CEP Clin Exp Pediatr Vol. 67, No. 9, 474–476, 2024
https://doi.org/10.3345/cep.2024.00451

Pediatric abdominal ultrasound training program for pediatricians

To the editor,

Formerly confined to the realm of radiology, ultrasound examinations are now established as important diagnostic tools across various clinical fields under the concept of Point of Care Ultrasound (POCUS), serving as a screening tool in almost every stage of physical examination.[1] Clarification is needed on what POCUS is required for primary care pediatricians. In Korea, the content of abdominal ultrasound training in pediatric residency curriculum programs has not yet been specifically established. This is because guidance specialists are not actively utilizing ultrasound in their clinical practice.

To establish a pediatric residency program, it is essential to consider the necessary POCUS training for primary care pediatricians. Due to the high rate of anomaly diagnosis in newborns, standardized screening of abdominal organs through abdominal ultrasound is necessary even in cases where there are no symptoms.[2,3] In cases where liver ultrasound is performed within one week of birth, even in full-term infants, the presence of residual ductus venosus is common, which can be mistaken for portal vein thrombosis, and the diagnosis rate of renal pevic dilatation is also very high.[4,5] Around one month after birth, if projectile vomiting worsens within 2–3 days and the infant is vomiting most of the feeding, it is imperative to consider differential diagnosis for infantile hypertrophic pyloric stenosis.[3,4] Additionally, in the newborn period, when gastrointestinal symptoms such as poor oral intake, vomiting, irritability, abdominal distension, and bloody stool are observed, although rare, conditions requiring emergency surgery such as midgut volvulus due to intestinal malrotation or intestinal obstruction are important.[2,4,6] Observation of the bowel wall is essential to not miss the golden time, and understanding of abnormal findings such as wall thickening or thinning, loss of peristalsis, pneumatosis intestinalis, portal venous gas, abnormal vascularity, pneumoperitoneum, inflammatory fluid or fat infiltration, and severe luminal dilatation is necessary. Delay in such diagnoses can lead to intraoperative death on the surgical table.[2] Around 10 months old, when irritability or bloody stool is observed, intestinal obstruction due to intussusception is commonly diagnosed.[4-6] Anomalies in the hepatobiliary system of newborns include conditions such as biliary atresia, gallbladder anomalies, choledochal cysts, as well as diagnoses of portal vein thrombus, arteriovenous shunt, and occasionally misinterpretations of prenatally persisting vessel structures as abnormal cysts in the ligament location.[3,4,6] To optimize newborn ultrasound imaging, fasting for 3–4 hours enhances gallbladder distention and reduces bowel gas, improving image quality. During the examination, feeding formula can help stabilize the infant, glucose intake may further reduce irritability, and water intake can also aid in improving imaging. In cases of acute abdominal pain in children, depending on the location, right upper quadrant (RUQ) pain may indicate cholecystitis with gallbladder stones, flank pain may suggest acute pyelonephritis, renal abscess, right lower quadrant (RLQ) pain could be indicative of appendicitis, mesenteric lymphadenitis, inflammation of the terminal ileum or cecum (wall thickness), obstruction and dilatation, ascites, abscess, inflammatory fat infiltration, etc.[1,4,6] Lower abdominal pain may indicate cystitis or, in girls, ovarian torsion or ovarian cysts.[1,4,6] Furthermore, the application of pressure with the probe refers to evaluating tenderness or rebound tenderness during the physical examination. This alone explains why abdominal ultrasound examination is necessary for clinicians. Fatty liver is commonly observed in obese children, and confirmation of hepatomegaly and splenomegaly is also necessary during ultrasound examination. These listed findings are common ultrasound findings in pediatric abdominal ultrasound based on symptoms and age. Additionally, although rare, pediatric gastroenterologists and specialists in adolescent medicine consider various diseases and screen the abdomen accordingly.

Understanding pediatric abdominal ultrasound and training in standard views is an essential aspect for clinicians to utilize ultrasound equipment effectively. Technical proficiency in handling the equipment can be attained through a few training sessions. Practitioners must have a thorough understanding of the 3-dimensional (3D) anatomy of organs within the abdomen while interpreting the 2-dimensional planes (displayed on the monitor) that encompass the 3D structure. Skillful manipulation of the probe through

Received: 15 March 2024, Revised: 19 July 2024, Accepted: 20 July 2024

tilting, rocking, and rotation rather than simply moving it is key to finding the desired image. Fundamentally, ultrasound cannot penetrate gas and calcifications, making it unable to visualize structures beyond them. Therefore, it is essential to examine a simple abdominal x-ray before performing abdominal ultrasound.[2,5,6] While some gas can be maneuvered through soft abdomen using pressure from the probe to identify the intestines, excessive gas can removed by enema. It's very helpful for good image. In South Korea, since 2018, standard images have been provided for abdominal ultrasound examinations as part of the national healthcare coverage.[7] This initiative aims to conduct meticulous screening without missing any abnormalities. Hence, it is necessary to practice capturing required standard images in pediatric abdominal ultrasound, considering commonly diagnosed findings.

