Complicated Meckel`s diverticulum; to be considered as a differential diagnosis in the acute abdominal pain. Ultrasound and MDCT imaging finding

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Learning objectives

- Recognize complicated Meckel's diverticulum as a possible etiology of acute abdominal pain.

- Identify and become familiar with both ultrasound imaging findings on MDCT as Meckel's diverticulum and its complications.

Background

Meckel's diverticulum is the most common congenital anomaly gastrointestinal tract, occurs in about 2% of the population. It is a remnant of the duct omphalomesenteric. Meckel diverticulum is the most common (98% of cases) of the omphalomesenteric duct anomalies.

It is a true diverticulum, with all layers of the intestinal wall can contain ectopic gastric mucosa and less frequent pancreatic and duodenal mucosa, colon or bladder. Meckel diverticulum is identified as a saccular, blind-ending structure located on the antimesenteric border of the ileum.

The diverticulum is usually found within 100 cm of the ileocecal valve.

In the majority of patients, Meckel diverticulum is asymptomatic. Many Meckel diverticula are discovered incidentally during a radiologic evaluation or surgical procedure performed for other reasons or they are found at autopsy.

Clinical symptoms from complications of Meckel diverticulum occur more commonly in children than adults. Sixty percent of Meckel diverticula become symptomatic before patients reach 10 years of age. Hemorrhage is the most frequent complication in the pediatric population. Intestinal obstruction is the second most common complication. It is usually seen in older children and adults.

There are many mechanisms for small intestinal obstruction from a Meckel diverticulum. These mechanisms include intussusception; volvulus or internal hernia from persistent attachment of the diverticulum to the umbilicus by the obliterated omphalomesenteric duct, mesodiverticular band, or adhesion; luminal obstruction from an inverted diverticulum, diverticulitis, or foreign body impacted in the diverticulum; inclusion of the diverticulum into a hernia; neoplastic obstruction; or
rarely, the inclusion of a Meckel diverticulum in a true knot that forms between the ileum and sigmoid.

Acute Meckel diverticulitis usually manifests as abdominal pain, fever, and vomiting. The pathogenesis of Meckel diverticulitis is related to obstruction or narrowing of the mouth of the diverticulum by an enterolith, fecolith, parasite, foreign body, neoplasm, or inflammation and fibrosis from peptic ulceration.

Enteroliths are considered rare complications of Meckel diverticulum.

Meckel diverticulum entrapped in a hernia has become known as Littre hernia.

Ultrasound evaluation is limited, identifying a tubular structure that ends in blind pouch containing liquid in the antimesenteric border of the terminal ileum, located at the lower right abdominal quadrant (Fig. 1).

On CT, Meckel's diverticulum is difficult to distinguish from normal small bowel in uncomplicated cases. However, a blind-ending fluid or gas-filled structure in continuity with small bowel may be seen (Fig. 2). CT may also show enteroliths, intussusception, diverticulitis, and small bowel obstruction. A recent innovation of CT enterography has resulted in better visualization of small bowel and consequent higher sensitivity in the diagnosis of Meckel's diverticulum.

We review the radiological findings of possible complications.

**Intestinal obstruction**

Represents up to 40% of symptomatic Meckel's diverticulum. Although intestinal obstruction is the second most common complication of Meckel diverticulum, the diagnosis is rarely made preoperatively. The diagnosis can be made with certainty only if the diverticulum is visualized at the site of obstruction.

However, the diagnosis can be suggested if features of the known complications of Meckel diverticulum can be identified on radiographs or cross-sectional images.

The obstruction can occur from twisting the diverticulum on its own meso, by intussusception (Fig 3-4) or by the introduction of a hernia sac diverticulum existing (Littre hernia `s) and often occur in large diverticulum.
Enterolith formation is an uncommon complication of Meckel's diverticulum despite diverticula being the most likely sites of a smallbowel enterolith. Enteroliths are thought to form as a result of stasis. When present, enteroliths in Meckel diverticula are almost always visualized on abdominal radiographs.

Most commonly, enteroliths manifest as peripheral calcification with a radiolucent center and less often have a laminated appearance.

They are most commonly located in the right lower quadrant of the abdomen, but they may be present in the middle and upper abdomen if adhesions from inflammation or congenital bands fix and alter the location of the diverticulum.

However, unenhanced CT should be more valuable in detecting an enterolith.

**Meckel Diverticulitis**

Diverticulitis accounts for up to 30% of symptomatic cases.

Diverticulitis commonly occurs secondary to acid secretion from ectopic gastric mucosa. It also can occur due to obstruction by enteroliths, foreign bodies, or neoplasm.

CT is a sensitive technique for diagnosing Meckel's diverticulitis, which usually appears as a blind-ending pouch of variable size with mural thickness and containing fluid, air, or particulate material with surrounding mesenteric inflammation (Fig. 7).

The wall of the diverticulum may show inflammatory changes such as mural thickening and contrast material enhancement.

The presence of a pouchlike structure attached to the adjacent small intestine is a helpful clue to the diagnosis. Other features that are helpful with the diagnosis include the presence of a secondary small intestinal obstruction and visualization of a normal appendix.

In more severe cases may appear abscesses (Fig. 8).

