Turkish Archives of Pediatrics

SCIENTIFIC LETTER
DOI: 10.5152/TurkArchPediatr.2025.24259

Point-of-Care Ultrasound in Pediatric Emergency Setting: Description of a Complicated Case in a Pediatric Emergency Department

Maria Elena Cucuzza, Maria Paola Sambataro, Vita Antonella Di Stefano

Pediatric Unit and Pediatric Emergency Room of Emergency Hospital Cannizzaro, Catania, Italy

Point-of-care ultrasound (POCUS) refers to the use of portable ultrasound devices by trained healthcare professionals to diagnose and monitor medical conditions at or near the site of patient care. This can include settings, such as hospitals, Emergency Departments, and ambulances. POCUS allows for real-time imaging to inform clinical decision-making and guide treatment interventions.[1] In critically ill patients, integrating POCUS with physical examination can be highly beneficial. It allows clinicians to perform rapid, real-time assessments tailored to the patient's immediate clinical needs, combining both visual and tactile information. In the Emergency Department, POCUS can be a game-changer, helping clinicians make faster decisions in urgent situations by providing immediate, real-time imaging at the bedside. In pediatric care, POCUS has become increasingly valuable, as it is non-invasive, well-tolerated by children, and does not expose them to ionizing radiation. Pediatricians can use it for a range of conditions, from abdominal pain to identify signs of appendicitis, intestinal obstruction, and intussusception, to respiratory issues such as pneumonia or foreign body aspiration. This expanded use in pediatrics allows for more accurate and efficient diagnoses in a population that can be harder to assess due to their smaller body size, fast evolution of the clinical picture, and potential difficulty with traditional imaging.[2]

A 4-year-old child is described, who presented to the Pediatric Emergency Department of Emergency Hospital Cannizzaro, with acute gastrointestinal symptoms: nausea, vomiting, diarrhea, and abdominal pain. The child showed signs of dehydration (refusal to eat and capillary refill of 2 seconds). Physical examination revealed diffuse abdominal tenderness and distension, and dry tongue and skin, although vital signs and laboratory results were normal. The child underwent an initial treatment phase with antiemetic therapy, fluids, and bowel rest, which helped to resolve vomiting. However, after a few hours, the onset of spasmodic abdominal pain with tenderness in the right lower quadrant (without Blumberg's sign, which is a sign of peritoneal irritation typically tested by rebound tenderness) occurred. Therefore, abdominal ultrasonography was performed at the patient's bedside that revealed a loop of the distal small intestine telescoped into another, resembling a "pseudo-renal structure." This Indicated that the appearance of the invaginated loop was somewhat similar to that of a kidney, either due to the shape or positioning of the bowel. Furthermore, there was anechoic (clear) fluid collection in the pelvic cavity on both sides, which suggested bilateral pelvic effusion and a thin layer of effusion between the loops of the intestine on the right side (Figure 1). This ultrasound image could indicate intussusception, a condition in which one segment of the intestine folds into another, often causing obstruction and potentially leading to ischemia if untreated. Therefore, the child was transferred to the Pediatric Surgery Unit, where he underwent emergency surgery. During the procedure, the surgeons identified a 30-cm segment of the bowel involved in intussusception at the site of the Meckel's diverticulum (MD). Fortunately, no bowel resection was needed. The postoperative period was uneventful and the patient recovered without any complications. Verbal informed consent was obtained from the patient's parents.

Meckel's diverticulum is a congenital anomaly of the gastrointestinal (GI) tract. This condition results from incomplete obliteration of the omphalomesenteric duct (also called the

Corresponding author:
Maria Elena Cucuzza
✉ me.cucuzza@gmail.com
Received: October 22, 2024
Revision Requested: October 30, 2024
Last Revision Received: November 7, 2024
Accepted: November 14, 2024
Publication Date: April 14, 2025

Cite this article as: Elena Cucuzza M, Paola Sambataro M, Antonella Di Stefano V. Point-of-care ultrasound in a pediatric emergency setting: description of a complicated case in a pediatric emergency department. *Turk Arch Pediatr.* 2025;60(3):344-346.

