

“Second Step” Imaging Of Gastrointestinal Symptoms

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Chapter 7 covered the “first step” in the imaging evaluation of gastrointestinal symptoms, and noted that while there are many imaging options available to evaluate gastrointestinal symptoms, the “first step” imaging options are relatively few. This chapter picks up where the prior chapter leaves off, and addresses situations when the first step has been taken, but more imaging is warranted. The major points of this chapter are:

1. Women with low abdomen/pelvic pain may need both computed tomography (CT) and ultrasound (US) for evaluation.
2. More than US may be necessary for evaluation of RUQ pain and suspected biliary disease, particularly with abnormal enzyme studies.
3. Small bowel imaging may require additional evaluation after a standard CT study.
4. CT may demonstrate incidental lesions or be performed in asymptomatic patients.

WOMEN WITH LOW ABDOMEN/PELVIC PAIN MAY NEED BOTH CT AND US FOR DIAGNOSIS

Because of the proximity of the bowel, bladder, uterus, ovaries, and fallopian tubes, many disease processes may result in low abdomen/pelvic pain in women¹. Often, women will have ambiguous or even frankly misleading signs and symptoms because of the proximity of the disease processes. Diagnosis may be elusive without performing *both* CT and US (and, occasionally, even *when* performing both).

CT for bowel abnormalities

If the primary suspicion is for a bowel related abnormality, CT is the study of choice, particularly if there are features of inflammation or obstruction (see page 97). CT is performed to evaluate for diverticulitis, appendicitis, appendagitis epiploicae, and colitis. CT abnormalities in the pelvis may be further characterized with ultrasound, which can often provide a more specific diagnosis (Figure 1).

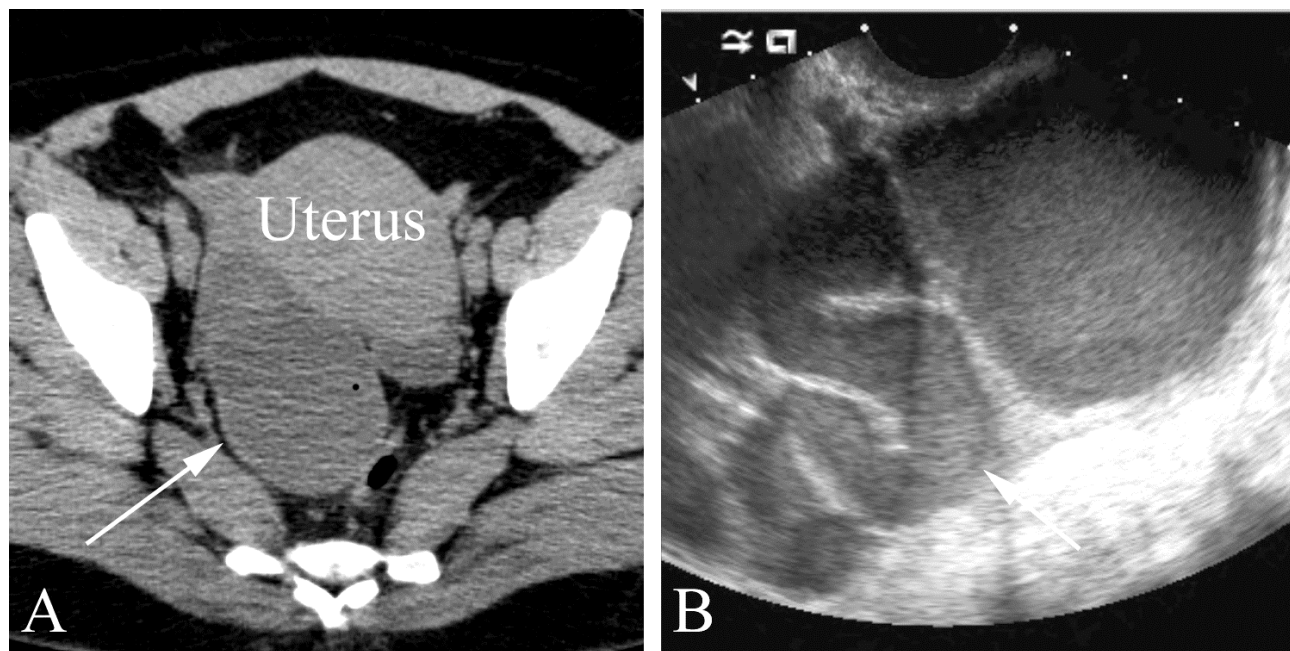


Figure 1. Pyosalpinx in a 42 year old woman with chronic right adnexal and lower abdominal pain. CT supplemented with US to arrive at a diagnosis. A. Axial CT shows an apparent large right adnexal cyst (arrow). B. Pelvic US demonstrates a “tadpole” appearance, characteristic of a hydrosalpinx or pyosalpinx. The patient had surgical resection of the right ovary and fallopian tube demonstrating pyosalpinx superimposed upon a chronic hydrosalpinx.

