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Review Article

ROLE OF RADIOLOGY IN INVESTIGATION OF JAUNDICE

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ABSTRACT

The principal role of imaging in the jaundiced patient is the iden-tification and detailed assessment of major bile duct obstruction. The clinical suspicion is based on a variable combination of dark urine, pale stools, pruritus, cholangitis and cholestatic liver function tests. US is the preferred initial imaging investigation, but will usually be supplemented with a combination of CT, MRCP, direct cholangiography and, in some centres, endoscopic and/or intraoperative US.

Keywords: Jaundice, Ultrasonography (USG), Cholangio Computed Tomography (CCT), Magnetic resonance Imaging (MRI) with Magnetic Resonance Cholangio Pancreatography (MRCP) and invasive modalities like endoscopic retrograde cholangiography (ERCP) and percutaneous trans hepatic cholangiography (PTC).

INTRODUCTION

Jaundice, or icterus, is yellowish discoloration of the skin, mucous membranes, sclerae, and body fluids resulting from excess accumulation and deposition of bilirubin in the body in the presence of serum hyperbilirubinemia. The yellow hue may be mimicked by carotenemia, but in the latter condition, no scleral icterus is present and bilirubin levels are normal.[1]

To appreciate the differential diagnosis of jaundice requires an understanding of the fundamental metabolism of bilirubin; the risk factors, epidemiology, and pathophysiology of common causes of jaundice; and the available serologic and imaging studies used in the workup of jaundiced patients. This article focuses on assessment of the adult patient with new-onset jaundice, reviews guidelines for selecting appropriate tests, and discusses interpretation of results.

The first-line imaging study for jaundice is ultrasonography (US), which is inexpensive, noninvasive, and does not require use of contrast or ionizing radiation. US is useful for identifying biliary duct dilation, is more accurate for diagnosis of gallstones and for determining the location of the obstruction (in 90% of patients),[1,2] and can evaluate the liver parenchyma for cirrhosis, tumor, steatosis, or congestion.[2] Nondilated biliary ducts caused by early, intermittent, or incomplete biliary obstruction, tumor encasement of ducts, sclerosing cholangitis, or cirrhosis may produce falsenegative results. Endoscopic ultrasonography is more invasive but allows excellent visualization of the ductal system while avoiding problems of overlying bowel gas and obese habitus.

CT with intravenous contrast provides better resolution, allowing evaluation of the anatomy; is less operatordependent; and provides information about pancreatic abnormality, lymph node involvement, and tumor extent in malignancy.[2] CT offers additional information following an abnormal US or may be the initial imaging modality in some cases.[3] Magnetic resonance cholangiopancreatography (MRCP) is a relatively new noninvasive procedure that allows visualization of the biliary ductal system without exposure to ionizing radiation (making it safe during pregnancy). Studies show that MRCP determines the cause and level of obstruction with a sensitivity of 95% and specificity of 94% and will assess tumor anatomy, vascular involvement, and staging parameters.[2]

Direct visualization of the biliary tree with either endoscopic retrograde cholangiopancreatography (ERCP) or percutaneous cholangiography (PTC) provides diagnostic and therapeutic options, including sphincterotomy, stone extraction, stent placement, or balloon dilation and biopsy. ERCP is particularly useful when biliary obstruction is strongly suspected, is the test of choice for choledocholithiasis, and is useful for diagnosing pancreatic cancer.[3] ERCP involves catheter insertion through the ampulla of Vater with contrast; there is a 3% complication rate, including pancreatitis, duodenal perforation, and bleeding.[2] PTC involves a

transhepatic route and may allow visualization of anatomy above the level of obstruction in patients with complete biliary obstruction.[2]

BOOK GRINGER

The first task is to determine if there is intrahepatic and/or extrahepatic duct dilatation as a marker of duct obstruction. The intrahepatic ducts should measure no more than 2–3 mm centrally; more peripherally they are usually only just visible on US and should be clearly smaller than the adjacent portal vein branches. Mild dilatation of the intrahepatic ducts may occur without duct obstruction in the elderly.

