

American College of Radiology ACR Appropriateness Criteria®

Clinical Condition: **Jaundice**

Variant 1: **Acute abdominal pain; at least one of the following: fever, history of biliary surgery, known cholelithiasis.**

Radiologic Procedure	Rating	Comments	RRL*
US abdomen	9		None
CT abdomen without and with contrast	7		High
MRI abdomen without contrast with MRCP	5	If cholangitis or hepatic abscess is suspected, with contrast is preferred.	None
INV ERCP	4	If high suspicion of common bile duct stones, some would advocate doing ERCP initially.	Med
NUC cholescintigraphy	2		Low
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: **Painless; one or more of the following: weight loss, fatigue, anorexia, duration of symptoms greater than 3 months. Patient otherwise healthy.**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen without and with contrast	9	Dynamic, multiplanar, or helical.	High
US abdomen	8		None
MRI abdomen with contrast with MRCP	7	See comments regarding contrast in text under "Anticipated Exceptions."	None
INV ERCP	6		Med
INV PTC	4		IP
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Clinical Condition: Jaundice

Variant 3: Painless; one or more of the following: weight loss, fatigue, anorexia, duration of symptoms greater than 3 months. Patient will not tolerate radical surgical procedure.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen without and with contrast	9	Dynamic multiplanar or helical.	High
US abdomen	8		None
MRI abdomen with contrast with MRCP	7	See comments regarding contrast in text under “Anticipated Exceptions.”	None
INV ERCP	6	Not as an initial test. Would do imaging study first.	Med
INV PTC	5		IP
NUC cholescintigraphy	2		Low
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 4: Clinical condition and laboratory examination make mechanical obstruction unlikely.

Radiologic Procedure	Rating	Comments	RRL*
US abdomen	8		None
MRI abdomen with or without contrast with MRCP	6	See comments regarding contrast in text under “Anticipated Exceptions.”	None
CT abdomen with or without contrast	5		Med
INV ERCP	3		Med
NUC cholescintigraphy	3		Low
INV PTC	2		IP
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 5: Confusing clinical picture; patient not described in previous scenarios.

Radiologic Procedure	Rating	Comments	RRL*
US abdomen	8		None
CT abdomen with or without contrast	7		Med
MRI abdomen with or without contrast	6	See comments regarding contrast in text under “Anticipated Exceptions.”	None
INV ERCP	5		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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JAUNDICE

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Summary of Literature Review

One of the difficulties in determining a rational imaging strategy to evaluate jaundiced patients stems from the fact that jaundice is a clinical finding, not a single disease entity. The causes of nonhemolytic jaundice can be divided into two distinct categories: intrahepatic biliary stasis (hepatocellular jaundice) and mechanical biliary obstruction.

Because imaging plays little useful role in the evaluation of intrahepatic biliary stasis, the first task of the clinician caring for the jaundiced patient is to determine if jaundice is caused by bile duct obstruction. Several studies have shown that this distinction can be made in approximately 85% of patients using only clinical findings (age, nutritional status, pain, systemic symptoms, stigmata of liver disease, palpable liver or gallbladder) and simple biochemical tests [1,2]. Patients with a high pretest probability of nonobstructive jaundice usually have either diffuse hepatocellular disease (eg, cirrhosis, hepatitis), or, more rarely, inability of the liver to handle a bilirubin load (eg, hemolytic anemia), or a metabolic deficiency (Gilbert's disease). These patients need no imaging studies. Instead, percutaneous needle liver biopsy is often the next step.

Obstructive jaundice is jaundice resulting from obstruction to the flow of bile from the liver to the duodenum. In adults, extrahepatic (mechanical) obstruction accounts for 40% of patients presenting with jaundice as the primary symptom [1], and this likelihood increases with advancing age. The most common causes of obstructive jaundice in the United States are neoplasms of the pancreas, ampulla of Vater or biliary tract, choledocholithiasis, pancreatitis, and iatrogenic strictures of the biliary tree. Other less common causes include tumors metastatic to the biliary epithelium, sclerosing

cholangitis, and other causes of cholangitis. Other less common causes include tumors metastatic to the biliary epithelium, sclerosing cholangitis, hepatic tumors adjacent to the hilum, perihepatic lymphadenopathy, and other causes of cholangitis.