US for uterus/ovarian abnormalities

If the primary suspicion is for an abnormality of the uterus or ovary, ultrasound is the first study of choice (see pages 16-21). Ultrasound is performed to evaluate for ovarian torsion, adnexal masses, uterine fibroids, ectopic pregnancy, and other disorders that may present with either low abdominal and pelvic pain or a mass. Sometimes, CT (Figure 2; see also Figure 7, page 20) or MR (see Figures 6 and 8, pages 19-20) is obtained for further evaluation of a mass discovered on ultrasound. If the ultrasound is negative, a CT may provide an explanation for the symptoms.

CT, US, and even MR for “lining abnormalities”

In *cystitis* (inflammation of the bladder wall), imaging studies will typically be normal unless the cause of the symptoms is actually outside the bladder (Figure 3). In *endometritis* (inflammation of the uterine lining), the ultrasound may be normal or demonstrate (in severe cases) a thickened endometrial stripe with air bubbles if there is a gas-producing infection. In *colitis* (inflammation of the colon wall), the bowel wall may show thickening and associated pericolic fat stranding (Figure 3; see

also Figure 7, page 98). *Endometriosis* (ectopic endometrial tissue outside of the uterus) may cause pain in the abdomen and be challenging to diagnose with either US or CT, which may simply show a nondescript soft tissue mass (or masses) of the peritoneal cavity or adnexa (see Figure 5, page 18). MR may assist in making this diagnosis because of the ability to detect blood breakdown products which are often seen in endometriomas.

MORE THAN ULTRASOUND MAY BE NECESSARY FOR EVALUATION OF RUQ PAIN

While ultrasound is the first step in evaluation of suspected biliary colic and pancreatitis (see pages 93-94), there are occasions when the evaluation will not stop with the ultrasound. Further evaluation may be directed according to the pattern of liver enzyme abnormalities, patient symptoms, or the abnormalities seen on the ultrasound study.

Liver enzyme abnormalities

Many times, RUQ ultrasound will be requested for “abnormal LFTs”. Occasionally, abdomen CT will

be requested for the same reason. Purists will maintain that the terminology is often used incorrectly – that “LFT” is the wrong term to apply to, for example, the aminotransferases, which are

more properly called “liver *damage* enzymes”. These purists reserve the “liver function test” label to measures of synthetic function such as serum albumin and prothrombin time².