Selection of a single common duct diameter to predict distal bile duct obstruction is problematic. The maximum diameter of the normal common duct (includes the common hepatic and common bile duct) is influenced by age and where the duct is measured. A diameter of >7 mm is commonly used as a predictor of bile duct obstruction in the jaundiced patient but this is only a guide4. Lower values should be used in younger adults and, conversely, in the normal older population values of 8 mm or more are not unusual. If there has been a cholecystectomy the upper limit of 'normal' is less well defined and the duct tends to be larger, commonly up to 10 mm. Further investigation is guided by the level of clinical and laboratory evidence of duct obstruction.

The diameter of the duct at the superior end of the portal vein tends to be less than it is in the more distal duct and this can sometimes be quite misleading. The author's practice is to attempt to visualize the whole length of duct and to measure the largest internal diameter, which tends to be in the suprapancreatic portion. If only the very upper end of the common duct is seen and is not dilated this does exclude pathological dilatation of the more inferior portion. Conversely, if there is mild dilatation of the suprapancreatic portion but the duct tapers to a normal size in its pancreatic portion, further imaging is not mandatory and should be guided by the clinical likelihood of duct obstruction4. Hilar biliary obstruction will produce only intrahepatic duct dilatation, whilst more distal obstruction will result in extrahepatic dilatation followed by intrahepatic dilatation.

Approximately 95 per cent of patients with bile duct obstruction have biliary dilatation, the degree of which is related to the duration and completeness of the obstruction. In the remaining 5 per cent there are usually sufficient clinical/biochemical indicators of duct obstruction to suggest that cholangiography of some form (MRCP or ERCP) is warranted. Most cases of biliary obstruction without duct dilatation are due to choledocholithiasis, primary sclerosing cholangitis or postoperative stricturing. If there is evidence of duct obstruction (i.e. duct dilatation) the next question is to determine the anatomical level, namely whether it is hilar (at or close to the confluence of the right and left hepatic ducts), or low/mid common duct (Fig. 36.18). This helps with the differential diagnosis as well as in the selection of further imaging tests.

The main differential diagnoses are summarized in Table 36.1. The choice of further imaging tests is determined by what has been shown on US. If US shows choledocholithiasis, patients can proceed to endoscopic sphincterotomy or cholecystectomy. If US does not show stones but stones are highly likely on clinical grounds (e.g. pain and fever associated with jaundice) patients should proceed to ERCP in most cases, especially in the presence of sepsis. In patients with significant comorbidities that might contraindicate ERCP or surgery, MRCP is helpful in providing confirmatory evidence of stones or suggesting another cause of obstruction.

US detects the level of obstruction in up to 95 per cent and cause in up to 88 per cent10. If the cause is not evident on US, and stones are not considered the most likely diagnosis, CT is usually the next most useful test, although MRCP, MRI and endoscopic ultrasound (EUS) may be substituted depending on local access and expertise.

A meta-analysis has shown that MRCP identifies the presence of obstruction in 99 per cent, the level of obstruction in 96 per cent and detects tumour in 88 per cent of patients with a malignant cause9. Multislice CT is highly accurate for identifying the level and cause of obstruction, having similar accuracy to MRI and MRCP, especially with use of multiplanar and cholangiography-type CT reformats (Fig. 36.19)5,6.

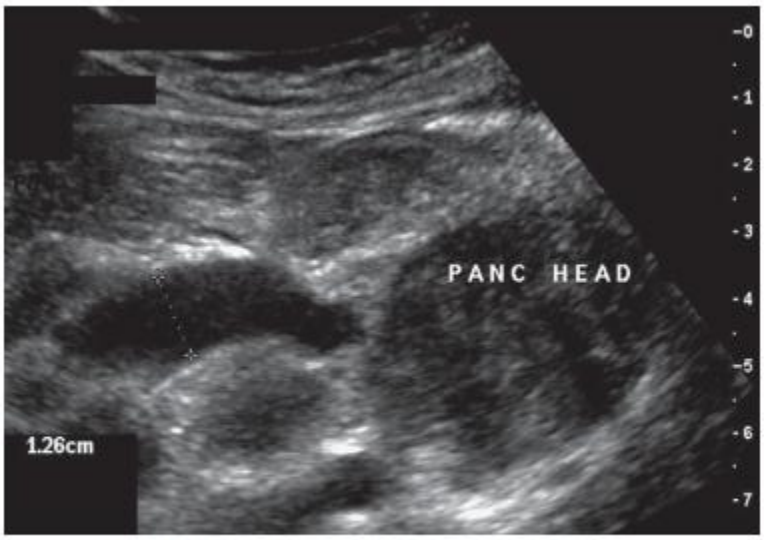

Figure 36.18 Low biliary obstruction. Longitudinal US shows a very dilated bile duct (13 mm) and a large pancreatic head carcinoma.