Imaging Methods

Radiographs

Radiographs rarely provide any information on the site or the cause of obstruction and have no place in the evaluation of the jaundiced patient.

The methods used in evaluating the jaundiced patient today include ultrasound (US), computed tomography (CT), radionuclide cholescintigraphy (CS), magnetic resonance cholangiopancreatography (MRCP), percutaneous transhepatic cholangiography (PTC), and endoscopic retrograde cholangiopancreatography (ERCP). These examinations are effective to varying degrees in assessing both the cause and the site of obstruction; ERCP also can relieve the obstruction in a significant portion of cases [3,4].

The literature is replete with articles confirming the usefulness of all of these methods. Comparative studies have rarely considered the effect of factors that may influence the validity of their conclusions. Among these factors are the prevalence of extrahepatic obstruction in the population studied, the various causes of obstruction (case mix) in the series (often a function of institutional bias), and the frequency of uninterrupted results or unsuccessful studies. These factors can have a profound influence on apparent differences in efficacy [5]. In designing appropriateness criteria, therefore, we have chosen to consider strategies in terms of the pretest probability that, if present, the obstruction is more likely benign than malignant.

It must be remembered that the results of any given imaging method strongly depend on the population studied and the expertise of the examiners. For this reason, local conditions and expertise should properly influence the method by which jaundiced patients are evaluated.

Cholescintigraphy

Cholescintigraphy is unreliable in differentiating intrahepatic cholestasis from obstructive jaundice and in depicting either the site or cause of obstruction, and CS is no longer routinely used or recommended in the evaluation of jaundice [1].

Ultrasound

US is the least invasive and lowest cost imaging technique available for evaluating obstructive jaundice. US determines the presence of obstructive jaundice by detecting dilated bile ducts, with sensitivity of 55%-95%

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and specificity of 71%-96% [1]. False-negative studies are due to two factors: inability to see 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 direct cholangiography (either PTC or ERCP) in determining the site and the cause of obstruction [1].

Computed Tomography

CT is slightly more sensitive (74%-96%) and specific (90%-94%) than US in detecting the presence of biliary obstruction; in addition, the ability to determine the site and the cause of obstruction is greater with CT than with US. CT is strongly recommended as the primary modality for evaluating patients with suspected malignant biliary obstruction, both for diagnosis and for staging [6,7]. CT cholangiopancreatography generated by slab volume imaging with minimum-intensity projections and curved planar reformations may be useful for preintervention planning.

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 three-dimensional anatomy of the biliary and pancreatic ducts. For detection of ductal calculi, MRCP is the most sensitive of the noninvasive techniques [8]. The use of MRCP may decrease the number of ERCP studies obtained prior to elective cholecystectomy [9-11]. More recent studies have recommended MRCP as the preferred test in patients with a high likelihood of choledocholithiasis [12]. MRCP is valuable in the clinical situation of failed ERCP [13,14] and in patients with hilar biliary obstruction due to ductal tumor or periductal compression [15-17].

Percutaneous Transhepatic Cholangiography

PTC permits visualization of the intrahepatic and extrahepatic biliary tree to diagnose the etiology of jaundice, and it also allows therapeutic intervention if biliary obstruction is found. Its success rate depends on the prevalence of biliary obstruction. If obstruction is found, success is on the order of 90%-99% [1]. The sensitivity and specificity for the presence of obstructive jaundice are high, but the procedure is invasive, with major complications in 3%-5% of patients; it is also more expensive than CT or US.

Endoscopic Retrograde Cholangiopancreatography

ERCP is the most common invasive diagnostic biliary procedure. It requires a skilled endoscopist and has a lower success rate than PTC and the other modalities [3,4]; it is also the most expensive procedure described in these criteria. On the other hand, its complication rate is lower than or equal to that of PTC, and it provides a greater range and ease of therapeutic options for relief of the obstruction (stone extraction, internal biliary stent

placement, etc) [18,19]. Its ability to give specific information about the site and cause of obstruction is similar to that of PTC. Both ERCP and PTC enable directed brushing and/or fine needle aspiration (FNA) for tissue diagnosis.

