Cholestatic Jaundice: Diagnostic Imaging Pathways

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Learning objectives

Know the place of imaging techniques in the exploration of cholestatic jaundice.

Discuss the main causes of jaundice in adults according to the seat of the obstruction on the biliary tract.

Describe iconographic aspects of the main etiologies of jaundice in adults.
Background

Cholestatic jaundice is a condition in which there is a blockage in the flow of bile movement from the liver to the duodenum. The two basic distinctions are: intrahepatic biliary stasis (hepatocellular jaundice) and mechanical biliary obstruction, bearing in mind that several intrahepatic causes of cholestatic jaundice can mimic extrahepatic obstruction to varying degree.

Ultrasound is the first imaging modality used in the algorithm for the investigation of cholestatic jaundice. Further imaging depends on whether the bile ducts are dilated. If the bile ducts are dilated and an ultrasound fails to demonstrate a cause, further imaging depends on a provisional clinical diagnosis. Investigations may the include CT scan of the abdomen, Magnetic Resonance Cholangiopancreatography (MRCP) and Endoscopic US (EUS). If the bile ducts are not dilated, hepatocellular causes of jaundice should be excluded prior to further imaging.
Findings and procedure details

Imaging Methods

The methods used in evaluating the jaundiced patient currently include ultrasound (US), computed tomography (CT), magnetic resonance cholangiopancreatography (MRCP), endoscopic retrograde cholangiopancreatography (ERCP), and endoscopic US (EUS).

Ultrasound

US is the initial imaging test of choice in jaundiced patients because it is non-invasive, inexpensive and readily available. US is used to determine the presence of obstructive jaundice by depicting dilated bile ducts, with sensitivity of 55% to 95% and specificity of 71% to 96%. False-negative studies are due to 2 factors: inability to visualize the extrahepatic biliary tree (often because of interposed bowel gas) and the absence of biliary dilation in the presence of obstruction.

US is less effective than CT or MRCP for determining the site and the cause of obstruction.

Computed Tomography

CT is slightly more sensitive (74% to 96%) and specific (90% to 94%) than US for detecting biliary obstruction, especially given the advent of multidetector CT and image reformations[1,2,3,5]; in addition, the ability to determine the site and the cause of obstruction is greater with CT than with US. It also allows better evaluation of the portal and retroperitoneal lymph nodes and vascular structures[2].

CT is strongly recommended as the primary modality for evaluating patients with suspected malignant biliary obstruction, both for diagnosis, staging and predicting tumor extension and potential resectability.

CT cholangiopancreatography generated by slab volume imaging with minimum-intensity projections and curved planar reformations may be useful for pre-intervention planning.

The major advantages of spiral CT over ERCP or EUS include its low level of invasiveness, minimal operator dependence, low technical failure rate and, in contrast to ERCP, ability to produce a three-dimensional image of the biliary tree. The major limitations of CT are the inability to detect small peritoneal implants, small hepatic metastases, lymph node metastasis in normal-sized nodes, and intraductal tumour extent. Spiral CT gives a relatively high dose of radiation to patients and a further drawback is a small risk of adverse reaction to the iodinated contrast agents. Its main
limitation is in patients with impaired renal function with high serum creatinine levels, as contrast may be nephrotoxic. Artefacts produced by patient movement, respiration and support devices also limit diagnostic value.

**Magnetic resonance imaging**

Magnetic resonance imaging (MRI) can demonstrate both the site and cause of biliary obstruction. MR cholangiography has been shown to be useful in depicting the 3-dimensional anatomy of the biliary and pancreatic ducts.

For detection of ductal calculi, MRCP is the most sensitive of the non-invasive techniques.

MRCP constitutes a non-invasive alternative if ERCP is unsuccessful or cannot be performed. It has a high diagnostic precision (>94%) for the diagnosis of bile duct obstruction, choledocholithiasis, and malignant bile duct obstruction.

The major advantages of MRCP are that it is non-invasive, has no ionising radiation or contrast material, and allows diagnosis and treatment planning in many patients without invasive cholangiography.

The major limitations of MRCP are its inability to offer therapeutic opportunity, its low spatial resolution and its availability and cost.

**Endoscopic retrograde cholangiopancreatography**

ERCP is the most common invasive diagnostic biliary procedure and has evolved gradually from its initial role as a diagnostic tool.

ERCP is generally reserved for therapeutic interventions, such as the removal of stones or dilatation of strictures. ERCP can also be used to obtain tissue from biliary strictures (via brushings) to identify malignancy.

Therapeutic procedures via ERCP are successful at about 90% of the cases.

The most common complications after ERCP are acute pancreatitis and cholangitis, which are severe in 1% of patients.

Because of its inherent risks, costs, and invasive nature, and due to significant advances in cross-sectional imaging, in particular the advent of MRCP, ERCP should be indicated only for therapeutic reasons or when it can alter patient management.

**Endoscopic ultrasonography**
EUS can be used as an adjunct examination to ERCP in cases of common bile duct obstruction and can be used to determine whether the obstruction is from mass or stone with high sensibility and specificity.