The liver consists of left lobe (Fig. 1A) and right lobe, 8 segments divided by 3 hepatic veins (right, middle, and left) and is delineated by the portal veins. Therefore, practitioners must identify the 3 veins draining into the inferior vena cava (IVC) (Fig. 1B) and understand the structure of the portal vein to trace it accurately. While tracing the portal vein, training includes identifying the gallbladder (Fig. 1C and D). Directly beneath the left lobe, the stomach antrum can be located, and from there, the pyloric canal can be traced. Moving the probe towards the navel, the splenic vein (an important vessel branching from the portal vein outside the liver) and the pancreas, which lies smoothly above it, can be traced. Below the splenic vein, the rounded cross-section of the superior mesenteric artery (SMA) branching from the aorta can be identified, and rotating the probe around this point can provide a longitudinal view of the SMA branching from the aorta (Fig. 1E). To the left of this, the superior mesenteric vein (SMV) branching from the external portal vein descends. On the left side of the aorta, the oval-shaped IVC can be observed, with the spine lying deepest in the center (Fig. 1F). Moving the probe to the right flank, the right kidney and the adjacent liver 6th segment can be found. Through a right subcostal or intercostal view, an image centered on the right hepatic vein crossing the right lobe longitudinally (Fig. 1G) and an image centered on the right portal vein leaving the liver in a Y-shape can be obtained (Fig. 1H). Moving the probe to the left flank, the spleen adjacent to the left kidney can be traced (Fig. 1I). In the lower abdomen, locating the bladder below the navel and identifying the internal genitalia deeper inside are necessary. In girls, abnormal lesions in the ovary area and the presence of ascites are common findings around the bladder. In the RLQ area, identifying the psoas muscle and iliac artery vein and tracing the terminal ileum located above them are essential. The terminal ileum extends laterally to connect with the cecum, which often shows only the anterior wall with fecal materials inside and can be easily recognized by its structural features (haustral marking) (Fig. 1J and

