

ULTRASONOGRAPHY IN PEDIATRIC CLINICAL PRACTICE

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ABSTRACT. Ultrasonography is a simple, accessible and non-invasive method used at a large scale in clinical practice, both for routine examinations and as a first-intention investigation in the diagnosis of different pathologies; concurrently, it is a practical tool for monitoring the evolution of certain conditions. At the same time, this method is also easily accepted by children. This paper presents information on echography training programs in our country and a series of images depicting the experience of a general department of pediatric echography.

Keywords: echography, imaging, child

INTRODUCTION

Echography (ultrasonography) (US) is an imaging examination method using ultrasound reflected in the human body as an information vector. Technological progress over recent years allowed for the high quality of imaging to enable both accurate interpretations and a wide range of applicability in clinical practice. The preliminary consideration of advantages, as well as the factors limiting ultrasound examination, is an important factor in the subsequent therapeutic conduct.

Ultrasound scanning is non-invasive and non-painful. Being a non-ionizing procedure, it allows for repeated scanning, as deemed necessary during an examination, and highlights the opportunity of this technique for further investigations. The mobility of the ultrasound probe offers a unique flexibility to imaging procedures, as scanning can be performed in several planes, almost irrespective of the patient's body position. The limitation to areas of particular interest is facilitated via the manual control of the scanning transducer.

Advantages of US	Limitations of US
Exact method, does not distort sizes	Imaging artifacts
Multiplane examination technique	Difficult to use in obese patients
Non-invasive and non-ionizing method	Subjective, operator-dependent method
Real-time diagnosis method	Sensitive, but non-specific
Productive investment	
Short preparation time	

Table 1. Advantages and limitations of US

In Romania, any specialist doctor with complementary studies in ultrasonography can practice general echography; there are specialties such as gastroenterology and

pediatric gastroenterology, where the right to practice echography is achieved after taking the board certification exam. The skill levels in general echography such as they are regulated by the professional society in Romania are as follows:

Level 1 – Normal and pathological aspects in the echography of the liver and suprahepatic veins, gallbladder and intra- and extra-hepatic bile ducts, pancreas, spleen, splenic-portal axis, aorta and ileac veins, inferior vena cava, kidneys and suprarenal glands, internal genital organs, the diagnosis of ascites, color or power Doppler examinations of the portal system and suprahepatic veins. Compared to level 1, level 2 comprises digestive tract echography (esophagus, stomach, small and large intestine), echography of the peritoneal and mesenteric cavity (localized collections, mesenteric masses), of shallow soft tissues, echography of the chest and lungs and peripheral blood vessels, Doppler echography, other complex echography techniques (echo-endoscopy, intraoperative echography, echography with contrast, 3D echography) as well as diagnostic and therapeutic interventional echography. (1)

In our country there are different certificates of complementary studies in the echography of various tracts and systems, namely: general ultrasonography certificate, obstetrical and gynecological ultrasonography certificate, transesophageal echocardiography certificate, vascular echography certificate, endocrine echography certificate, cerebral Doppler ultrasonography certificate.

The abdominal echography can be performed to assess the aspect and size of the

appendix, stomach and pylorus, liver, gallbladder, spleen, pancreas, intestines, kidneys, urinary bladder, testicles, ovaries, uterus and can help determine the source of abdominal pain, identify the location quantity of abnormal free intra-abdominal fluid. Doppler ultrasound images enable the assessment of blood flow blockages, vein stenosis, congenital vascular tumors and malformations, low or absent blood flow, increased blood flow. Doppler echography can also evaluate abnormal testicular or ovarian torsion. (2)

Hypertensive patients require a complete echography-based evaluation combining abdominal ultrasonography with the Doppler ultrasonography of renal arteries, echocardiography, carotid artery echography, and last but not least measuring flow-mediated vasodilation in response to hyperemia, the latter being the gold standard in investigating the endothelial function. (3-6)

Doppler venous echography is the primary imaging investigation recommended to patients with suspected deep vein thrombosis. (7, 8)

Echography aspects frequently encountered in pediatric practice

Hydatid cyst

Hydatidosis is most frequently located in the liver, and ultrasonography is the essential examination for diagnostic purposes, as well as for any complications such as pressure on surrounding organs or even portal hypertension. There can be multiple localization, often in association with pulmonary hydatid cyst. (9)



Figure 1. Hydatid cyst (echography, CT and lung radiography)

Choledocal cyst

Congenital choledocal cysts are a genetic defect in the structuring of the biliary tree, primarily affecting the female population and most often diagnosed in children under

the age of 10. The echography image describes a transonic formation with hyperechogenic declival deposit located on the choledocal topography, dilated intrahepatic bile ducts. (10)



Figure 2. Choledocal cyst

Gastric trichobezoar

Bezoars are conglomerates of food or fibers in the gastric tract. In children these are associated with pica, mental retardation and coexisting mental disorders.