**Causes of jaundice in adults**

According to the clinic and the seat of the obstruction on the biliary tract, the main causes of jaundice in adults are listed in figure1 and table1 (Tab.1)

**Tab.1:**

**Extrahepatic causes of cholestatic jaundice**

<table>
<thead>
<tr>
<th>Benign pathologies</th>
<th>Malignant pathologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Stones of the bile ducts and choledocholithiasis</td>
<td>- Pancreatic carcinoma</td>
</tr>
<tr>
<td>- Complicated hydatid cyst</td>
<td>- Cholangiocarcinoma of either the proximal or distal duct</td>
</tr>
<tr>
<td>- Benign bile duct strictures</td>
<td>- Ampullary tumors</td>
</tr>
<tr>
<td>- Sclerosing cholangitis</td>
<td>- Biliary compression by lymph nodes</td>
</tr>
<tr>
<td>- Pancreatic pseudo-cysts</td>
<td>- Carcinoma of gallbladder</td>
</tr>
<tr>
<td>- Chronic pancreatitis</td>
<td>- Metastatic cancer</td>
</tr>
<tr>
<td>- Choledochal cyst</td>
<td>- Tumor infiltration</td>
</tr>
</tbody>
</table>

**Intrahepatic causes of cholestatic jaundice**

- Hepatitis (alcoholic, non-alcoholic and autoimmune hepatitis)
- Cirrhosis
- Drug-induced jaundice
- Primary sclerosing cholangitis
- Infiltrative and granulomatous diseases
**Fig. 1:** Choledocholithiasis A 35 years old female presented with jaundice. (a) US imaging shows a dilated CBD obstructed by a stone with a posterior acoustic shadow. (b) CT (coronal oblique reconstruction without injection) shows the dilatation of the CBD upstream of the stone.
Fig. 2: Hydatid cyst ruptured into the biliary tract. A 45 years old female, with a history of cholecystectomy 10 years ago, presented with abdominal pain. (a) Abdominal US revealed a multivesicular hydatid cyst of the liver dome (Gharbi type III). (b) Communication of the hydatid cyst with the right bile duct, and presence of a hydatid material in the bile duct. (c,d) CT shows the dilated bile ducts, the communication of the cyst with the right bile duct, and the presence of hydatid material into the biliary tract. (e) Intraoperative cholangiography showed the presence of hydatid vesicles in the lower bile duct.
**Fig. 3:** A 41-year-old woman, with a history of cholecystectomy 2 years ago, has recurrent abdominal pain and jaundice appeared 3 days ago. Abdominal CT scan shows: (a) dilatation of intrahepatic bile duct. (b,c) dilatation of the CBP upstream sub-hilar stenosis (Bismuth type II). This stenosis is secondary to the metal clip cholecystectomy. (d) the CBD is not dilated in its retropancreatic portion.

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**Fig. 4:** Fig 4Pancreatic carcinoma A 59 years old men presented with painless jaundice over past several days. Contrast enhanced CT (with multiplanar and MIP reconstructions) showed: (a) intra hepatic dilated bile ducts. (b) the 'double duct' sign with dilatation of both the CBD and pancreatic duct (arrows) and distension of the gallbladder. (c,d,e,f,g) irregular pancreatic head mass with heterogeneous enhancement and central necrosis.

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Fig. 5: Carcinoma of ampulla of Vater A 64 years old male presented with painless jaundice. Contrast enhanced CT showed: (a) intra hepatic dilated bile ducts. (b) the 'double duct' sign with dilatation of both the CBD and pancreatic duct, and distension of the gallbladder. (c,d) ampullary mass (arrow).

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Fig. 6: Carcinoma of ampulla of Vater MRI (e) Coronal T1-FS-Gado, (f) Coronal T2, and (g) MRCP showed intrahepatic and common bile ducts dilatation with abrupt distal termination

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Fig. 7: Carcinoma of gallbladder Irregular mass at the gallbladder fundus with perihilar lymph nodes compression

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Fig. 8: Carcinoma of gallbladder with biliary compression by metastatic lymph nodes. A 52 years old woman presented with obstructive jaundice. (a,b) CT image revealed lymph nodal mass at the porta hepatis (arrow) with intrahepatic biliary ducts dilatation. (c) The CBD is not dilated in its distal portion. (d) A gallbladder focal lesion highly enhanced at the fundus.

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Fig. 9: Klatskin tumor (hilar cholangiocarcinoma)

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**Fig. 10:** Cholangiocarcinoma of the extrahepatic bile ducts

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Conclusion

Ultrasound is a useful initial investigation of cholestatic jaundice because it is non-invasive and assesses pancreaticobiliary structures in real-time without exposing the patient to ionising radiation. CT and MRCP are performed second line.
References


[2] Department of Health Western Australia - Diagnostic Imaging Pathways - Cholestatic Jaundice, 01 December 2011 - Publisher: Department of Health Western Australia.