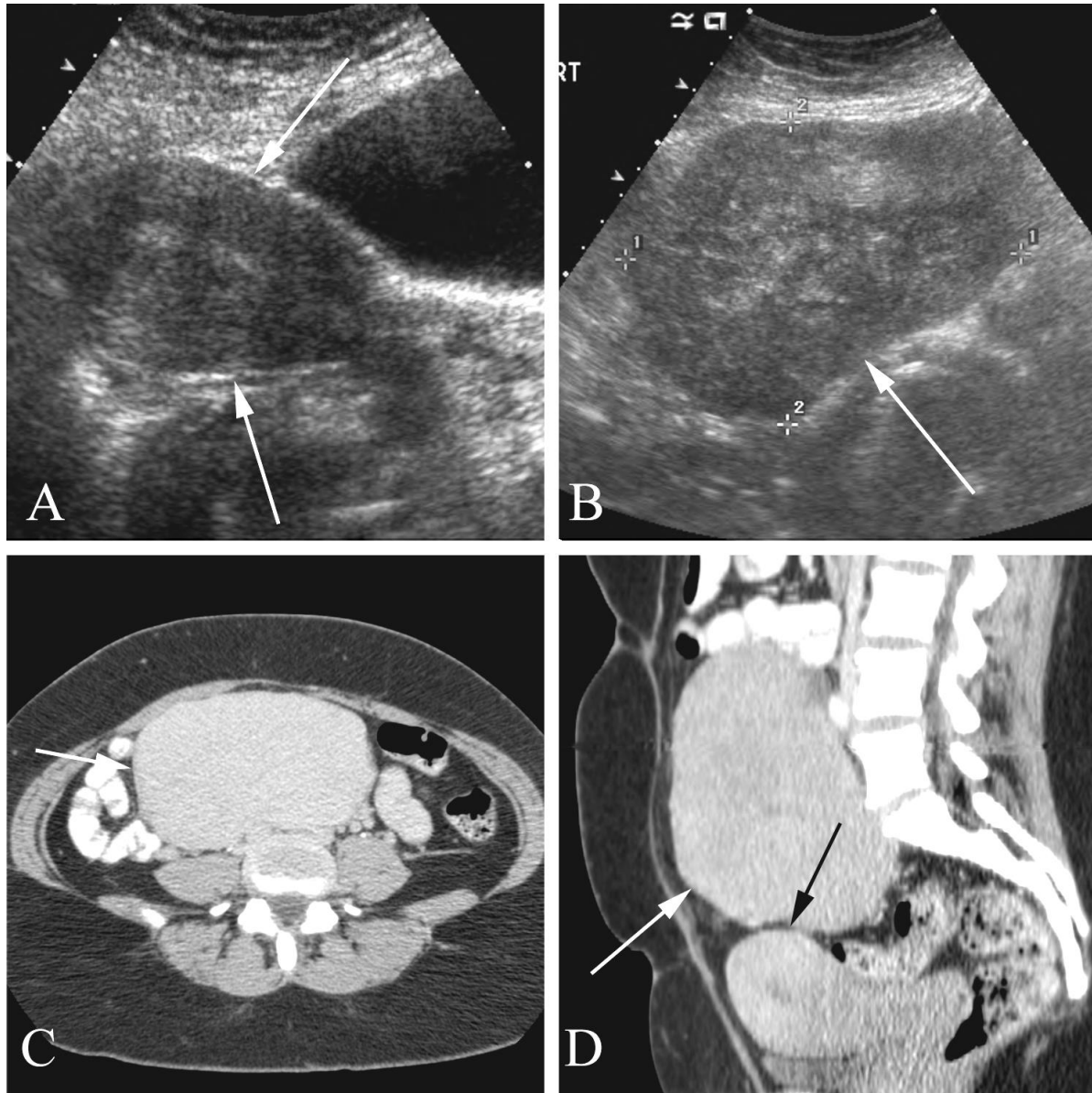


Figure 2. Extrauterine leiomyoma in a 40 year old woman with a lower abdominal and pelvic mass. US supplemented with CT to arrive at a diagnosis. A. Transabdominal US demonstrates a normal appearing uterus (arrows). B. Transabdominal US lateral and somewhat superior to the uterus demonstrates an isoechoic-to-hyperechoic mass (arrow) which had the texture of a fibroid. It was difficult to separate this lesion from the uterus. C. Axial CT study confirms a large, homogeneous mass of the lower abdomen (arrow). D. Sagittal reformatted image demonstrates the mass (white arrow) with a clear demarcation plane separating the mass from the patient's uterus (black arrow). CT-directed biopsy (not shown) was consistent with a leiomyoma. Subsequent surgical removal showed an extra uterine, intra-abdominal leiomyoma.

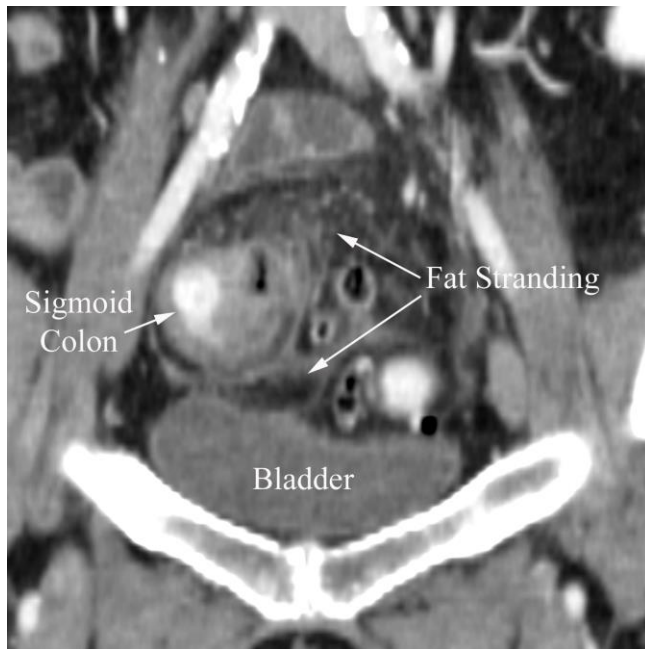


Figure 3. Diverticulitis in a 68 year old woman with urinary frequency and bacteriuria. Coronal reconstruction CT demonstrates the proximity of the urinary bladder to the inflamed loop of sigmoid colon, providing an explanation of the patient's symptoms.

