normal small intestine mucosa (H. Ex100).

#### 4. Discussion

The diagnosis of Meckel's diverticulum can be difficult.  $^{99m}\text{Tc}$  pertechnetate has high affinity for gastric mucosa; hence planar scintigraphy has been widely used to identify ectopic gastric mucosa in children and young patients with unexplained gastrointestinal bleeding [2, 3]. The method has a diagnostic sensitivity of 85%, specificity of 95% and an overall accuracy of 90% [2, 8], however in adults the test is only 9% specific and 62% sensitive [9].

Besides the presence of interpretation criteria, there is a variety of imaging patterns that can be found in patients with ectopic gastric mucosa [2]. Moreover, false positive and false negative results may occur [2, 3].

The sources of errors and the number of equivocal findings could be reduced using SPECT/CT hybrid imaging [8]. It provides better anatomical landmarks, it reduces image misinterpretation, and it assists in the detection of lesions not visualized on planar images. Moreover, it enables a direct relationship between the position of Meckel's diverticulum and the adjacent abdominal organs [5-7].

When Meckel's diverticulum is highly suspected and planar images have negative or equivocal findings, other considerations are recommended [8]. In our case,  $^{99m}\text{Tc}$  pertechnetate scintigraphy was performed in an adult patient presented with active intestinal bleeding. Planar imaging revealed a focal uptake of radioactivity in the right hemiabdomen. As the result of atypical location of the activity, we were unable to differentiate between a focal pooling of tracer in the urinary bladder (bladder diverticulum) and an ectopic gastric mucosa. SPECT/CT hybrid imaging prevented scan misinterpretation and improved diagnostic confidence. Moreover, it improved treatment plan, and it facilitated surgical access.

Meckel's diverticulum constitutes the most common cause of lower gastrointestinal bleeding in children. The role of SPECT/CT in paediatric patients has not been established yet owing to the even though small amount of additional radiation exposure from the CT portion. Gelf and et al suggested that radiation dose reduction can be accomplished by altering CT imaging parameters according to patient's age

and body mass [8,10].

In a recent study, Liu et al referred to the clinical utility of SPECT/CT in the detection of ectopic gastric mucosa. They concluded that SPECT/CT alone or the combination of the two imaging techniques results in higher specificity of scintigraphic findings [11]. Additionally, it improves anatomical information and obviates unnecessary referrals to surgical treatment [11].

#### 5. Conclusion

$^{99m}\text{Tc}$  pertechnetate planar scintigraphy is considered the standard method for the diagnosis of Meckel's diverticulum. However, if the clinical suspicion for Meckel's diverticulum is high and the planar images have ambiguous or negative findings, SPECT/CT may significantly enhance diagnostic outcome. The utility of fusion imaging on bleeding Meckel's diverticulum requires further clarification.

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