Table 36.1 CAUSES OF MAJOR BILE DUCT OBSTRUCTION

Anatomical location	Malignant	Benign
Hilar	Gallbladder carcinoma*** Hepatocellular carcinoma**	
Low/mid duct	Pancreatic carcinoma*** Ampullary carcinoma**	Pancreatitis (acute or chronic)**
Either	Cholangiocarcinoma*** Metastases*** Lymphoma* Benign biliary tumors*	Stones**** Mirizzi syndrome** Postoperative strictures*** Primary sclerosing cholangitis*** Other cholangiopathy* Hemobilia* Parasites*

Astersiks indicate approximate relative incidence (**** = most common). Low/mid duct obstruction is more common than hilar obstruction.

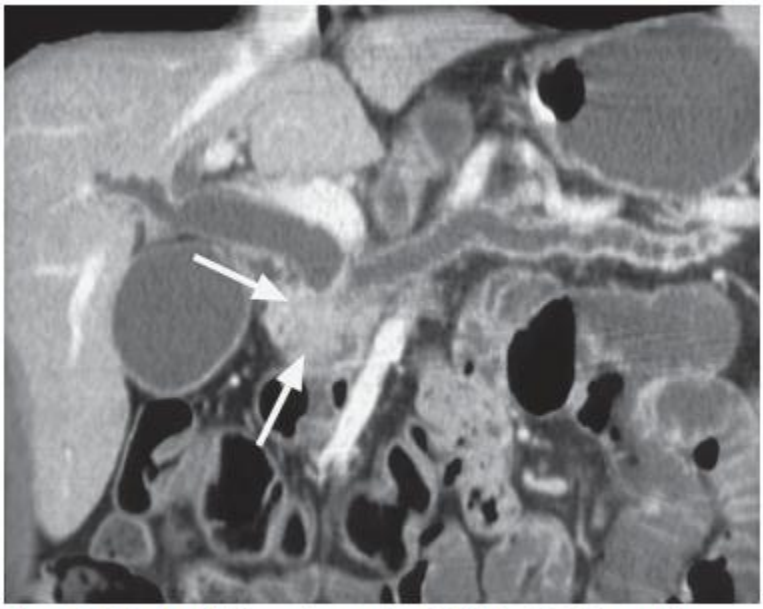

Figure 36.19 Low biliary obstruction. Multislice CT with curved coronal reformat displaying a pancreatic head tumour (arrows) obstructing the common bile duct and pancreatic duct.

The exception being that MRCP has a higher accuracy for detection of choledocholithiasis. The next questions relate to the detailed evaluation of malignant obstruction in regard to tumour resectability and biliary decompression options. In malignant hilar obstruction any evaluation should assess the proximal extent of stricturing into the right and left hepatic ducts, the presence of lobar

atrophy, the patency of the portal veins (main, right and left branches) and the presence of any intrahepatic or local extrahepatic metastases. The proximal extent of stricturing is classified according to the modified Bismuth classification (Fig. 36.20)7.

In malignant low obstruction, usually due to pancreatic carcinoma, the main factors to assess are tumour size, vascular involvement (portal vein, superior mesenteric vein and superior mesenteric artery), lymph node metastases and hepatic metastases .