From a radiologist's perspective, this distinction (between *function* and *damage*) is probably not nearly as important as the general *pattern* of enzyme abnormality, which provides at least a clue as to the diagnosis associated with the “abnormal LFTs”. An important point to remember here is that the radiologist may not have access to the exact lab values when interpreting the study, and therefore it makes sense to provide not only “Abnl LFTs” on the requisition, but also the pattern of this abnormality so the radiologist is on alert for findings associated with the appropriate disease. So, what are the patterns?



Figure 4. Fatty liver in a 55 year old woman with elevated transaminases and right upper quadrant pain, compatible with steatohepatitis. US shows a diffusely echogenic liver, with the liver parenchyma demonstrating increased echogenicity compared with the renal cortex (arrow).

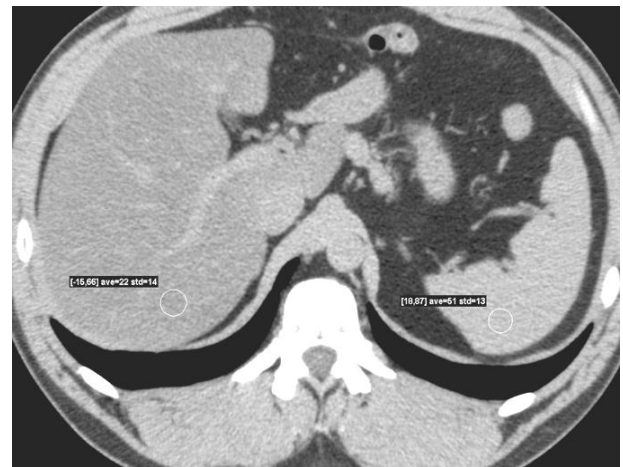


Figure 5. Fatty liver in a 40 year old man with dyslipidemia and elevated AST and ALT. CT shows diffusely decreased density compared to the spleen, with Hounsfield Units [HU] of 22 in the liver target area versus HU of 51 in the spleen target area.

