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Paediatric ultrasonography of the liver, hepatobiliary tract and pancreas

R.R. van Rijn[a,*], R.A.J. Nievelstein[b]

[a] Department of Radiology, Emma Children's Hospital – Academic Medical Center, Meibergdreef 9, 1105 AZ Amsterdam, The Netherlands
[b] Department of Radiology, Wilhelmina Children's Hospital – University Medical Center, Heidelberglaan 100, 3584 CX Utrecht, The Netherlands

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ABSTRACT

In the field of paediatric radiology ultrasonography (US) is the most versatile imaging tool available. Children in general, by virtue of their body composition, are excellent candidates for US exams in whom abdominal anatomy and pathology can be visualised in great detail. The fact that during the US study a clinical history can be obtained strongly adds to the value of the US exam. This does require investment in time and expertise and ideally a paediatric radiologist performing the exam. In this review the role of ultrasonography (US) of the liver, biliary tract and pancreas in children is discussed.

1. Introduction

In children ultrasonography (US) will in almost all cases be the first imaging modality to be implemented in the visualization of the abdomen and its organs. Children in general, by virtue of their body composition, are excellent candidates for US exams in whom abdominal anatomy and pathology can be visualized in great detail. The use of CT and MRI, where the latter is preferred due to radiation issues, will in most cases only be considered in complex cases or oncological diseases.

In this review paper we will address the most common pathologies of the liver, biliary tract and pancreas encountered in the paediatric patients. As most pathologies are predominantly seen in specific age groups, this review is divided up into sections based on the developmental stage of the patient (due to the scope of this review pre-natal imaging is not discussed). For each age group only the most important or prevalent diseases will be discussed, by no means is this review paper meant as a complete overview of abdominal paediatric pathology.

During the US exam the sonographer/radiologist should use the appropriate settings of the US machine. This implies that he/she should have extensive knowledge of the capabilities of the US machine in use. In contrast to adults, high frequency probes can be used in the evaluation of the abdomen, the younger the child is the higher the frequency of the probe can be and including both convex as linear probes. It is advisable to use pre-warmed US gel, e.g. using a contrast media warmer, as this will promote cooperation from your patients.

The advantage of US over other imaging modalities is the hands-on approach during the exam making observation of the reaction of the patient to the exam possible while visualizing the abdomen. If the patient displays signs of inconvenience or pain, this is of significant importance. Also it makes it possible to obtain a clinical history, as in most cases the information obtained during the US exam supersedes the clinical information on the radiology request form. In all age groups a close collaboration between the radiologist and the clinician, may it be the paediatrician, the paediatric surgeon or otherwise, is a key to success. In difficult cases the presence of a clinician during the US exam can be of value.

2. Pathology by age

This section is divided up into ages and type of pathology; congenital anomaly, acute abdomen, chronic disease and oncology. Although this is a convenient approach for daily practice it is important to understand that pathologies do overlap age groups. For practical purposes, the pathology is reported in the age group in which it is most prevalent (Table 1).

* Corresponding author at: Department of Radiology, Emma Children's Hospital – Academic Medical Centre Amsterdam, Meibergdreef 9, 1105 AZ Amsterdam, The Netherlands. Tel.: +31 20 5669111.
E-mail address: r.r.vanrijn@amc.uva.nl (R.R. van Rijn).

