

## Radionuclide diagnosis of Meckel's diverticulum: A case report

*Arben Dhima*

Radiologist, Head of Department of Imaging and Nuclear Medicine,  
American Hospital, Albania

*Esilda Trushaj*

Radiology resident in the Department of Imaging and Nuclear Medicine,  
QSUT, Lecturer at the University of Medicine, Tirana, Albania

*Amarildo Blloshmi*

Radiology resident in the Department of Imaging and Nuclear Medicine,  
QSUT, Albania

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### Abstract

**Introduction:** Meckel's diverticulum is a common congenital anomaly of the small intestine that results from the incomplete obliteration of the vitelline duct (omphalomesenteric duct). The most common symptom leading a patient to the emergency department is painless gastrointestinal bleeding. The most sensitive diagnostic test is the Meckel radionuclide scan using <sup>99m</sup>Tc-pertechnetate, commonly known as the Meckel scan. This case report presents an 18-year-old patient who came into the emergency department with gastrointestinal bleeding and was diagnosed with Meckel's diverticulum using Meckel scan. **Methodology and Discussion:** An 18-year-old male patient presented to the emergency department with hematochezia, several days of abdominal pain, nausea, and vomiting. After clinical assessment and objective examination, several tests were conducted, all of which returned normal results. The clinical suspicion pointed towards Meckel's diverticulum. The diagnosis was confirmed with a simple examination: scintigraphy, a nuclear imaging method in which technetium-99m is injected and absorbed by the mucous-producing cells of the ectopic gastric mucosa. The patient underwent

laparotomy and the histopathological examination confirmed the diagnosis of Meckel's diverticulum. **Conclusion:** Scintigraphy is the appropriate diagnostic modality in cases of unexplained gastrointestinal bleeding when Meckel's diverticulum is suspected. This radionuclide scan has very high specificity and sensitivity when performed according to protocol. Additionally, it is a low-cost examination with lower radiation exposure compared to other imaging modalities.

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**Keywords:** Meckel's diverticulum, nuclear medicine, scintigraphy, technetium-99m, gastrointestinal bleeding

### **Introduction**

Meckel's diverticulum is a common congenital anomaly of the small intestine that results from the incomplete obliteration of the vitelline duct (omphalomesenteric duct). In early fetal life, the vitelline or omphalomesenteric duct that connects the midgut to the yolk sac is normally obliterated by the sixth week. (MSD manuals, Jul 2024). If the portion connecting to the ileum fails to atrophy, a Meckel diverticulum results. This congenital diverticulum arises from the antimesenteric margin of the intestine and contains all layers of the normal bowel and is thus a true diverticulum. In less than 25% of patients, a Meckel diverticulum also contains heterotopic tissue of the stomach that are parietal cells that secrete hydrochloric acid, pancreas, or both.

Its prevalence is 3-5 times higher in males than in females and occurs in about 2% of the population (Chang YC et al, 2021). Most patients are asymptomatic and the most common symptom that leads a patient to present to the emergency department is painless gastrointestinal bleeding, as the ectopic gastric mucosa secretes acid that is not neutralized, leading to ulceration. In all ages, intestinal obstruction is manifested by cramping abdominal pain, nausea, and vomiting. Acute Meckel diverticulitis is characterized by abdominal pain and tenderness typically localized below or adjacent to the umbilicus. Its occurrence in males and females is equal, but incidence of complications is three to four times greater in males. The most frequent complications in the adults are: obstruction due to the intussusception or adhesive band (14%-53%); ulceration (<4%); diverticulitis; and perforation. (Sagar et Kumar, 2006).

It is important to emphasize that imaging diagnosis remains challenging. The most preferred diagnostic method is laparoscopy in doubtful cases. However, laparoscopy is not an initial step of diagnostic modalities as it is more invasive compared to conventional imaging methods (Malik et al, 2010). Ultrasonography it is not specific for diagnosis, it may reveal only the disease complications. Computed tomography may reveal a gas-filled

structures or blind-ending fluid in continuity with the small intestine. Angiograms of the arteria mesenterica superior may display the location of the hemorrhage and the reason for the hemorrhage. Nevertheless, the most sensitive imaging examination and non-invasive commonly used is the Meckel scan, a Meckel radionuclide scan with  $^{99m}\text{Tc}$ -pertechnetate.