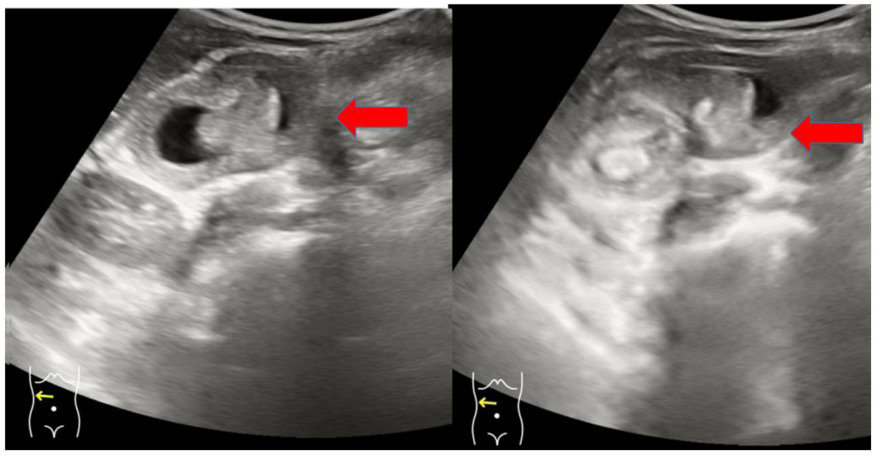

Figure 1. POCUS performed in the emergency room by the treating medical doctor showed on the right side and lower quadrant, a small intestine loop with a "pseudo-renal" appearance, which raised the suspicion of intussusception.

vitelline duct) during embryonic development. It typically occurs approximately 60 cm from the ileocecal valve, but can range anywhere from 7 cm to 2 m away from the valve, and its length can vary between 1 and 12 cm. The diameter of the diverticulum can range from 0.3 to 7 cm.[3] Meckel's diverticulum is found in approximately 2%-4% of the population.[4-5] Meckel's diverticulum is often asymptomatic and may not cause any noticeable symptoms unless complications arise. It may be incidentally discovered during imaging or surgery, such as during an appendectomy or other abdominal procedures.[6-8] Its complications occur in about 4%-16% of cases.[9] The incidence of MD is generally equal between males and females in individuals who do not exhibit symptoms. However, symptomatic MD occurs more frequently in males. In fact, the male-to-female ratio in symptomatic cases is reported to range from 1.5:1 to 4:1, indicating that men are 4 times more likely to experience the symptoms of MD than women.[6] The incidence of complications decreases with age, and MD is more commonly diagnosed in those under the age of 10 years, with a significant proportion of patients (60%) being diagnosed before the age of 2 years. It is uncommon in adults older than 50.[10,11] A study describe an incidence rate in boys affected by MD being complicated approximately 2.3 times more often than girls, with about 53% of children affected requiring surgery before the age of 4 years old.[12] the same study shows that the most common presentations for primary cases in children are obstruction (30%), bleeding (27%), and intussusception (19%).[12] Another study suggests 48.27% of cases in individuals aged between 7 and 16 years presented with an occlusive syndrome.[5] Alemayehu et al[13] investigated children with complicated MD using a pediatric hospital information system database;their study showed that 60.1% of children had obstruction of the GI tract, and 35.6% had GI tract bleeding. In adult patients, the most common clinical presentation of MD is intestinal obstruction (24%-53%); GI bleeding is less common than in children. Furthermore, in the pediatric population, MD is the most frequent cause of GI bleeding and melena (black, tarry stools). Bleeding is often caused by ectopic gastric mucosa within the diverticulum, which can lead to ulceration. This bleeding is typically painless and may be noted only when the child passes dark, sticky stools associated with abdominal pain, nausea, and vomiting.[14]

Though more common in adults, intestinal obstruction can also occur in children. In fact, intestinal obstruction can be the primary or initial presenting symptom of MD under 4 years of age if it becomes complicated. The mechanism underlying this obstruction often involves volvulus (twisting of the intestine) or intestinal incarceration at the site of the diverticulum. The ectopic tissue contained in MD can also contribute to inflammation and obstruction.[15]