Sonography may be of value in the evaluation of children with a suspected Meckel diverticulum. Meckel diverticulitis appears as a round or tubular, cystlike structure with a thick, irregular hyperechoic internal wall and a hypoechoic external wall. This mural pattern of echogenicity has been called the **gut signature** (Fig. 9-10). The outer hypoechogenic layer corresponds to the muscularis propria of the intestinal wall, and the inner hyperechogenic layer corresponds to the mucosa and submucosal layers.
The differential diagnosis of Meckel diverticulitis on cross-sectional images includes appendicitis, inflammatory bowel disease, colonic diverticulitis, perforated neoplasm, and pelvic inflammatory disease in female patients. If findings are limited to the periumbilical region, complications of a urachal remnant should also be considered in the differential diagnosis.

**Perforation**

Meckel's diverticulum can rarely be complicated by perforation, which is a serious health event. Perforation is usually secondary to inflammatory diverticulitis, gangrene, and peptic ulceration. Perforation can be suggested by the presence of free intraperitoneal air in the setting of Meckel's diverticulum. This can be further detected on CT (Fig. 11).

**Hemorrhage**

Hemorrhage accounts for up to 30% of symptomatic Meckel cases.

Is the most frequent complication of Meckel diverticulum in the pediatric population. Hemorrhage usually occurs secondary to ectopic gastric mucosa. Angiography is usually used to diagnose hemorrhage secondary to the bleeding Meckel's diverticulum.

Technetium-99m pertechnetate scintigraphy is the modality of choice for evaluating pediatric patients with gastrointestinal hemorrhage and a suspected Meckel diverticulum.

In emergency setting, CT examination is a very useful tool in diagnosing both the localization and the source of overt gastrointestinal hemorrhage.

When active extravasation of contrast occurs in the terminal ileal loops, without underlying anomalies seen on CT, the diagnosis of bleeding Meckel's diverticulum is most likely. The differential diagnosis of an active hemorrhage in the terminal ileum takes into consideration bleeding from ruptured aneurysm of the ileocolic artery or bleeding from vasculitis or angiodysplasia; the differential diagnosis also includes hemorrhage associated with an underlying small bowel tumor. Bleeding Meckel's diverticulum is suggested when extravasated contrast accumulates into an outpouching of the terminal ileum.

A definitive diagnosis of active bleeding into a Meckel's diverticulum is made when intravenous-enhanced CT shows extravasation of the contrast at the diverticular neck.
(Fig. 12), with delayed contrast accumulation into the saccular structure attached to the terminal ileum.

**Neoplasm**

Neoplasms arising in Meckel's diverticula are rare, accounting for up to 3% of complicated cases. The most frequently reported neoplasm complicating a Meckel's diverticulum is carcinoid tumor. Other reported tumors include leiomyoma (Fig. 13), leiomyosarcoma, angioma, neuroma, lipoma, carcinosarcoma, and adenocarcinoma. These tumors have nonspecific imaging features, including a sessile or lobulated filling defect. Malignant neoplasms may infiltrate the adjacent mesenteric fat.

**Images for this section:**
Fig. 1: Drawing illustrate Meckel Diverticulum.
Fig. 2: Intravenous contrast-enhanced CT scan shows ght lower quadrant one thin-walled tubular structure with liquid content relative to the distal ileum (arrow) and separate appendix blind, close to the anterior abdominal wall.
Fig. 3: Oral and intravenous contrast-enhanced CT scan shows an intraluminal mass of fat attenuation within the small intestinal lumen. There is a rim of soft-tissue attenuation surrounding the fatty mass. Inverted Meckel diverticulum.
Fig. 4: Coronal CT scan shows bowel obstruction (white arrow) to perforated Meckel's diverticulum (black arrow). There are surrounding inflammatory changes and thickening of the subjacent small intestine.
**Fig. 5:** Sagittal CT scans show enterolith (black arrow) in dilated infected Meckel's diverticulum. Note adjacent infiltration of ileocolic mesentery, suggesting superimposed diverticulitis (white arrow).

**Fig. 6:** Coronal CT scans show enterolith (arrow) in dilated infected Meckel's diverticulum.
Fig. 7: Intravenous contrast-enhanced CT scan shows a blind-ending rounded structure (arrow) attached to the adjacent ileum. Note adjacent infiltration of ileocolic mesentery, suggesting superimposed diverticulitis.
Fig. 8: CT scans show inflammatory process in right lower quadrant with small abscess (arrow).
Fig. 9: Transversal sonogram of the pelvis shows a blind-ending, tubular cystlike structure containing internal echoes from debris. Irregular hyperechoic internal wall and a hypoechoic external wall (arrow). Pelvic fluid collection (asterisk).
Fig. 10: Transversal sonogram of the pelvis shows a blind-ending, tubular cystlike structure containing internal echoes from debris. Irregular hyperechoic internal wall and a hypoechoic external wall (arrow).

Fig. 11: Intravenous contrast material-enhanced CT scan shows perforated Meckel's diverticulum (black arrow). Extraluminal gas and inflammatory changes are seen adjacent to diverticulum.
**Fig. 12:** Intravenous-enhanced CT scan shows contrast extravasation seen as linear hyperattenuating pooling of contrast at the neck of the Meckel's diverticulum (arrow), arising from a distal ileal loop.
Imaging findings OR Procedure details

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Conclusion

- Meckel diverticulum is the most common anomaly of the gastrointestinal tract.

- Complications are more frequent in the pediatric population but manifest in adults as well.

- Familiarity of the radiologist with the appearance of this pathologic entity enables an accurate diagnosis in emergent settings.

- CT findings of complicated Meckel's diverticulum are very polymorphic and should be remembered in the evaluation of adult patients with acute abdomen; we hope that our series will be helpful for the radiologist to better understand some of the presentations of this entity.

References


Personal Information