

IMAGING OF MECKEL'S DIVERTICULUM

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ABSTRACT

The primary purpose of this brief review is to discuss the basic facts about Meckel's diverticulum, its complications like bleeding and role of radiological and nuclear medicine imaging in the detection of Meckel's diverticulum and heterotopic gastric mucosa.

Key words: Meckel's diverticulum; bleeding; ultrasound; scintigraphy; computerized tomography

Among the congenital gastrointestinal anomalies, Meckel's diverticulum (a remnant of omphalomesenteric duct) is the most common with a reported incidence of 2% in autopsy studies with no gender predilection.¹ In clinical practice, it is the common reason of painless lower gastrointestinal bleeding with a reported incidence of >50% in children 2 years.² Although there is no gender predilection, complications of Meckel's diverticulum is more common among male. Heterotopic mucosa lines the Meckel's diverticula in about 60% of cases with a reported distribution like: gastric mucosa (62%), pancreatic (6%), gastric plus pancreatic (5%), jejunal (2%), Brunner's glands (2%) and gastric plus and duodenal (2%).³ Production of acid by parietal cells of heterotopic gastric mucosa is responsible for ulceration of mucosal lining of Meckel's diverticulum and adjacent ileum.⁴

In 1809, Johann Friedrich Meckel, presented the anatomy and embryology of this anomaly. It is a true diverticulum which includes all three layers of small intestine. It is a remnant of the omphalomesenteric or vitelline duct which usually obliterated by 5-8th week of gestation and failure of this closure gives

rise to Meckel's diverticula. It arises from the antimesenteric border of distal small intestine (usually within 80-100 cm of ileocecal valve) with a dimension of 5 x 2 cm.⁵ It is supplied by omphalomesenteric artery arising from the ileal branch of superior mesenteric artery.

Sonography: Ultrasound has a limited role in the investigation of Meckel's diverticulum but it is commonly used one the first investigations in patients presented with acute abdomen or lower gastrointestinal bleed. In case of an obstructed Meckel's diverticulum with an impacted enterolith, scan usually shows fluid filled thickened walled blind tubular structure in the right lower quadrant with an antimesenteric position with a hyperechoic mucosa called as gut signature sign. Enteroliths are seen with acoustic shadowing at the neck of distended loop.⁶

Computerized Tomography: Multidetector computerized tomography (MDCT) with neutral oral contrast agent has considerably improved the delineation of small bowel linings than the conventional scanners.

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The characteristic finding on CT examination is a blind-ending Meckel's diverticulum with thickened mucosal folds⁵ (Fig. 1). Visualization of a fibrous band connecting the diverticulum to the anterior abdominal wall is helpful for confident diagnosis. Mural thickening and infiltration of the surrounding mesenteric fat may be present if there is active inflammation. CT has better diagnostic accuracy for enteroliths, intussusception, diverticulitis, and small bowel obstruction.

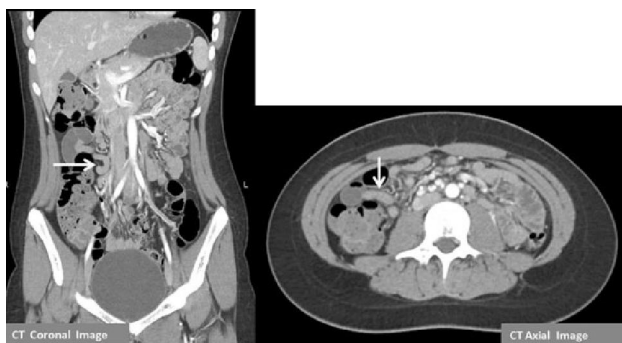


Figure 1: CT scan abdomen (with oral and intravenous contrast enhanced) showing a Meckel's diverticulum as blind loop (arrow) in the right mid abdomen region.

