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Abstract

Examination of the papilla of Vater and biliary system is feasible using radial or longitudinal scanning echoendoscopes, respectively. The complete extrahepatic bile duct may be followed from the papilla to liver hilum. Additionally, the gallbladder and intrahepatic biliary tree of the left liver can be visualized. Altered anatomy and juxtapapillary duodenal diverticulum may impede the evaluation of the papilla and distal common bile duct. Benign stenosis or adenomyomatous hyperplasia of the papilla are conditions occurring predominantly in older patients with a history of gallbladder stones. EUS is the procedure of choice in the evaluation of a dilated common bile duct or in suspected biliary pathology when transabdominal ultrasound fails. This article is part of an expert video encyclopedia.

Keywords

Biliary system; Common bile duct; Endoscopic ultrasound; Papilla of Vater; Standard endoscopy; Video.

Video Related to this Article

Video available to view or download at doi:10.1016/S2212-0971(13)70208-5

Materials

- Radial echoendoscope: EG-3670 URK; Pentax Europe GmbH, Hamburg, Germany.
- Longitudinal echoendoscope: EG-3870 UTK; Pentax Europe GmbH, Hamburg, Germany.
- High-end ultrasound platform: HI vision Preirus; Hitachi Medical Systems GmbH, Wiesbaden, Germany.

Background and Endoscopic Procedure

Transabdominal ultrasound (TUS) is the preferred method for examination of the biliary system. However, complete imaging of the bile duct is not always possible. Endoscopic ultrasound (EUS) overcomes the limitations of TUS, because the transducer comes very close to the anatomical structures of papilla and bile duct without the interference of bowel gas. Moreover, in comparison with magnetic resonance cholangiopancreatography, EUS is a real-time examination and therefore allows dynamic examination of the papilla.

Radial and longitudinal scanning echoendoscopes may be used to evaluate the biliary system with the same efficiency.

Basically there are three positions to evaluate the biliary system:

- A position in the second portion of the duodenum directly at the level of the papilla (papilla, distal bile duct, and gallbladder);

- a position in the duodenal bulb (liver hilum, common bile duct, and gallbladder); and
- a position in the gastral antrum or lower body with the transducer in close contact with the smaller curvature (liver hilum and gallbladder).

Using these positions, the complete extrahepatic bile duct may be followed from the papilla to liver hilum. Additionally, the gallbladder and intrahepatic biliary tree of the left liver can be visualized. Distorted anatomy and juxtapapillary duodenal diverticulum may impede the evaluation of the papilla and distal common bile duct.

Longitudinal Scanning Echoendoscope

The first step is to advance the echoendoscope into the descending part of the duodenum. Having straightened the echoendoscope in the same way as in endoscopic retrograde cholangiopancreatography (ERCP), close contact is established with the duodenal wall at the minor side by suction of the luminal gas and flexion of the tip of the scope. Now the pancreatic head is visualized. Endoscopic visualization of the papilla is helpful to position the transducer directly in contact to the papilla. Filling of the water balloon may support acoustic coupling, but is not necessary in most cases. Very slow, cautious, and gentle movements of the scope (predominantly backward and clockwise/counterclockwise torque) will lead to identification of the small triangular or oval hypoechoic structure of the papilla. Mostly, the pancreatic duct will appear more distant to the transducer at first. Very gentle counterclockwise rotation will bring a longitudinal section of the distal bile duct into focus. The bile duct runs near the transducer. From this point, the echoendoscope is very slowly withdrawn and slightly rotated counterclockwise along the course of the common bile duct to liver hilum. Conversely, gradual clockwise turning and minimal advancement of the scope shaft will allow the transducer to follow the course of the common bile duct

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back to papilla again. The liver hilum and gallbladder are imaged best from a position with the duodenal bulb or from the gastric antrum or lower body. The tubular structures of the portal vein, common hepatic artery, and intrahepatic ducts may be very well visualized. Color-coded duplex scanning facilitates correct identification of these anatomical structures.