Endoscopic Ultrasound

Endoscopic ultrasound (EUS), an adjunct procedure to ERCP, can be used to detect small distal biliary ductal calculi, for local staging of periampullary neoplasm, and for guided FNA [20-23]. In patients with a high likelihood of biliary stone disease, MRCP, rather than EUS, is recommended [12].

The relative role of ERCP in diagnostic and therapeutic medicine of biliary tract disease—specifically calculus disease, pancreatitis, and neoplastic obstruction—is well summarized in a “state of the science” consensus statement developed by the National Institutes of Health [24].

Appropriateness Criteria

To determine the appropriateness of any imaging test, it is necessary to consider the general clinical category to which the patient belongs. The major categories are 1) high likelihood of a mechanical obstruction, 2) low likelihood of mechanical obstruction, and 3) indeterminate. For situations in which the preimaging probability of obstruction is high, it is also appropriate to consider a second question: whether the obstruction is likely to be benign or malignant.

Situation 1A: High Likelihood of Benign Biliary Obstruction

Patients in this category present with jaundice and acute abdominal pain. There may be a prior history of gallstones documented by sonography or of prior biliary surgery. Sonography is an accurate and the least expensive method for detecting dilated intrahepatic bile ducts and the common hepatic duct at the hepatic hilum. Biliary ductal calculi are not detected with the same sensitivity as gallbladder calculi. The subhepatic common duct may not be visible due to overlaying bowel gas. In addition, intrahepatic bile ducts may not be dilated in the early phase of acute obstruction or in patients with partial obstruction. Despite recognized limitations, sonography is recommended as the initial diagnostic test in patients with suspected calculus obstruction of the common duct.

In patients with acute biliary obstruction and suspected complicating conditions such as cholangitis, cholecystitis or pancreatitis not well evaluated by sonography, a preintravenous and postintravenous contrast-enhanced abdominal CT study is useful in defining the level of obstruction, likely cause, and coexistent complications. CT can detect partially calcified biliary calculi, but is relatively insensitive in detecting bilirubinate or cholesterol calculi.

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MRCP and ERCP are equivalently sensitive for detecting biliary ductal calculi [9-12]. The use of MRCP will improve the therapeutic yield of ERCP. Endoscopic sphincterotomy and associated therapeutic interventions may be curative. In patients with previous gastroenteric anastomoses, MRCP is recommended as the technique of choice to evaluate the extrahepatic biliary ductal system.

In patients with suspected sclerosing cholangitis or biliary structure, MRCP is the preferred imaging test, avoiding the possibility of suppurative cholangitis that may be induced by endoscopic catheter manipulation of an obstructed biliary system. MRCP findings may guide directed approaches such as ERCP with brushing, percutaneous transhepatic biliary stenting, or reconstructive surgery.

Situation 1B: High Likelihood of Malignant Biliary Obstruction

Patients in this category typically present with insidious development of jaundice and associated constitutional symptoms (weight loss, fatigue, etc). Mechanical biliary obstruction can be confirmed by sonography. Malignant obstruction is most commonly due to pancreatic carcinoma but may be secondary to cholangiocarcinoma of either the proximal or distal duct or to periductal nodal compression. A contrast-enhanced multipass CT examination with multiplanar reformation has high sensitivity to lesion detection and a 70% accuracy in discriminating resectable and unresectable disease [7]. Important information in tumor staging includes tumor contiguity or invasion of the superior mesenteric and portal vein, peripancreatic tumor extension, regional adenopathy and hepatic metastases. Contrast-enhanced multipass CT has a 70% accuracy in tumor staging [7].