Trichotillomania is the irresistible urge to pull out one's own hair, primarily affecting young girls with or without any known mental disorders. (11)

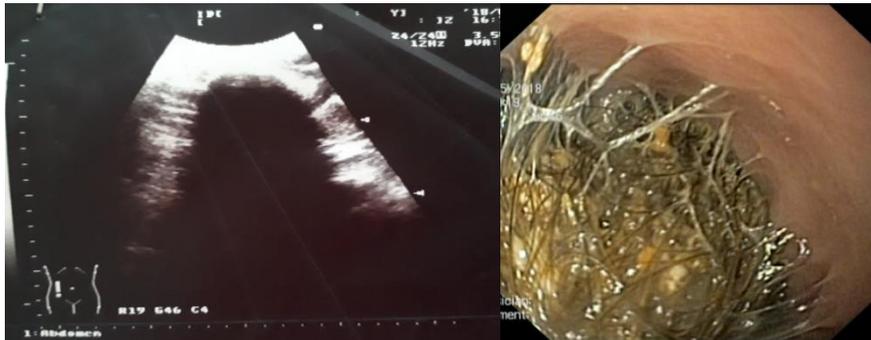


Figure 3. Gastric trichobezoar: Echographic image and endoscopic aspect

Echography and particularly endoscopic echography (endo-sonography) have a wide applicability in stomach pathology. (12-14)

Vesicular lithiasis

Abdominal echography has a 95-96% specificity, the typical aspect is of a hyperechogenic image with a posterior shadow cone, and when shifting the patient's position, the calculus has a gravity-dependent movement. (15)

The risk factors in vesicular lithiasis in children include chronic hemolysis, obesity, wide ileal resections, long-term

parenteral nutrition, family history, etc.

The most frequent causes of vesicular lithiasis are: surgical interventions to the abdomen, sepsis, trauma, hypocaloric diets, and pregnancy in teenage girls. The literature also mentions the association between vesicular lithiasis and the Down syndrome. (16)

Vesicular pseudolithiasis is associated with the use of certain antibiotics (Ceftriaxone); various studies report that it has an incidence ranging between 17 and 57.5%. (17)

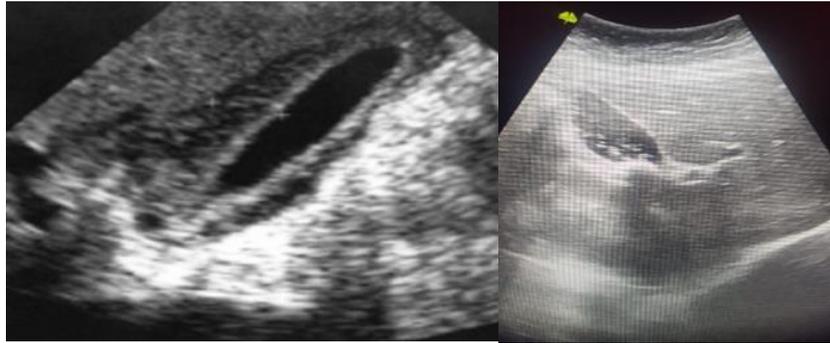


Figure 4. Acute acalculous cholecystitis

Figure 5. Vesicular pseudolithiasis



Figure 6. Vesicular lithiasis

Splenic cysts can be of a parasitic etiology (hydatid), being rarely encountered; the echography aspect is that of a transonic formation with a thick wall and inner septa. Splenic cysts of a non-parasitic etiology have thin walls, can present with a posterior shadow cone and most of the times it is asymptomatic. (18)

Accessory spleen appears in approximately 10% of pediatric patients; it can be round or ovoid, having similar echogenicity to the spleen, and it is located near the hilum or one of the splenic pole, being completely asymptomatic.

Echography is the first-intention method for investigating the kidneys. **Kidneys** are retroperitoneal organs and the echography examination thereof is performed in left/right lateral decubitus, as well as in ventral decubitus via lumbar approach. The echography image can be optimized via lateral decubitus approach, deep inspiration breath hold, arm lifted above the head and scoliotic position. The anatomical markers for the right kidney are the liver and the psoas muscle, and the spleen and psoas muscle for the left kidney. Examination difficulties are often encountered in abdominal meteorism. (19)

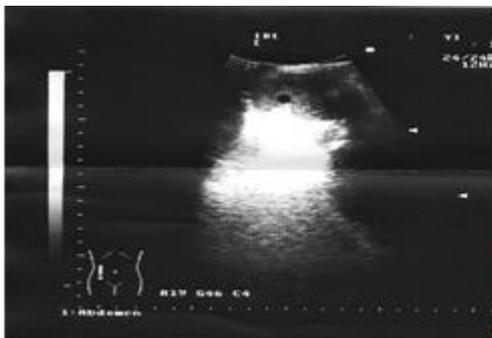


Figure 8. Splenic cyst



Figure 9. Accessory spleen

Polycystic renal disease is a monogenic autosomal dominant disorder, with renal and extra-renal manifestations and characterized by the expansive occurrence of renal cysts. Prognosis depends on the evolution of the

renal function, evolution of comorbidities and presence of complications.