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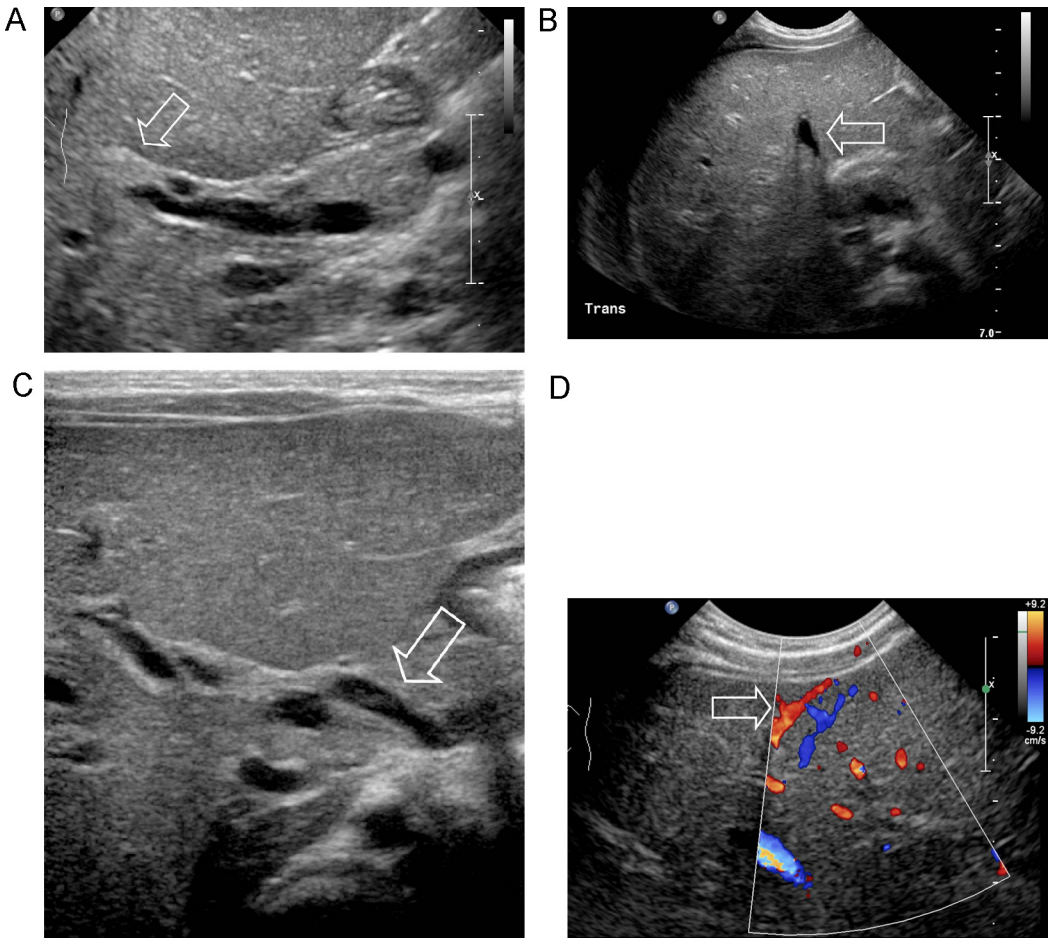

Fig. 1. (A) Two-month-old girl with persistent neonatal cholestasis. Ultrasonography shows the increased echogenicity in the porta hepatis (triangular cord sign, arrow). (B) There is a small gallbladder (arrow) after prolonged fasting. (C) US shows the enlarged hepatic artery (arrow). (D) Increased subcapsular vascularity in the liver parenchyma is present. These imaging findings are characteristic for biliary atresia, which was biopsy-proven.

3. Neonate

3.1. Congenital disorders

3.1.1. Biliary atresia

Biliary atresia is a rare congenital disorder characterized by an obstruction of the intra- and/or extrahepatic bile ducts [1–3]. The overall incidence is approximately 1:15,000 births, but it is far more common in the Asian population. It is one of the causes of persistent neonatal jaundice and diagnostic imaging plays an important role in differentiating biliary atresia from other causes of jaundice.

US is the imaging modality of choice to initially evaluate neonates with persistent jaundice. In biliary atresia, one of the most common findings is an absent, small (<1.5 cm) or empty gallbladder, after fasting for several hours. Absence of the gallbladder is present in approximately two thirds of neonates with biliary atresia (Fig. 1A–D) [4]. The triangular cord sign, (defined as a triangular or tube-shaped echogenic focus at the porta hepatis that follows the portal veins and measures more than 4 mm in thickness) is another characteristic finding [4–6]. This sign has a reported sensitivity of 62–93% and specificity of 96–100%. However, it may be difficult to distinguish this sign from diffuse periportal echogenicity due to inflammation or cirrhosis. Other signs that have been described in the diagnosis of biliary atresia include an absent common bile duct (reported sensitivity 93% and specificity 95%), a hypertrophic hepatic artery (reported diameter 2.2 mm ± 0.59 mm) and an increased hepatic subcapsular flow on colour Doppler sonography (CDS) (reported sensitivity 100% and specificity 86%) [6]. When combining all these signs, the overall sensitivity, specificity and accuracy of high-frequency US has been reported to be 93.3%, 92.9%, and 92.2%, respectively [7].

Hepatobiliary scintigraphy (HBS) with ^{99m}Tc-labelled iminodiacetic acid (IDA) derivatives may play a role in the evaluation of biliary atresia, although its role has decreased with the improvements in US and image-guided biopsies [8]. Magnetic resonance cholangiopancreatography (MRCP) should only be utilized as a problem-solving technique provided that the biliary tree is dilated.

Table 1
Definition of stages of development.

Stage	Age range
Neonate	First 28 days of life
Infant	First year of life after the first 28 days of life
Preschool child	Aged between 1 and 5 years of age
Child	Aged between 6 and 12 years of age
Adolescent	Aged between 12 and 18 years of age

3.1.2. Choledochal cysts

Choledochal cysts are very rare congenital saccular or fusiform dilatations of the biliary tree, with an overall incidence of approximately 1–2:100,000–150,000 live births and a three times higher prevalence in females [3]. As in biliary atresia, they are far more common in the Asian population with a reported prevalence of up to 1:1000 in Japan [9,10]. Choledochal cysts are usually classified