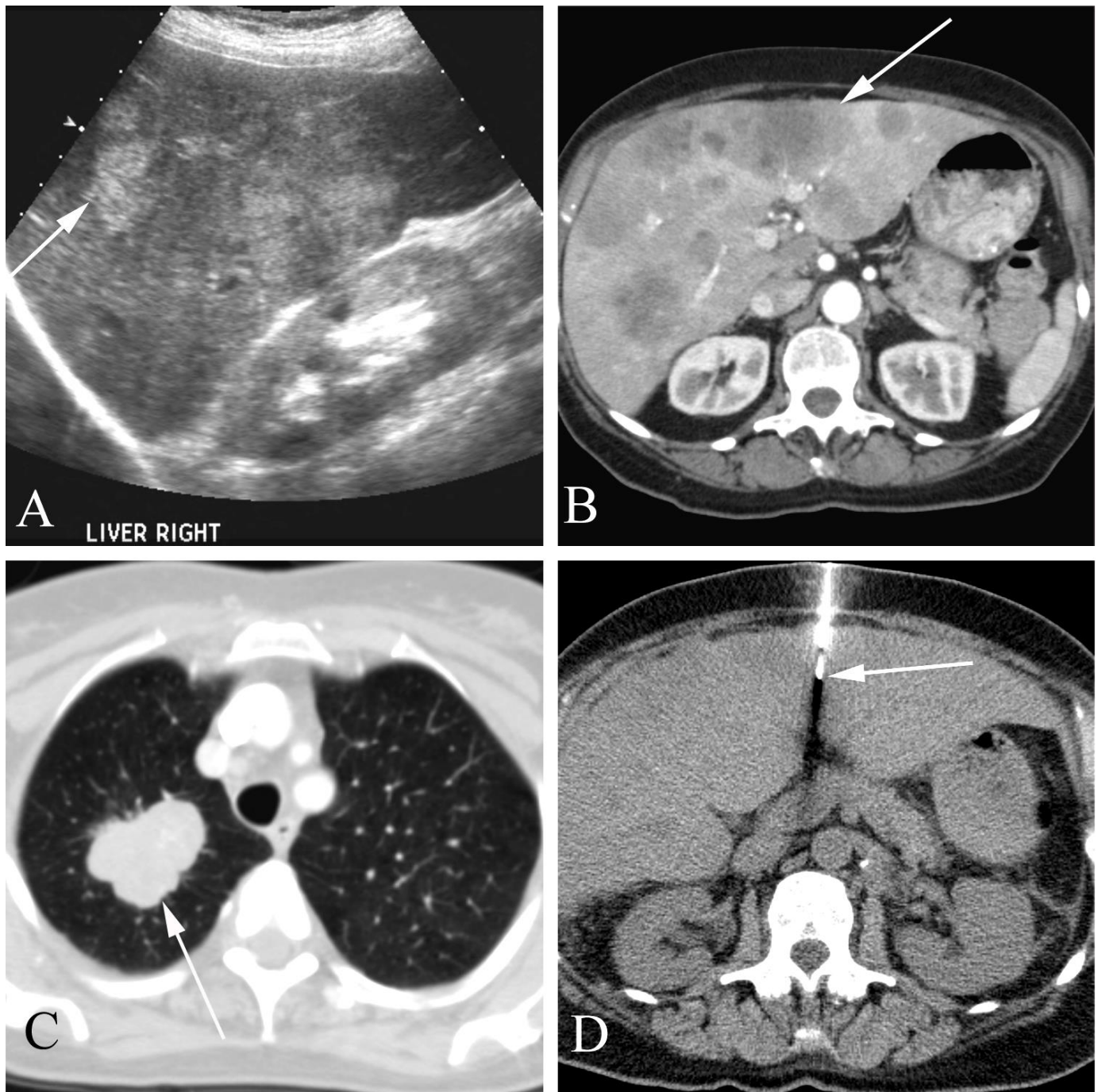


Figure 6. Metastatic liver disease in a 66 year old woman with abnormal liver function tests (elevation of AST, ALT, alkaline phosphatase, and GGT). A. The hepatobiliary ultrasound shows multiple, hyperechoic lesions scattered through the liver (arrow). B. The CT scan of the abdomen confirmed multiple liver lesions (arrow). C. The chest CT, done at the same time as the abdominal CT for tumor evaluation, demonstrates a tumor of the right upper lobe (arrow). D. CT-directed biopsy shows the needle tip in the left lobe of the liver, at the location of the lesion seen on the contrast-enhanced exam (arrow). As no contrast was given, the liver lesions are much less conspicuous on this study. Biopsy results indicated a metastatic lung tumor.

Hepatocellular damage pattern

Hepatocellular abnormalities typically manifest as disproportionate elevations of aminotransferases compared to alkaline phosphatase². Multiple disease processes may cause hepatocellular injury, but many of these demonstrate either no imaging abnormality or a nonspecific imaging abnormality, at least until late in their course. Statistically, abnormal aminotransferases, especially if the elevation is mild, have either no cause of liver disease found, or have hepatitis, alcoholic liver disease, or nonalcoholic steatohepatitis (NASH). While an ultrasound study (Figure 4) or a CT study (Figure 5) may show a fatty liver, the imaging study cannot differentiate between asymptomatic steatosis and NASH. Note also that ultrasound, while less expensive, is not as accurate in evaluation of fatty liver as CT or MR³. The ratio of aspartate aminotransferase (AST) to alanine aminotransferase (ALT) may help in discriminating between NASH and alcoholic hepatitis: the AST/ALT ratio is typically *less* than one in NASH and *greater* than one in alcoholic hepatitis. In general, with the hepatocellular pattern of enzyme abnormalities, the expected imaging finding is a normal study or a fatty liver, and with either a normal or fatty liver, further evaluation for hepatitis (with serum screening), alcohol use, other drug use (including prescription drugs), and follow-up is probably necessary. In at least some cases, a liver biopsy will ultimately be necessary to establish a diagnosis and may be considered for those with persistent two-fold elevation of aminotransferases². Of course, there are nonhepatic causes of elevated aminotransferases, including muscle disorders (e.g., injury and pyomyositis), thyroid disorders, celiac disease, adrenal insufficiency, and anorexia nervosa².