Solitary renal cyst – a serous collection in the renal cortex, of an unknown etiology; the echography aspect is that of a transonic image, with fine walls.



Figure 10. Polycystic renal disease

Figure 11. Right solitary renal cyst

Hydronephrosis

The echography aspect is that of a transonic triangular image, with significant dilation of the pelvis and the cortical narrowing is typical of Hydronephrosis.

Wilms' tumor or nephroblastoma is the most frequently encountered abdominal malignancy during childhood. The average age for Wilms' tumor diagnosis is approximately 3 years. Once the current multimodal therapy is implemented, approximately 80-90% of children

diagnosed with Wilms' tumor survive. (20)

Neuroblastoma is the most frequently encountered neonatal solid extracranial tumor. It is an embryonic malignancy of the sympathetic nervous system resulting from neuroblasts (pluripotent sympathetic cells).

In the developing embryo, these cells undergo invagination, migrate along the neuraxis and populate the sympathetic ganglions and adrenal medulla. (21)

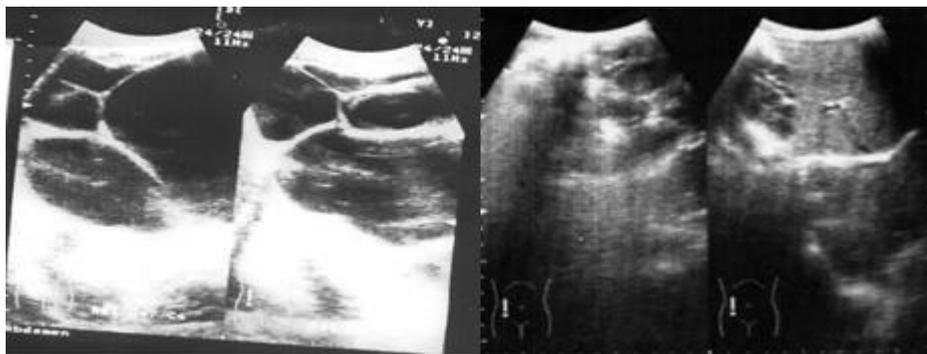


Figure 12. Giant Hydronephrosis

Figure 13. Wilms' tumor



Figure 14. Undifferentiated left adrenal neuroblastoma

The urinary bladder is examined by suprapubic transversal and longitudinal

sections. The normal aspect is that of a transonic image, with well-defined walls.

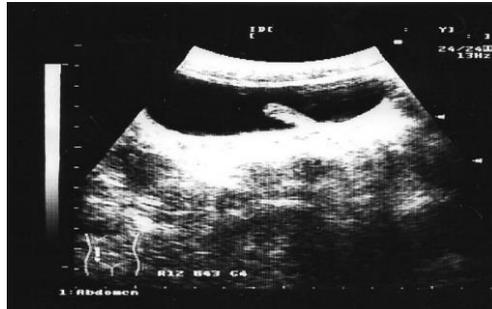


Figure 15. Urinary bladder polyp

Uterus and appendages

The presence of ovarian follicles can be ascertained via echography up to an 84% in little girls aged 0 to 2 years old and in approximately 68% of cases aged 2 to 6 years old.

Imperforate hymen is the most common type of vaginal flow obstruction.

As a result of normal development, the central portion of the hymen membrane is usually absent. This absence creates the typical configuration of a structure similar to the vestibulovaginal ring. The persistence of the intact hymen membrane determines the imperforate hymen disorder. (22)



Figure 16. Follicular aspect of ovary



Figure 17. Hydrometrocolpos



Figure 18. Ovarian cyst

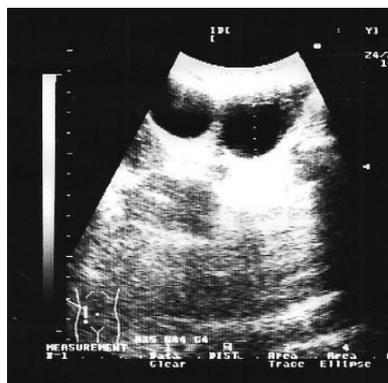


Figure 19. Free intraperitoneal fluid



Figure 20. Fine trace of fluid in right iliac fossa

Free intraperitoneal fluid in moderate quantity was not associated with any morbidity. A large quantity of fluid discovered accidentally should be deemed pathological and investigated. Following a study on 272 children, it was determined that up to 22% of the healthy children may present with small quantities of free intraperitoneal fluid. (23)

CONCLUSIONS

Echography is an efficient, cheap, safe, sensible, method that can be

successfully used in all pediatric and family medicine sub-specialties, and granting the necessary time and optimal conditions for its performance ensures a high quality of the imaging results.

The ability to take echography sections, recognize pathological entities, as well as discerning between normal and pathological is instrumental to the diagnostic process and subsequent therapeutic approach.

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