

# Meckel's Diverticulum: Demonstration of Heterotopic Gastric Mucosa with Tc-99m Pertechnetate SPECT

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**Abstract:** Meckel's diverticulum is the most common congenital malformation of gastrointestinal tract. It can cause complications in the form of ulceration, haemorrhage, intussusception, intestinal obstruction, perforation and, very rarely, vesicodiverticular fistulae and tumours. These complications, especially bleeding, are more common in the paediatric age group than in adults. Gastric mucosal secretions can cause peptic ulceration resulting in pain, bleeding and perforation. Technetium-99m (99mTc) pertechnetate scintigraphy is helpful in diagnosing ectopic gastric mucosa. This paper presents and describes a case of Meckel's diverticulum and reviewed the literature regarding general considerations for diagnostic difficulties.

**Keywords:** Meckel's diverticulum, SPECT, Technetium-99m (99mTc) Pertechnetate Scintigraphy.

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## I. INTRODUCTION

Meckel's diverticulum 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, but only 25%-40% of the cases are symptomatic. 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. The complications include: obstruction; intussusception; ulceration; haemorrhage; and, rarely, vesicodiverticular fistulae and tumours. Due to the rarity of cases in adults, it is still misdiagnosed preoperatively—although with the wide spread use of technetium-99m pertechnetate scan and diagnostic laparoscopic approach, the rates of preoperative diagnosis have improved. 99mTc-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. The aim of this study was to assess the utility of 99mTc-pertechnetate scintigraphy in the diagnostic workup of the pediatric patient with gastrointestinal (GI) bleeding and a suspected MD.

## II. CASE REPORT

An 2 year old male is brought to the ED by his parents with a chief complaint of passing large amounts of dark red blood from his rectum, and black jelly-like stools of two days duration. The child does not appear to be in acute distress at rest, He has not cried, complained, or shown any signs of focal pain. He has not vomited and continues to feed regularly. Prior to the onset of symptoms, he is reported as having a good appetite and is a generally "healthy and active baby" with no significant Past medical history.

Exam: VS T 37.5 (rectal), P150, RR 40, BP 90/50, oxygen saturation 100% in room air. His weight, height and head circumference are at the 50th percentile. He is pale and quiet, lying supine on the exam table. HEENT exam is significant for pale conjunctiva and lips. His neck is supple, non-tender, no bruits, no lymphadenopathy. His heart is slightly tachycardic, regular rhythm, no murmurs, no rubs, no gallops. His lungs are clear to auscultation. His abdomen is mildly distended with possible generalized tenderness upon palpation. No inguinal hernias are noted. Testes and penis are normal. A small amount of dark red blood is present in the diaper. Labs: WBC 8,000, hemoglobin 9.8 g/dl, hematocrit 32%, MCV 68. Bleeding from a Meckel's diverticulum is suspected.

A Tc-99m pertechnetate scintigraphy scan is ordered, which demonstrates an area of focal uptake in the right lower quadrant of the abdomen. This focus appears at the same time as gastric activity, and its intensity increases in parallel with gastric activity. These findings are consistent with ectopic gastric tissue in a Meckel's diverticulum. He is given an IV normal saline infusion. A transfusion is completed, A surgeon is consulted, and an emergent laparotomy is performed in which a portion of the patient's ileum is resected containing a 8 cm x 2.5 cm ulcerated appendage (a Meckel's diverticulum). He recovers well postoperatively.

### III. TC-99M PERTECHNETATE SCINTIGRAPHY

Tc-99m pertechnetate has been used since 1970 to diagnose heterotopic gastric mucosa, most commonly Meckel diverticulum, as the cause of gastrointestinal bleeding in a child. Other types of heterotopic gastric mucosa have been diagnosed and localized with the study uptake has been found in gastric tissue with no parietal cells, and autoradiographic studies have shown uptake in the mucin cell .The Tc-99m pertechnetate scan is considered the standard method for preoperative diagnosis of a Meckel diverticulum .

#### A. Methodology:

Patient preparation is important. Barium studies should not be performed for several days before scintigraphy because attenuation by the contrast material may prevent lesion detection. Procedures such as colonoscopy or laxatives that irritate the intestinal mucosa can result in Tc-99m pertechnetate uptake and should be avoided. Some drugs (e.g., ethosuximide [Zarontin]) may cause unpredictable uptake.

A full stomach or urinary bladder may obscure a Meckel diverticulum; thus fasting for 2 to 4 hours before the study or continuous nasogastric aspiration to decrease stomach size is recommended. The patient should void before the study and at the end before imaging

Summary Protocol for Tc-99m pertechnetate scan
<p><b>PATIENT PREPARATION</b>                      Fasting 4 to 6 hours before study to reduce size of stomach.                      No pretreatment with sodium perchlorate; may be given after completion of study.                      No barium studies should be performed within 3 to 4 days of scintigraphy.                      Void before, during if possible, and after study.</p> <p><b>PREMEDICATION</b>  <i>Optional:</i> Cimetidine 20 mg/kg orally starting 24 hours before study and last taken 1 hour before study.</p> <p><b>RADIOPHARMACEUTICAL</b>                      Tc-99m pertechnetate  <i>Children:</i> 30-100 uCi/kg (1.1-3.7 MBq/kg) Minimum Dose: 200 uCi (7.4 MBq)  <i>Adults:</i> 5 to 10 mCi (185-370 MBq) intravenously</p> <p><b>INSTRUMENTATION</b>                      Gamma camera: Large field of view                      Collimator: Low energy, all purpose or high resolution.</p> <p><b>PATIENT POSITION</b>                      Position patient supine under camera with xiphoid to symphysis pubis in field of view</p> <p><b>IMAGING PROCEDURE</b>                      Obtain flow images: 60 1-second frames.                      Obtain static images: 500k counts for first image, others for same time every 5 to 10 minutes for 1 hour.                      Erect, right lateral, posterior, or oblique views may be helpful at 30 to 60 minutes.                      Obtain postvoid image.</p>