Both intestinal obstruction and GI tract bleeding are frequent presentations associated with complicated MD. MD perforation is a rare but serious complication of this congenital anomaly and is considered a surgical emergency. This is especially more likely during the first year of life. Studies suggest that around 10% of those with symptomatic MD may experience perforation, which can lead to peritonitis and present with symptoms like severe abdominal pain, vomiting, and signs of sepsis.[14] Other rare MD complications include inflammation, perforation, malignant degeneration, and Littre's hernia, which is found in only 1% of all cases of MD.[17] Furthermore a rare cause of intestinal obstruction and small bowel ischemia is MD necrotic annular.[17] Since Meckel's diverticulum is often asymptomatic, it is typically discovered incidentally during surgeries or imaging studies conducted for other reasons. When MD becomes symptomatic, the clinical presentation can vary, which complicates the diagnosis. Furthermore, the symptoms of complicated MD can resemble other abdominal conditions such as acute appendicitis, pancreatitis, and other conditions (diverticulitis, Crohn's disease, and bowel obstruction). Imaging is crucial for diagnosing MD, but it has limitations, particularly when trying to identify a small, sometimes non-inflamed, diverticulum. Given the nonspecific nature of its symptoms and the low diagnostic yield of some imaging techniques, computed tomography imaging plays an important role in the diagnosis of symptomatic MD, especially in adults. However, ultrasound is the first imaging modality used, particularly in children with complicated MD.[18] Therefore, represents the most reliable method for diagnosing and treating complicated MD.[3] Preoperative diagnosis of complicated MD remains a significant challenge for pediatricians and pediatric surgeons, and it is often missed.[18]

In early childhood, complicated MD can present with severe and life-threatening conditions such as peritonitis, intestinal obstruction, ischemia, perforation, and sepsis. Because MD is a congenital anomaly, its complications can occur suddenly and often mimic other acute abdominal conditions, making early diagnosis challenging. In children presenting with acute abdominal pain, complicated MD should be considered, particularly when other common causes of abdominal pain (e.g., appendicitis, gastroenteritis) have been ruled out. Therefore, a high index of suspicion is essential, and any child with acute abdominal symptoms, particularly associated GI bleeding or bowel obstruction, should prompt consideration of complicated MD in the differential diagnosis. Timely intervention is key, as early surgical treatment can prevent more complicated procedures such as resection of an invaginated loop, which would otherwise be necessary if ischemia or perforation occurs. In this case, the attending physician's use of POCUS helped establish an early diagnosis, which facilitated prompt intervention and a favorable outcome for the child.

In this diagnostic challenge, the strength of POCUS lies in its ability to provide real-time, bedside imaging, allowing for rapid decision-making. It can complement physical examination by offering immediate visual confirmation of suspected conditions such as abdominal emergencies.

The integration of POCUS with clinical examination creates a more holistic and efficient diagnostic approach, helping physicians make well-informed decisions without delays that might occur when relying on more traditional imaging methods. Ultimately, this case demonstrates that, in emergency settings, POCUS can significantly save time in patient management, leading to improved outcomes. Therefore, it is crucial to promote ultrasonography as the "fifth pillar" of clinical examination at the patient's bedside. Expanding the use of POCUS not only enhances pediatric training standards, but also has the potential to improve patient outcomes, especially in emergency situations.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Informed Consent: Verbal informed consent was obtained from the patient's parents who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – M.E.C.; Design - M.E.C.; Supervision - V.A.D.; Resource - M.P.S.; Materials - M.E.C.; Data Collection and/or Processing - M.E.C.; Analysis and/or Interpretation - M.P.S.; Literature Search - M.E.C.; Writing - M.E.C.; Critical Reviews - V.A.D.

Acknowledgments: The authors thank their colleagues from the Pediatric Surgery Unit of "Policlinico" and the Pediatric Emergency Room of "Cannizzaro" hospitals for their contribution.

Declaration of Interests: The authors have no conflicts of interest to declare.

Funding: This study received no funding.