Radial Scanning Echoendoscope

At first, the echoendoscope is pushed forward to the duodenum. The imaging stations are essentially the same as in longitudinal endosonography. A detailed assessment of the structures of the papilla and distal bile duct may be achieved from a position perpendicular to the papilla. After advancing the scope into the descending part of the duodenum, luminal air is aspirated and the balloon is inflated slightly. The scope is pulled back until achieving a straightened position of the scope. The first recognizable image of the pancreatic head to appear is below the papilla: The inferior caval vein and the aorta on the left side of the screen, and the superior mesenteric vessels on the right side form a 'V' shape. After further slow withdrawal of the scope and slightly turning its shaft right, the hypoechoic structure of the papilla will appear, and the distal bile duct (close to the transducer) as well as pancreatic duct (distant to the transducer) will appear in cross or oblique sections. In most cases, the second position at the apex of the duodenal bulb will provide a better longitudinal overview of the common bile duct from the papilla to liver hilum. At this position, the balloon is filled a little bit more with water to achieve a stable position within the duodenal bulb and to prevent the scope slipping back into the stomach. Very gentle clockwise rotation of the shaft of the scope combined with minimal advancement of the shaft opens the view onto the distal bile duct and papilla. Counterclockwise torque and exercising a slight pull of the scope allows visualization of the liver hilum and gallbladder. The duodenal bulb is also the best position for imaging of the gallbladder and liver hilum. Another position for examination of these structures is the prepyloric antrum.^{1,2}

Pitfalls and Variants

- Juxtapapillary duodenal diverticulum.
- Dilatation of the common bile duct without clinical or laboratory signs of biliary obstruction (e.g., several years after cholecystectomy).
- Benign stenosis of the papilla and adenomyomatous hyperplasia.³

Key Learning Points/Tips and Tricks

- Radial and longitudinal scanning echoendoscopes are both suited to examine the biliary system.
- The biliary system is visualized from three defined scope positions: second part of the duodenum, apex of the duodenal bulb, and gastric antrum or lower body.

- Longitudinal scanning echoendoscope: first visual inspection of the papilla, suction, close contact of the transducer to the duodenal wall, and gentle withdrawal.
- Water balloon: not necessary, but may help to stabilize the scope within the duodenum.
- The balloon should never be overinflated. If too much pressure is applied, the bile duct is compressed and pathological findings of the distal duct and the papilla may be overlooked.
- In doubtful cases, color-coded duplex sonography should be used to differentiate the bile duct from vessels.
- The diameter of the common bile duct increases after the age of 70 years and following cholecystectomy. In patients with intact gallbladder, a bile duct diameter ≥ 8 mm warrants further investigation.⁴
- Dilated bile duct (and pancreatic duct): Very careful inspection of the papilla and ampullary region of the pancreatic head is necessary.
- Slight compression of the bile duct using the (longitudinal) transducer may help to differentiate an obstructed bile duct from clinically irrelevant bile duct ectasia.
- Suspicion of juxtapapillary diverticulum: The duodenal lumen and diverticulum is filled with water.

Complications and Risk Factors

The complication rate of diagnostic EUS of the biliary system without fine-needle aspiration biopsy is very low (approximately 0.03%). The main risk is duodenal perforation.⁵ However, the evaluation of suspected pathology of the common bile duct by an EUS-based strategy may prevent around two-third of ERCP, which has a much higher procedural risk (>5%).⁶⁻⁸ Therefore, application of EUS helps to select patients for therapeutic ERCP and hence, reduces the complication rate of endoscopic bile duct examination.^{6,9}

Annotations

In all videos, cephalad direction is displayed on the right side of the screen (yellow marker). The following abbreviations are used in images:

- A. hep. and A. hepatica ... Hepatic artery
- CBD ... Common bile duct
- EUS ... Endoscopic ultrasound
- PD ... Pancreatic duct

Scripted Voiceover

Time (min:sec)	Voiceover text
0:00–0:05	The video describes the endosonographic examination of the papilla and the biliary system.
0:05–0:30	Basically, there are three positions to evaluate the biliary system: (1) A position at the level of the papilla, (0:14)

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