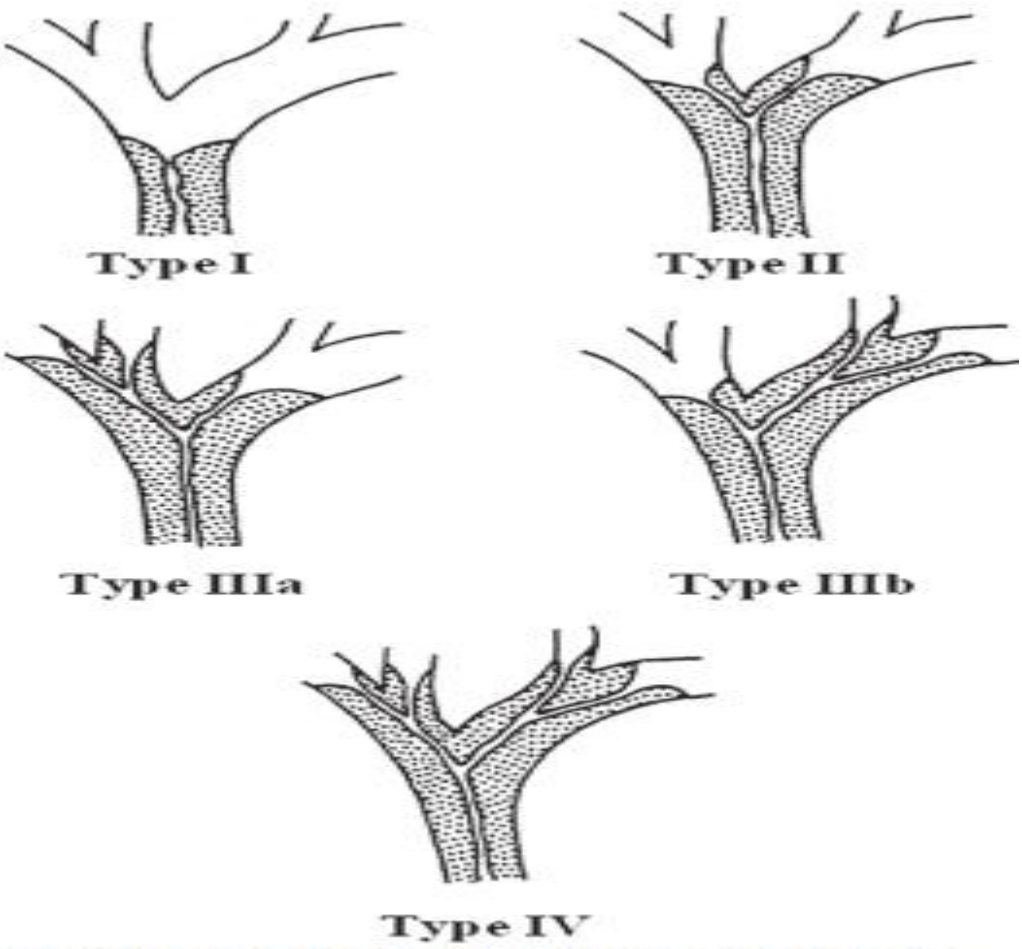

Figure 36.20 Modified Bismuth classification of malignant hilar biliary obstruction based on proximal extent of tumour.

US (including Doppler), CT and MRI (including MRCP and MRA) can all provide information about tumour resectability. Angiography and direct cholangiography (PTC and ERCP) have been replaced in most centres by the other modalities for purposes of resectability assessment. Positron emission tomography (PET) scanning is more helpful in identifying metastases than it is in identifying primary biliary tumours8.

Resectability assessment should, ideally, identify signs of nonresectability without excluding

appropriate patients from the chance of surgical cure. The choice of imaging technique depends on local facilities, expertise and surgical practice. Multislice CT has a good overall accuracy for respectability assessment. For a hilar tumour MRCP is especially helpful in assessing the proximal extent of the lesion and determining its Bismuth classification. EUS is useful for the assessment of any involvement of the superior mesenteric and portal veins by pancreatic head or periampullary tumours. It also allows fineneedle aspiration cytology of the tumour or suspicious lymph nodes. Core biopsy or fine-needle aspiration of suspected malig-nant obstructing lesions can be guided by US or CT, the choice depending on US access and user preference. If surgical resection is being attempted then a preoperative biopsy is not usually appropriate. If palliative stenting is being performed it is preferable to perform a biopsy *after* decompression to reduce the risk of a bile leak

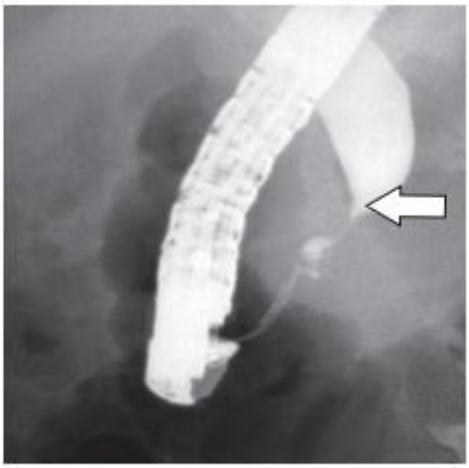

Fig. 4. An ERCP demonstrating a malignant distal CBD stricture (arrow) secondary to a pancreatic carcinoma.