REFERENCES

1. Vieira RL, Hsu D, Nagler J, et al. Pediatric emergency medicine fellow training in ultrasound: consensus educational guidelines. *Acad Emerg Med.* 2013;20(3):300-306. [CrossRef]
2. Singh Y, Tissot C, Fraga MV, et al. International evidencebased guidelines on point of care ultrasound (POCUS) for critically ill neonates and children issued by the POCUS working group of the european society of paediatric and neonatal intensive care (ESPNIC). *Crit Care.* 2020;24(1):65. [CrossRef]
3. Capelão G, Santos M, Hilário S, Laureano M, Nobre J, Gonçalves I. Intestinal obstruction by giantMeckel's diverticulum. *GE Port J Gastroenterol.* 2017;24(4):183-187. [CrossRef]
4. Alemayehu H, Stringel G, Lo IJ, et al. Laparoscopy and complicated Meckel diverticulum in children. *JSLS.* 2014;18(3):e2014.00015. [CrossRef]
5. Stănescu GL, Pleşea IE, Diaconu R, et al. Meckel's diverticulum in children, clinical and pathological aspects. *Rom J Morphol Embryol.* 2014;55(3 suppl):1167-1170.
6. Hansen CC, Søreide K. Systematic review of epidemiology, presentation, and management of Meckel's diverticulum in the 21st century. Medicine (Baltimore). 2018;97(35):e12154.
7. Caruso G, Toscano C, Evola G, Benfatto SAM, Reina M, Reina GA. Gangrenous appendicitis in Amyand's hernia: surgical approach under local anesthesia. Case report and review of the literature. *Int J Surg Case Rep.* 2021;79:215-218. [CrossRef]
8. Evola G, Caruso G, Caramma S, et al. Tubulo-villous adenoma of the appendix: a case report and review of the literature. *Int J Surg Case Rep.* 2019;61:60-63. [CrossRef]
9. Sagar J, Kumar V, Shah DK. Meckel's diverticulum: a systematic review. *J R Soc Med.* 2006;99(10):501-505. [CrossRef]
10. Lohsiriwat V, Sirivech T, Laohapensang M, Pongpaibul A. Comparative study on the characteristics of Meckel's diverticulum removal from asymptomatic and symptomatic patients: 18-year experience from Thailand's largest university hospital. *J Med Assoc Thai.* 2014;97(5):506-512.
11. Park JJ, Wolff BG, Tollefson MK, Walsh EE, Larson DR. Meckel diverticulum: the Mayo Clinic experience with 1476 patients (1950-2002). *Ann Surg.* 2005;241(3):529-533. [CrossRef]
12. Ruscher KA, Fisher JN, Hughes CD, et al. National trends in the surgical management of Meckel's diverticulum. *J Pediatr Surg.* 2011;46(5):893-896. [CrossRef]
13. Alemayehu H, Hall M, Desai AA, St Peter SD, Snyder CL. Demographic disparities of children presenting with symptomatic Meckel's diverticulum in children's hospitals. *Pediatr Surg Int.* 2014;30(6):649-653. [CrossRef]
14. Evola G, Piazzese E, Bonanno S, Di Stefano C, Di Fede GF, Piazza L. Complicated Littre's umbilical hernia with normal Meckel's diverticulum: a case report and review of the literature. *Int J Surg Case Rep.* 2021;84:106126. [CrossRef]
15. Park JJ, Wolff BG, Tollefson MK, Walsh EE, Larson DR. Meckel diverticulum: the Mayo Clinic experience with 1476 patients (1950-2002). *Ann Surg.* 2005;241(3):529-533. [CrossRef]
16. Evola G, Caramma S, Caruso G, Schillaci R, Reina C, Reina GA. Intestinal obstruction and ischemia by necrotic annular Meckel's diverticulum: case report and review of the literature. *Int J Surg Case Rep.* 2021;82:105897. [CrossRef]
17. Menezes M, Tareen F, Saeed A, Khan N, Puri P. Symptomatic Meckel's diverticulum in children: a 16-year review. *Pediatr Surg Int.* 2008;24(5):575-577. [CrossRef]
18. Elsayes KM, Menias CO, Harvin HJ, Francis IR. Imaging manifestations of Meckel's diverticulum. *AJR Am J Roentgenol.* 2007;189(1):81-88. [CrossRef]