MRI and MRCP are also accurate in tumor detection and staging. There are no large comparative studies of state-of-the-art CT and MRI in the evaluation of malignant biliary obstruction. CT is generally more available and more frequently used, with MRI/MRCP reserved for patients with contraindications to CT.

ERCP is invasive and more expensive than CT or MRI and has equivalent sensitivity in tumor detection, but it does not provide staging information for operability. Tissue diagnosis can be obtained by endoscopically directed brushing or guided US with FNA [20-23]. In patients with pancreaticobiliary cancer who are surgical candidates, there is no established role for preoperative biliary drainage by ERCP [24]. However, endoscopic biliary drainage may be used for operative candidates in whom there is delay prior to surgery. Endoscopic or percutaneous transhepatic biliary drainage is appropriate for patients who are not candidates for surgery, the percutaneous transhepatic technique being preferred for patients with hilar biliary obstruction [18,19].

In patients with suspected malignant biliary obstruction and negative or equivocal CT or MRI studies, ERCP with EUS may provide an imaging and cytologic diagnosis (FNA) [22].

Pathological tumor diagnosis in nonoperative candidates can be obtained by EUS-directed brushing or FNA, by US- or CT- directed percutaneous pancreatic or nodal aspiration or core biopsy, or by fluoroscopically guided brushing or FNA (PTC).

Focal chronic pancreatitis may mimic pancreatic carcinoma on all imaging tests and only be conclusively diagnosed by operative exploration and biopsy.

Periductal nodal compression may result from metastatic disease or malignant lymphoma. Diagnosis is usually based on imaging appearances and clinical history. Tissue confirmation may be obtained by imaging-directed percutaneous biopsy.

Situation 2: Low Likelihood of Mechanical Biliary Obstruction

In situations in which the pretest probability of mechanical biliary obstruction is low but concern about the possibility exists, either US or MRCP is the first-line test, because of patient convenience and low complication rates. MRCP findings are likely to be accepted without proceeding to ERCP or PTC. Of the two, US is less expensive, though less definitive.

Situation 3: Indeterminate Likelihood of Obstruction

In this clinical situation, the patient's presentation is confusing, and the imaging workup frequently is geared to the dominant clinical symptom. US is an inexpensive, relatively accurate method, certainly appropriate if the sole question is whether or not obstruction exists. In cases in which most of the abdominal organs need to be assessed, either CT or MRI can be used, though CT more reliably displays all abdominal anatomy. When CT evaluation is compromised (eg, in patients unable to receive iodinated intravenous contrast material), the combination of MRI and MRCP is a reliable alternative.

Summary

In summary, the diagnostic approach for adults presenting with jaundice depends to a large extent on a) the preimaging probability that jaundice is obstructive rather than nonobstructive; b) the pretest probability that the most likely cause is benign versus malignant; and c) whether the patient is an operative candidate, once the diagnosis is made. Lastly, the availability of each possible modality and the expertise with which it is offered are important considerations in any clinical situation.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF), also known as nephrogenic fibrosing dermopathy) was first identified in 1997 and has recently generated substantial concern

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among radiologists, referring doctors and lay people. Until the last few years, gadolinium-based MR contrast agents were widely believed to be almost universally well tolerated, extremely safe and non-nephrotoxic, even when used in patients with impaired renal function. All available experience suggests that these agents remain generally very safe, but recently some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed NSF [25-27], a syndrome that can be fatal. Further studies are necessary to determine what the exact relationships are between gadolinium-containing contrast agents, their specific components and stoichiometry, patient renal function and NSF. Current theory links the development of NSF to the administration of relatively high doses (eg, >0.2mM/kg) and to agents in which the gadolinium is least strongly chelated. The FDA has recently issued a “black box” warning concerning these contrast agents (http://www.fda.gov/cder/drug/InfoSheets/HCP/gcca_200705HCP.pdf).

This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated GFR <30 mL/min/1.73m²), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s) [26].

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

Relative Radiation Level Designations	
Relative Radiation Level*	Effective Dose Estimate Range
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv
*RRL assignments are not included for some examinations. The RRL assignments for the IP (in progress) exams will be available in future releases.	

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