In patients with active lower gastrointestinal bleeding, a minimal bleeding rate of >0.5 cc/min is required to appreciate the extravasation of contrast on CT angiogram.⁷

Meckel's Diverticulum Scintigraphy: This nuclear medicine procedure is performed with Technetium-99m (^{99m}Tc) pertechnetate which is taken up by the mucinsecreting cells of native gastric mucosa and heterotopic mucosa in Meckel's diverticulum. An abnormal focus of radiotracer uptake in right lower quadrant having a temporal correlation with native stomach uptake is the hallmark of heterotopic gastric mucosa (Fig. 2). The reported sensitivity,

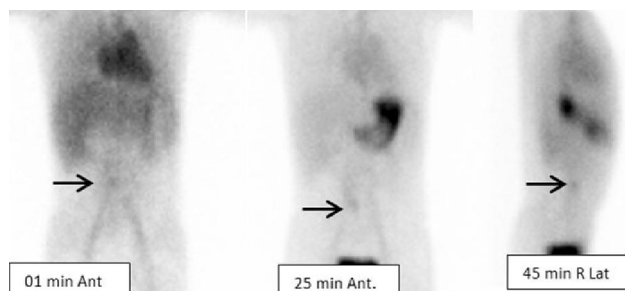


Figure 2: Radionuclide Tc-99m pertechnetate planar dynamic images showing a focal uptake in right lower quadrant consistent with Meckel's diverticulum with heterotopic gastric mucosa.

specificity and diagnostic accuracy is 85%, 95%, and 90% respectively⁸ and sensitivity is higher for pediatric population than adults.⁹ Premedication with H₂-blockers like cimetidine, ranitidine and famotidine inhibit acid secretion by the parietal cells and also limits release of pertechnetate by the mucosal cells and thus improves the sensitivity of scan.⁴ However, pharmacologic pretreatment is not considered necessary for a high-quality Meckel's scan.¹⁰ The administered dose of radiotracer is 1.85 MBq/kg for children and 296-444 MBq for adults. Dynamic images are acquired in anterior projection for 30-60 minutes followed by lateral or oblique static images to differentiate the ectopic focus from urinary activity. Single photon emission computerized tomography (SPECT) imaging co-registered with a simultaneously acquired low dose CT scan (SPECT/CT) may be helpful for localization of a Meckel's diverticulum¹¹ (Fig. 3) False positive causes include duplication

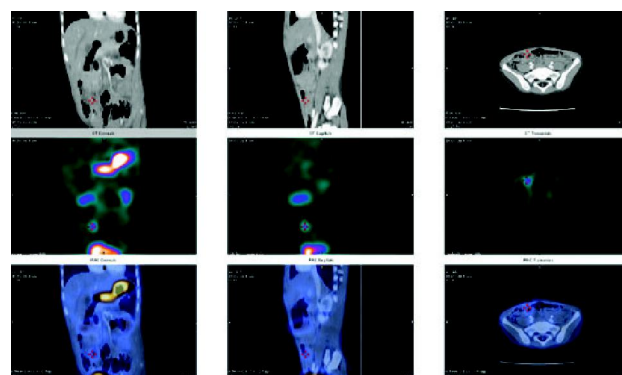


Figure 3: SPECT/CT images of same patient (Fig. 2) showing Meckel's diverticulum with better underlying anatomical localization.

cyst with ectopic gastric mucosa, inflamed bowel loop, intussusception, peptic ulcer, ureteric activity and uterine blush.¹⁰ False negative causes include shredding of mucosa by profuse bleeding, overlapping with urinary bladder or dilated ureter, small size ectopic mucosa (<1.8 cm) and prior use of perchlorate or barium.¹⁰ It is important to know that diagnostic accuracy of Meckel's scintigraphy is high when the patient is not actively bleeding and in patients with active bleeding (even young age group) tagged RBC scintigraphy is the method of choice.¹⁰ However, in patients scheduled for a Meckel's scan and who have had *in-vivo* tagged RBC study (not *in-vitro*) in few days back, possibility of an indeterminate scan result is likely. This attributes to labeling of RBCs by Tc-99m

pertechnetate in the presence of residual stan-nous pyrophosphate in circulation used in prior RBC study performed with in-vivo labeling method.

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