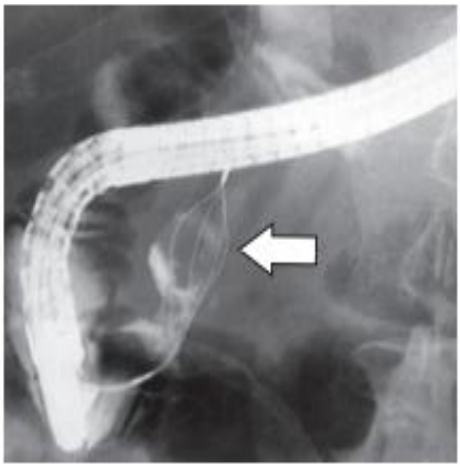

Fig. 5. ERCP basket extraction of CBD stone (arrow).

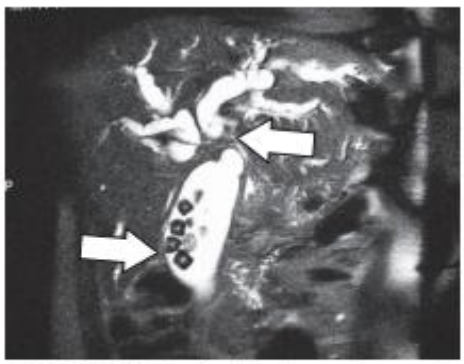

Fig. 3. MRCP showing bile ducts obstructed by a hilar cholangiocarcinoma(upper arrow) and incidental gallstones in the gallbladder (lower arrow).

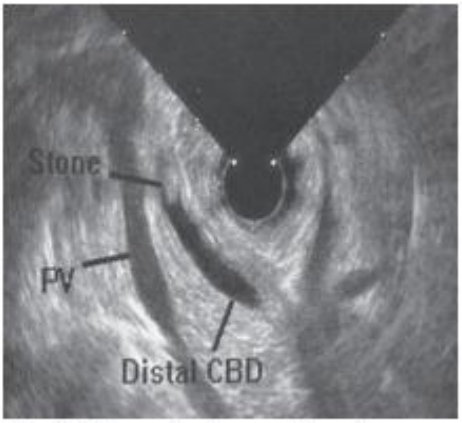

Fig. 8. Endoscopic ultrasound showing a gallstone in the CBD.

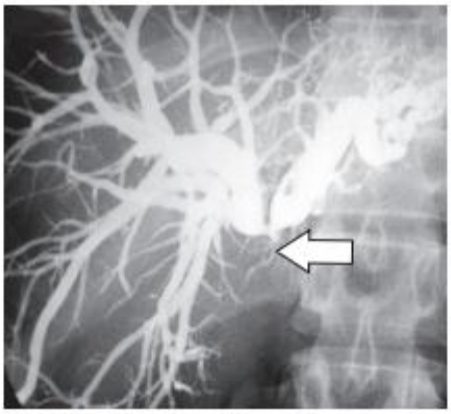

Fig. 7. PTC showing a hilar cholangiocarcinoma (arrow).

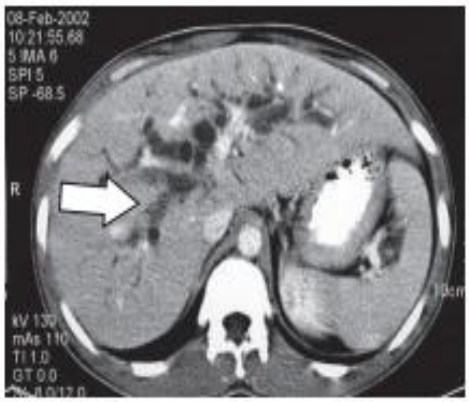

Fig. 2. CT scan showing dilated bile ducts (arrow).

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