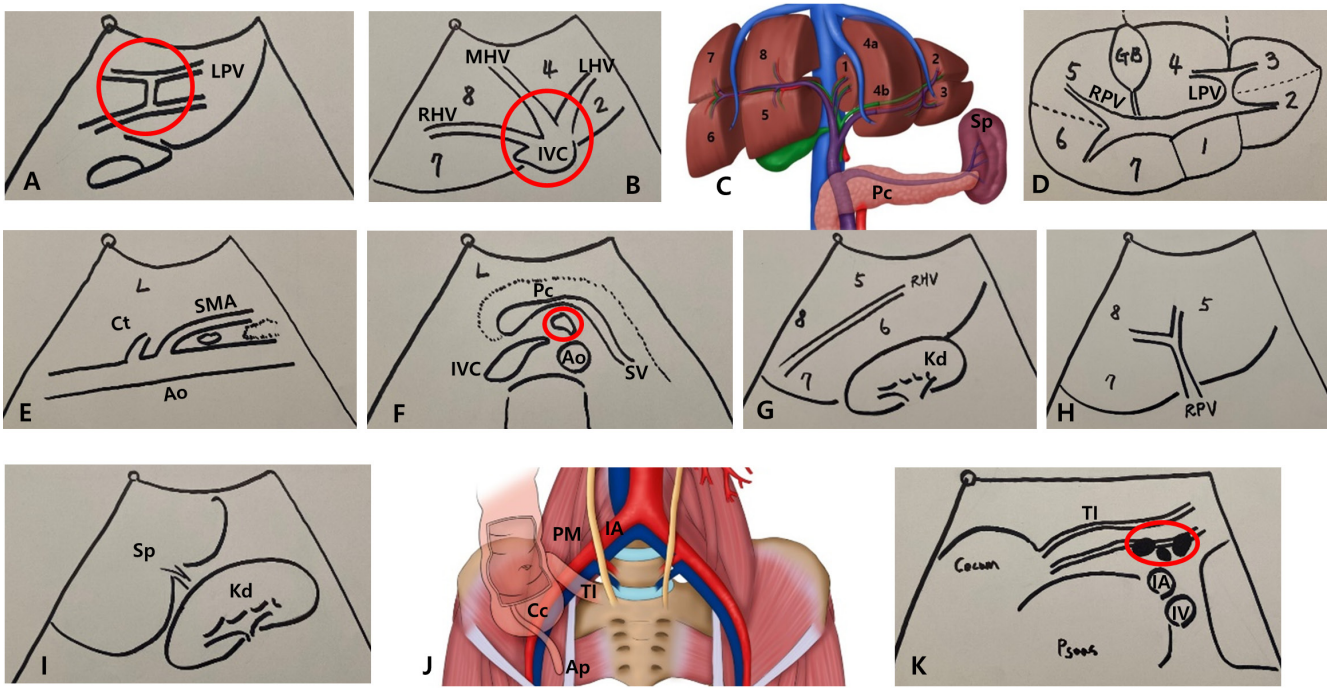

Fig. 1. (A) Left lobe with H-shaped left portal vein (LPV) (red circle). (B) Bunny sign with RHV, MHV, and LHV (red circle). (C) Eight segments of liver with hepatic vein (blue color) and PV (purple color), Pc, and Sp. (D) LPV and RPV with hepatic segments; (E) Longitudinal view of SMA branching from Ao. (F) Transverse view of Pc with SMA (red circle); (G) Right Kd with RHV. (H) RPV with hepatic segments 5, 7, and 8. (I) Sp and left Kd. (J) Lower abdomen anatomy. (K) PM with IA and IV, Cc, TI, and mesenteric lymph nodes (red circle). PV, portal vein; RHV, right hepatic vein; MHV, middle hepatic vein; LHV, left heptic vein; IVC, inferior vena cava; Pc, pancreas; Sp, spleen; Ao, aorta; Ct, celiac trunk; SMA, superior mesenteric artery; SV, splenic vein; Kd, kidney; Cc, cecum; Ap, appendix; TI, terminal ileum PM, psoas muscle; IA, iliac artery; IV; iliac vein; GB, gallbladder; L, liver.

K). Practice is needed to locate the appendix around the cecum. The appendix may not be visible if located behind the cecum. Understanding the structural characteristic that the intestinal wall has a high echo submucosa linearly connected is essential. The terminal ileum differs from the appendix in that it has a wider lumen and is more movable, but their structural shapes are similar. Training in capturing images of intestines located in the RLQ, RUQ, left upper quadrant, and left lower quadrant is essential for pediatric abdominal ultrasound, improving the ability to diagnose intussusception and examine the entire abdomen thoroughly. Placing an ultrasound machine in the clinical setting and conducting repetitive examinations is the only way to evolve into an expert. Prior to this, understanding abdominal ultrasound examinations and practicing to find standard views through hands-on lectures are essential. Recently, well-made abdominal models of the human body are being utilized to assess the performance and set up ultrasound equipment instead. Moreover, utilizing such abdominal models during hands-on lectures for beginners proves highly beneficial in familiarizing them with ultrasound procedures.

Soon Chul Kim, MD, PhD[1,2]

[1]Department of Pediatrics, Jeonbuk National University Medical School and Hospital, Jeonju, Korea; [2]Research Institute of Clinical Medicine of Jeonbuk National University -Biomedical Research Institute of Jeonbuk National University Hospital, Jeonju, Korea

Corresponding author: Soon Chul Kim, MD, PhD
Department of Pediatrics, Jeonbuk National University Children's Hospital, 20 Geonji-ro, Deokjin-gu, Jeonju 54907, Korea
✉ Email: kimsc@jbnu.ac.kr
https://orcid.org/0000-0002-5947-4599

Footnotes

Conflicts of interest: No potential conflict of interest relevant to this article was reported.

Funding: This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ORCID:
Soon Chul Kim http://orcid/org/0000-0002-5947-4599

References

1. Choi WJ, Ha YR, Oh JH, Cho YS, Lee WW, Sohn YD, et al. Clinical guidance for point-of-care ultrasound in the emergency and critical care areas after implementing insurance coverage in Korea. J Korean Med Sci 2020;35:e54.
2. Priyadarshi A, Rogerson S, Cruzado R, Crow A, Hinder M, Popat H, et al. Neonatologist-performed point-of-care abdominal ultrasound: What have we learned so far? Front Pediatr 2023;11:1173311.
3. Stewart DL, Elsayed Y, Fraga MV, Coley BD, Annam A, Milla SS. Use of point-of-care ultrasonography in the NICU for diagnostic and procedural purposes. Pediatrics 2022;150:e2022060053.
4. Watson TA, Barber J, Woodley H. Paediatric gastrointestinal and hepatobiliary radiology: why do we need subspecialists, and what is new? Pediatr Radiol 2021;51:554-69.
5. van Wassenaer EA, Daams JG, Benninga MA, Rosendahl K, Koot BGP, Stafrace S, et al. Non-radiologist-performed abdominal point-of-care ultrasonography in paediatrics - a scoping review. Pediatr Radiol 2021;51:86-1399.
6. Ruscica A, Chen C, Ng L. Updates in pediatric ultrasound. Curr Opin Pediatr 2023;35:24-330.
7. Jang MJ, Park SJ. A new health care policy in Korea Part 2: expansion of coverage by national health insurance on the abdominal ultrasound and MRI. J Korean Soc Radiol 2020;81:1069-82.

How to cite this article: Kim SC. Pediatric abdominal ultrasound training program for pediatricians. Clin Exp Pediatr 2024;67:474-6.