Cholestatic pattern

When alkaline phosphatase elevation exceeds that of the aminotransferases, the patient is said to have a cholestatic pattern of enzyme abnormalities, and a different set of diseases needs to be considered, namely partial bile duct obstruction, primary biliary cirrhosis (PBC), primary sclerosing cholangitis, drugs (particularly anabolic steroids), and unsuspected metastatic cancer². In patients with this

pattern of enzyme abnormality, as with all patients with suspected hepatobiliary issues, the first imaging study to order is ultrasound, which will evaluate for diffuse metastatic disease or biliary distension. If the ultrasound shows diffuse liver abnormality then liver biopsy will typically be performed (Figure 6). If the ultrasound demonstrates biliary distention, the patient is said to have extrahepatic cholestasis, and endoscopic retrograde cholangiopancreatography (ERCP) will usually follow to diagnose the cause (typically choledocholithiasis) and provide treatment (e.g., stone removal or stent placement). In some patients, magnetic resonance imaging cholangiopancreatography (MRCP) may represent an alternative to ERCP, for example when the likelihood of intervention is small². Note that this is an evolving area and local availability and expertise in ERCP and MRCP vary widely, so discussion with local radiologists, surgeons, and gastroenterologists in these patients certainly makes sense.

Nuclear medicine study for physiology and blockage

In patients with suspected biliary colic, as noted in Chapter 7, the initial study is hepatobiliary ultrasound. In many cases, this study will be definitive. It may be definitively *positive*, showing gallstones and features of inflammation such as pericholecystic fluid and a positive sonographic Murphy's sign allowing the surgeon to proceed with cholecystectomy. Or, it may be definitively *negative*, where the suspicion of acute cholecystitis was relatively low and the negative ultrasound supports the clinical diagnosis of, for example, gastritis. In patients where the clinical suspicion for hepatobiliary disease is high and the ultrasound study is either normal or ambiguous, further imaging may be helpful. As noted above, the pattern of enzyme abnormality – if the patient has both enzyme abnormalities and biliary pain – may help direct the search: patients with a cholestatic pattern (elevated alkaline phosphatase relative to aminotransferases) more likely need ERCP or MRCP, whereas those with a hepatocellular pattern more likely benefit from biopsy, if a definite diagnosis is clinically required. In patients with biliary pain and normal or ambiguous enzyme abnormalities, a

nuclear medicine hepatobiliary scan may provide additional important information.

The nuclear medicine study for gallbladder disease has two phases, but only the first phase may be necessary in some patients. In the first phase of the study, the patient is injected with an intravenous dose of radioactively labeled iminodiacetic acid, which the liver conjugates and secretes in the bile. Sequential imaging should demonstrate the liver, biliary tree, gallbladder, and small bowel (Figure 7). In patients with acute biliary pain and no gallstones seen on right upper quadrant ultrasound, non-visualization of the gallbladder by one hour indicates acute cholecystitis. If the patient is direly ill, the test will likely be terminated at this point and the patient taken to surgery⁴.

In the absence of a direly ill patient, the test will continue. If the gallbladder is not seen by one hour and sequential follow-up never reveals the gallbladder, then the diagnosis remains acute cholecystitis until proven otherwise (Figure 8). If the gallbladder visualizes between one and four hours, then the diagnosis is *chronic* cholecystitis. If the gallbladder visualizes within an hour, then the second phase of the nuclear medicine study is performed. Note that in almost all cases, these

patients are *not* the acutely ill patients suspected of having acalculous cholecystitis, but, rather, are patients with chronic pain suspected to have sphincter of Oddi dysfunction. The clinical features of these patients include epigastric or right upper quadrant pain, elevated aminotransferases, elevated bilirubin, or elevated pancreatic enzymes or pancreatitis-type pain⁵. Sphincter of Oddi dysfunction has a number of synonyms, including papillary stenosis, sclerosing papillitis, biliary spasm, and biliary dyskinesia. As is frequently the case when so many terms apply to one thing, there is confusion about what constitutes the condition, what causes the abnormality, and how to diagnose and treat the disease. With respect to the nuclear medicine study, the second phase of the study is designed to provide some information regarding hepatobiliary function. The patient is injected with cholecystokinin (a naturally occurring endogenous peptide), and the patient is imaged for up to approximately one hour (exact protocols differ). A normal response consists of an ejection fraction of greater than 40% (Figure 7), whereas a lower ejection fraction is compatible with gallbladder dyskinesia and the patient is a candidate for cholecystectomy⁵ (Figure 9).