Laparoscopy is the instrument most commonly chosen for symptomatic Meckel's diverticula. The diverticulum should be resected with primary closure of the small intestine. It is important to ensure that all ectopic mucosa is resected. If the lesion is resected for bleeding the intestinal mucosa should be inspected for the presence of an ulcer.

### **Literature review**

Meckel's diverticulum is the most common congenital abnormality of the gastrointestinal tract, but it is often difficult to diagnose because the symptoms are not specific. The most useful method of detection of a Meckel's diverticulum is technetium- $^{99m}$  pertechnetate scanning. There are studies that reveal that In children, the scan has a sensitivity of 85 percent and a specificity of 95 percent. (Martin et al, 2000).

The protocols are very important when performing Meckel scan for accurate results. Studies have shown that the sensitivity of a Meckel's scan can be increased by administering pentagastrin, glucagon, or  $\text{H}_2$  antagonists or by imaging with single-photon emission CT instead of the usual planar imaging (Kotha et al, 2014). Based on The Society of Nuclear Medicine and Molecular Imaging (SNMMI) guidelines, preexamination fasting of 3 to 4 hours may improve sensitivity for the detection of ectopic gastric mucosa. If possible, all drugs or procedures that may irritate the gastrointestinal tract should be stopped for 2 to 3 days before the study.

It is found that younger patients (especially those younger than 4 years) tend to present with obstruction, whereas older patients tend to present with bleeding. The frequency of symptomatic Meckel diverticulum decreased with age in the pediatric population and in the adult population. (Park et al, 2005) Because of the rare incidence of Meckel diverticulum, most publications are case reports. In an article similar to us, a seventeen-year-old boy was presented to the emergency department with massive hematochezia. It was performed abdominal computed tomography as the first radiological exam. There was a suspicion for Meckel diverticulum and after that technetium- $^{99m}$   $^{14}\text{mci}$  was administered intravenously. The scintigraphy images revealed a focal area of increased radiotracer in the right lower abdominal quadrant. Laparoscopy and histopathology later confirmed the diagnosis. ( Ramadas et Janis, 2005).

## Objective

In this case report, we present the case of an 18-year-old male patient who presented to the emergency department and was diagnosed with Meckel's diverticulum using the Meckel scan. The objective of this report is to evaluate and demonstrate the importance of scintigraphy in diagnosing this pathology.

## Methodology and Discussion

An 18-year-old male patient presented to the emergency department with hematochezia, abdominal pain lasting several days, nausea, and vomiting. He had no prior history of similar pain and his medical history revealed no previous diseases or surgical interventions. After clinical assessment and objective examination, several tests were performed, including fibrogastroscopy, colonoscopy, abdominal computed tomography (CT) without contrast, abdominal CT angiography, and abdominal magnetic resonance imaging with contrast. All these examinations were normal, showing no vascular thrombosis, no free peritoneal fluid, or evidence of contrast extravasation and intestinal obstruction.

A few days later, the patient underwent a repeat abdominal CT scan, which revealed changes indicative of intestinal obstruction, with dilated intestinal loops up to 30 mm in diameter. The only diagnostic suspicion remained a segment of the ileum with a hyperdense lumen, suspicious for Meckel's diverticulum.

It has been proved that preoperative diagnosis is difficult and a suspicion of Meckel's diverticulum must be investigated if the patient is presented with abdominal pain, bleeding per rectum, or intestinal obstruction (An and Zabbo, 2024).

The diagnosis was confirmed with a simple examination: scintigraphy, a nuclear study performed by injecting technetium-99m, which is absorbed by the mucous-producing cells of the ectopic gastric mucosa, secreted into the intestinal lumen, and allows for visualization of the diverticulum. The image showed an increased focus of radiotracer activity 5-10 minutes after injection. The intensity of the radiotracer activity varies based on intestinal peristalsis and secretions.

The patient underwent laparotomy, and an ileo-ileal anastomosis was performed 50 cm from the ileocecal valve. The specimen was sent to the pathology department for histopathological analysis which confirmed the diagnosis of Meckel's diverticulum with ectopic gastric mucosa.

The technique used to perform the Meckel scan is crucial for obtaining accurate results, which includes stopping medications or procedures that irritate the gastrointestinal tract and premedicating with proton pump inhibitors. A dose of 37 MBq (1 mCi) is administered intravenously. The images are taken dynamically, and the examination lasts around 30 minutes.

