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
ERCP	4	If high suspicion of common bile duct stones, some would advocate doing ERCP initially.	Med
Cholescintigraphy	2		Low
Rating Scale: 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 statement regarding contrast in text under "Anticipated Exceptions."	None
ERCP	6		Med
PTC	4		NS
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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 statement regarding contrast in text under "Anticipated Exceptions."	None
ERCP	6	Not as an initial test. Would do imaging study first.	Med
PTC	5		NS
Cholescintigraphy	2		Low
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition: **Jaundice**

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 statement regarding contrast in text under "Anticipated Exceptions."	None
CT abdomen with or without contrast	5		Med
ERCP	3		Med
Cholescintigraphy	3		Low
PTC	2		NS
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 statement regarding contrast in text under "Anticipated Exceptions."	None
ERCP	5		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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 uninterruptible 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% and specificity of 71%-96% [1]. False-negative studies

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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.

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) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m^2. For more information, please see the ACR *Manual on Contrast Media* [25].

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
*The RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, the region of the body exposed to ionizing radiation, the imaging guidance that is used, etc). The RRLs for these examinations are designated as NS (not specified).	

Supporting Document(s)

- ACR Appropriateness Criteria® Overview
- Evidence Table

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