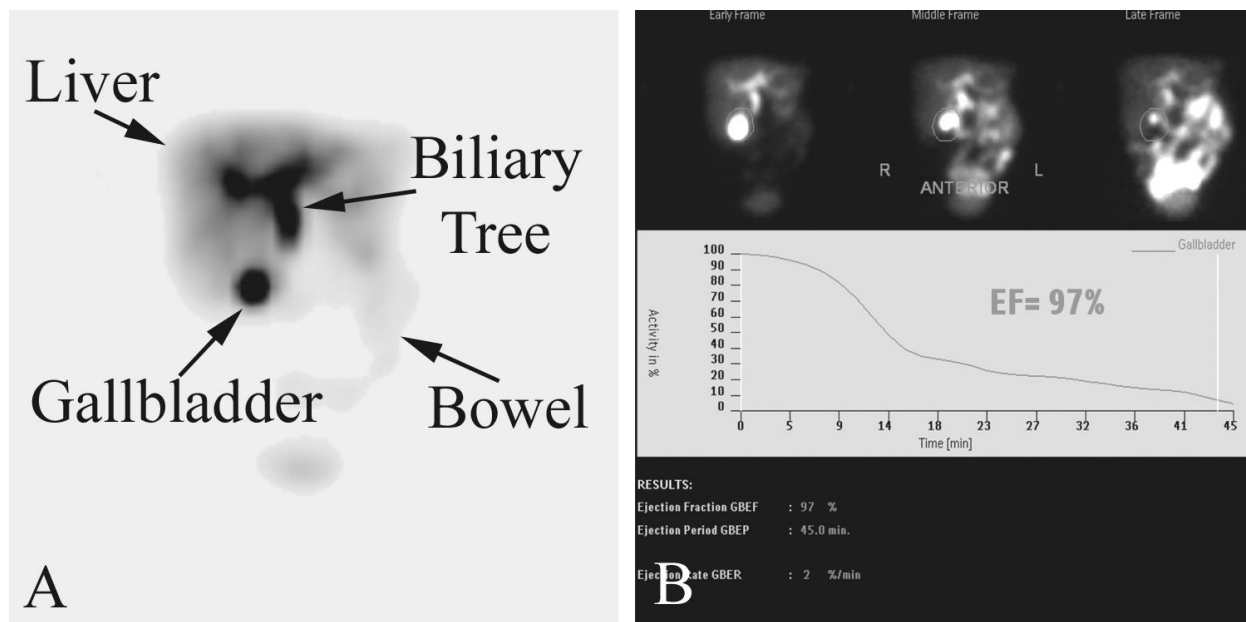


Figure 7. Normal nuclear medicine hepatobiliary scan in a 42 year old woman with chronic right upper quadrant pain. A. Images obtained during the first hour show normal visualization of the liver, biliary tree, bowel, and gallbladder. B. Following injection of cholecystokinin, there was a 97% ejection fraction, far above the normal cut-off value of 40%. Subsequent endoscopy showed gastritis.