Lateral and oblique views are used to differentiate the diverticulum from renal activity.

When performed correctly, the Meckel scan is an effective method for detecting diverticulum with approximately 100% sensitivity and specificity (Farrell and Zimmerman, 2020). Numerous studies have shown that it has a very low false positive rate and high negative predictive value, preventing unnecessary surgery (Titley-Diaz and Aziz, 2024). If the examination is performed with the correct technique, sensitivity and specificity can reach up to 90%, particularly in children. (Devi et al, 2022).

Our patient underwent several costly and radiation-intensive tests without diagnostic results. On the contrary, the scintigraphy examination is low-cost, affordable, and quick. (Kwak et al, 2023). When compared to a standard chest X-ray, the Meckel scan involves ~30 times less radiation (3.33 mSv), (Jaramillo et al, 2021) far less than an abdominal CT scan (5.56 mSv).

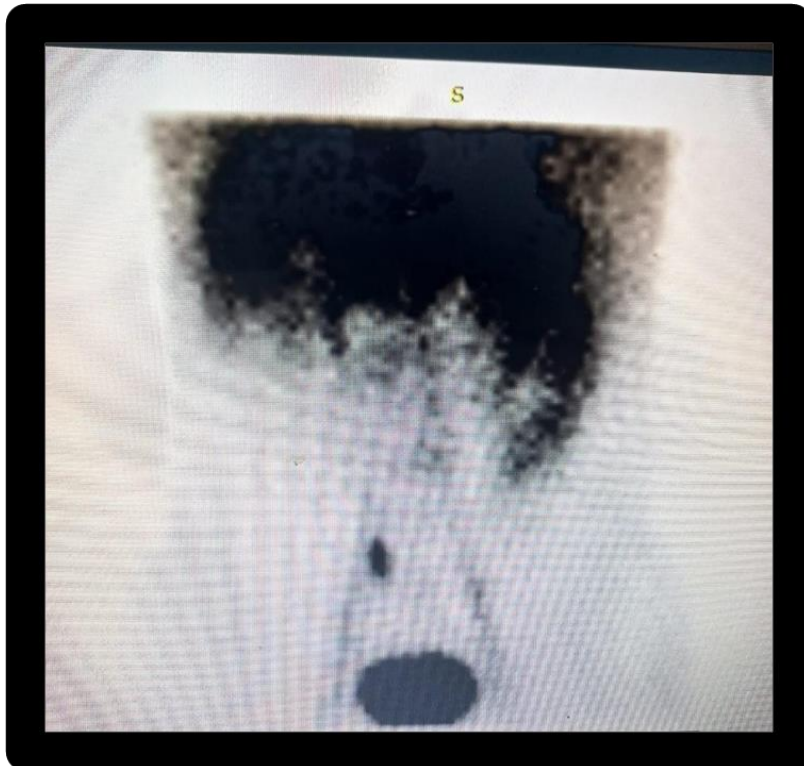
While our diagnostic method proved cost-effective and accurate for the presented case, acknowledge that further cases need to be evaluated before concluding that our approach is the most accurate. It is important to emphasize that scintigraphy is not commonly ordered by surgeons or pathologists in Albanian hospitals. However, by correctly diagnosing the patient with the Meckel scan, we highlight how this diagnostic method can efficiently resolve challenging cases, offering a quick, cost-effective solution with minimal radiation exposure.



**Figure 1.** A non-contrast abdominal CT scan that shows a blind ending structure in distal ileum with hyperdense content



**Figure 2.** A non-contrast abdominal CT scan performed five days after the first one that shows signs of intestinal obstruction



**Figure 3.** An image of scintigraphy that shows a tubular configuration of the radiotracer activity in the Meckel's diverticulum on the right

## Conclusion

The Meckel scan is the appropriate modality in cases of unexplained gastrointestinal bleeding when there is a clinical suspicion of Meckel's diverticulum. To achieve high sensitivity and specificity, pre-procedural and imaging protocols must be strictly followed. In addition, it is a low-cost examination with less radiation compared to other imaging modalities.

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## Author contributions

The authors' contributions are as follows: Esilda Trushaj conceived and developed the idea for the paper and revised the manuscript; Arben Dhima contributed to imaging interpretation. Amarildo Blloshmi contributed to medical data collection; All authors read and approved the final manuscript.

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