#### B. Mechanism of Uptake:

The mucosa of the gastric fundus contains a variety of cell types (e.g., parietal cells, which secrete hydrochloric acid and intrinsic factor, and chief cells, which secrete pepsinogen. The gastric antrum and pylorus contain G cells that secrete the hormone gastrin. Columnar mucin-secreting epithelial cells are found throughout the stomach. They excrete an alkaline juice that protects the mucosa from the highly acidic gastric fluid.

Parietal cells were originally thought to be solely responsible for Tc-99m pertechnetate gastric mucosal uptake and secretion. However, experimental evidence points to the mucin-secreting cells as important.

**C. Image Interpretation:**

Meckel diverticulum appears as a focal area of increased intraperitoneal activity, usually in the right lower quadrant. Tc-99m pertechnetate uptake is seen within 5 to 10 minutes after injection, and increases over time, usually at a rate similar to that of normal gastric uptake.

Lateral or oblique views can help confirm the anterior position of the diverticulum versus the posterior location of renal or ureteral activity. Upright views may distinguish fixed activity (e.g., duodenum, from ectopic gastric mucosa, which moves inferiorly); this also serves to empty renal pelvic activity. The intensity of activity may fluctuate because of intestinal secretions, hemorrhage, or increased motility washing out radiotracer. Postvoid images can empty the renal collecting system and aid in visualization of areas adjacent to the bladder.

**D. Accuracy:**

False negative studies can result from poor technique, washout of the secreted Tc-99m pertechnetate, or lack of sufficient gastric mucosa. Small diverticula may not be detectable by scintigraphy. An impaired diverticular blood supply from intussusception, volvulus, or infarction can give false negative study results.

**E. Causes for False Positive Results in Meckel's diverticulum Scan:**

URINARY TRACT	HYPEREMIA AND INFLAMMATORY
Ectopic kidney	Peptic ulcer
Extrarenal pelvis	Crohn disease
Hydronephrosis	Ulcerative colitis
Vesicoureteral reflux	Abscess
Horseshoe kidney	Appendicitis
Bladder diverticulum	Colitis
VASCULAR	NEOPLASM
Arteriovenous malformation	Carcinoma of sigmoid colon
Hemangioma	Carcinoid
Aneurysm of intraabdominal vessel	Lymphoma
Angiodysplasia	Leiomyosarcoma
SMALL BOWEL OBSTRUCTION	OTHER AREAS OF ECTOPIC GASTRIC MUCOSA
Intussusception	Gastrogenic cyst
Volvulus	Enteric duplication
	Duplication cysts
	Barrett esophagus
	Retained gastric antrum
	Pancreas
	Duodenum
	Colon

**IV. DISCUSSION**

Meckel's diverticulum is the most common congenital malformation of the gastrointestinal tract—most studies suggest an incidence of between 0.6% and 4%. It is also the most common cause of bleeding in the pediatric age group. This is due to the persistence of the proximal part of the congenital vitello-intestinal duct. It is a true diverticulum, typically located on anti-mesenteric border, and contains all three coats of intestinal wall with its separate blood supply from the vitelline artery. In some surgical textbooks, it is known by the rule of two: present in 2% population, 2 ft from the ileo-caecal junction and 2 in. long, although many anatomical variations exist. Gastrointestinal bleeding is a major cause of emergency hospital attendance in adults. Nearly 80% of this bleeding in adults originates proximal to the ligament of Treitz. The most common source of the lower gastrointestinal bleeding is colon, with less than 5% of bleeding from small intestine. The usual investigations include upper gastrointestinal endoscopy and colonoscopy as well as the usual biochemical and hematological investigations. Endoscopy may not be useful if there is significant blood pool obstructing the visibility. Technetium-bleeding scan and angiography may be used to diagnose rare focal sources of bleeding such as Meckel's diverticulum.

## V. CONCLUSION

Meckel's diverticulum is the most common congenital anomaly of gastrointestinal tract. Clinical manifestations arise from complications of this true diverticulum. Meckel diverticulum can be missed on small bowel radiography because it has a narrow or stenotic ostium, fills poorly, and has rapid emptying. Angiography is useful only with brisk active bleeding and rarely used. The Tc-99m pertechnetate scan is considered the standard method for preoperative diagnosis of a Meckel diverticulum. A preoperative diagnosis of a complicated Meckel's diverticulum may be challenging because of the overlapping clinical and imaging features of other acute surgical and inflammatory conditions of the abdomen. An adequate knowledge of embryological, clinical, pathologic and radiologic characteristics of Meckel's diverticulum will aid the early and accurate diagnosis of complicated cases.

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