



Visual Case Discussion

Pre-hospital detection of intrahepatic biliary duct dilatation: Recognizing the abundance of vessels in the liver

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1. Discussion

Diagnosing and confirming intrahepatic biliary duct dilation (IHBDD) involves a coordinated effort across multiple medical specialties, often relying on comprehensive blood analysis. However, the utility of screening ultrasound in detecting intrahepatic biliary dilation becomes particularly valuable in pre-hospital settings like our Basic Emergency Service, especially when access to alternative imaging techniques or detailed blood analyses are unavailable. Detecting the intrahepatic biliary dilation pattern through ultrasound is notably straightforward for a skilled sonographer. The presence of IHBDD can be efficiently identified during a screening ultrasound, allowing identification of imaging findings that help differentiate simple biliary colic from clinical cases that should be prompt referral to the reference hospital and without unnecessary delays or resource expenditure. The etiology of IHBDD is multifactorial¹, and while its presentations may vary, the characteristic ultrasound pattern often involves the visualization of “extra vessels within the liver,” related to the distinctive “shotgun” sign². This sign translates into the observation of dilated bile ducts exhibiting no flow on Doppler imaging³.

In cases of extrahepatic obstruction, dilation of the common bile duct (CBD) may be evident. However, with intrahepatic obstruction, a normal CBD caliber can occur. Thus, the sonographer needs to diligently observe the signs outlined and typical sonographic landmarks to identify early indications of bile duct dilation within the innermost or regions of the liver.

2. Visual Case Discussion

A 28-year-old female patient presented to a basic emergency service (BES) with right upper quadrant (RUQ) pain, accompanied by vomiting and worsening epigastric pain persisting for a duration of 2 days. This marked the seventh occurrence of similar symptoms within the past 2 years, with the last occurrence 5 months prior experiencing epigastric discomfort accompanied by vomiting. During that episode the reference hospital (RH) radiology ultrasound was read as cholelithiasis without other abnormalities.

Upon arrival at the BES, the patient was classified as yellow (Manchester triage), indicating a moderate urgency level, with a pain intensity rating of 5 on a scale of 0 to 10, promptly received analgesic and antiemetic therapy and an abdominal X-ray was performed which had no abnormal findings. A point-of-care ultrasound was performed of the gallbladder, the portal triad, and the surrounding liver and the obtained videos are seen below. During the examination, a positive sonographic Murphy finding was noted.

A longitudinal view of the gallbladder was recorded in Video 1. Note the presence of many small gallstones produced a WES sign (Wall-Echo-Shadow) wherein only the superficial edge of the gallbladder is visible due to the volume of the many small stones filling up nearly the entire gallbladder. The subsequent shadowing obscures everything beyond the leading edge. Additionally, the visibility of multiple vessel-like structures were noted in Video 1. The portal triad was examined in Video 2 and the presence of multiple vessel-like structures were again seen. Video 3 demonstrates the use of color Doppler on the same structures seen in Video 2 to further demonstrate that these some of these are

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vascular structures where others have no flow making them more likely to be dilated ducts. Given the concern for cholelithiasis and potential biliary tree obstruction, the patient was transferred to the RH for further evaluation.

Following the imaging findings at the BES, the attending physician decided to refer the patient to RH for further complementary studies, here comprehensive blood analyses were conducted and unveiled a cholestatic pattern, which in this case translated by slight elevations in Aspartate aminotransferase 311 IU/L (Reference range: 5 - 34), Alanine aminotransferase 416 IU/L (Reference range: < 55) and Alkaline phosphatase 332 U/L (Reference range: 40 - 150), normal values of Total bilirubin 0.3 mg/dL (Reference range: 0.20 - 1.20) were obtained.

After undergoing blood tests at the RH, the patient chose to leave the national health system and pursue treatment at a private hospital by signing a statement of responsibility. At the private hospital, the patient underwent a cholecystectomy, marking the conclusion of therapeutic intervention. Records from the private hospital was unavailable, hindering elucidation of the etiology of the IHBDD. It is crucial to emphasize that in the pre-hospital setting, the focus is not on diagnosing the precise cause of IHBDD but rather on identifying the characteristic ultrasound pattern. Recognition of this pattern facilitates prompt referral to relevant medical specialties for further evaluation and management.

1. Questions and Answers with a Brief Rationale True & false and / or multiple-choice questions

Question 1

The **video 1** depicts an axial scan of the middle and lower segments of the liver. What conclusions can be drawn from observing the video?

Answer Options

- a) Normal visualization of middle and lower liver segments.
- b) Visualization of middle and lower liver segments showing evident signs of cholecystitis.
- c) Visualization of middle and lower liver segments exhibiting clear signs of cholelithiasis.
- d) Visualization of the gallbladder revealing pericholecystic fluid and parietal thickening.
- e) Suspicious hypoechoic images detected in the superior pole of the right kidney.

Correct Answer = c

This approach entails positioning the ultrasound transducer with pressure just below the right ribs, oriented towards the liver or right shoulder. The accompanying video illustrates a partial axial scan focusing on the middle structures of the liver, revealing a gallbladder replete with small stones indicative of cholelithiasis. Notably, there are no discernible inflammatory signs within the gallbladder, such as pericholecystic fluid or edematous wall thickening.

Question 2

Carefully observe video 2, which demonstrates the middle component of the liver housing the portal vein, depicted longitudinally. Can any deviations from normality be discerned?

Answer Options.

- a) There are abnormal findings observed in the portal vein.
- b) Intrahepatic vascularization appears normal.
- c) The main bile duct clearly dilated, possibly due to obstruction downstream.
- d) This liver exhibits an unusual presence of supplementary "vessels," indicating a deviation from typical anatomical structures seen in standard examinations.
- e) The video lacks sufficient information for evaluation

Correct Answer = d

This video depicts a liver exhibiting an excessive level of vascularity, surpassing the expected norm. This anomaly arises from the abnormal visualization of intrahepatic biliary ducts, which under healthy

conditions should neither be visible nor exceed a diameter of 2mm. Such findings constitute intrahepatic biliary dilatation, a multifactorial pathology often associated with obstructive processes, particularly in patients with cholelithiasis. Failure to address this condition promptly can lead to severe consequences.

Question 3

Upon careful observation of video 3, utilizing the Doppler technique in the middle component of the liver where the portal vein is located and depicted longitudinally, are there any deviations from normality apparent? Furthermore, what is the intended purpose of employing this technique?

Answer Options

- a) This technique proves ineffective in distinguishing between normal and abnormal findings.
- b) Doppler technique confirms the normality of the examination.
- c) Doppler technique poorly executed, necessitating the use of filters and pulse wave Doppler to detect lower velocities flows.
- d) The presence of parallel vessels to the portal vein lacking color filling suggest vascular ischemia.
- e) Doppler technique enables the visualization of vessels without signal, indicating dilated intrahepatic bile ducts, hence an abnormal examination.

Correct Answer = e

Examination of the video 3; reveals multiple vessels exhibiting parallel alignment without detectable flow on Doppler imaging, a phenomenon colloquially termed the "shotgun sign." This observation arises due to the typical invisibility of bile ducts under normal circumstances, as they lack a discernible flow signal on Doppler. The presence of parallel vessels with absent flow indicates an obstructive condition hindering the progression of bile flow, leading to cholestasis. Consequently, the dilation of bile ducts occurs, rendering them visibly detectable.

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Sérgio Miravent: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Conceptualization. **Manuel Duarte Lobo:** Visualization, Validation, Supervision. **Rui Pereira de Almeida:** Visualization, Validation, Supervision.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.visj.2024.101992](https://doi.org/10.1016/j.visj.2024.101992).

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