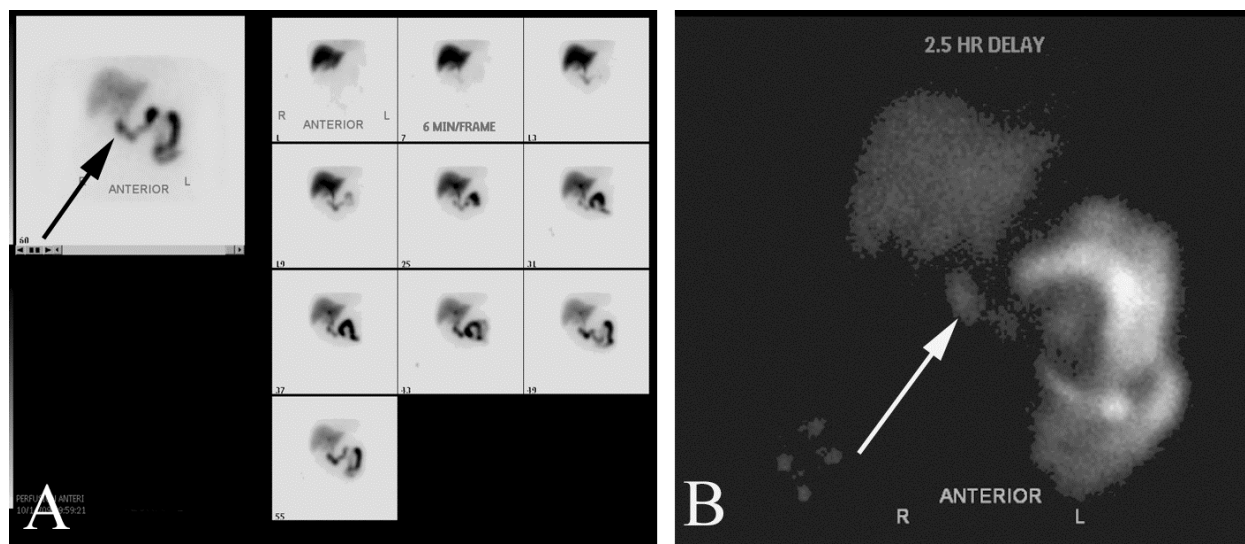


Figure 8. Cholecystitis on a nuclear medicine study in a 79 year old man with equivocal right upper quadrant pain and gallstones seen on an ultrasound study (not shown). A. HIDA scan through one hour shows no visualization of the gallbladder, although there is visualization of the liver, duodenum (arrow), and small bowel. B. Nuclear medicine scan done at 2.5 hours still shows only the duodenum (arrow) without gallbladder activity. The patient was taken to the operating room where acute cholecystitis was confirmed.

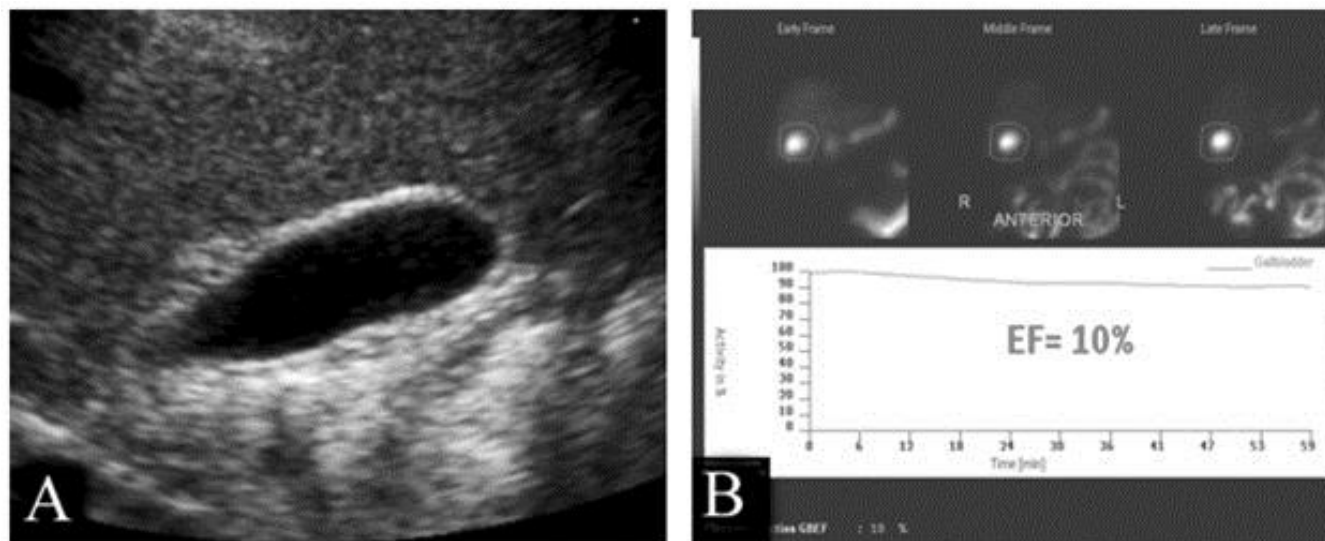


Figure 9. Sphincter of Oddi dysfunction in a 50 year old man with chronic right upper quadrant postprandial pain. A. Ultrasound study of the gallbladder is normal. B. Nuclear medicine hepatobiliary scan shows an abnormally diminished ejection fraction. The patient underwent elective cholecystectomy with relief of his symptoms.

Additional abnormalities seen on US

As noted above and in Chapter 7, the first step in evaluation of patients with right upper quadrant pain is biliary ultrasound. In some cases, this study will show abnormalities that prompt further evaluation with additional imaging studies. For

example, extensive liver abnormality may be followed by CT and biopsy (Figure 6), whereas renal abnormalities may be followed by CT and renal excretion studies (Figure 10).

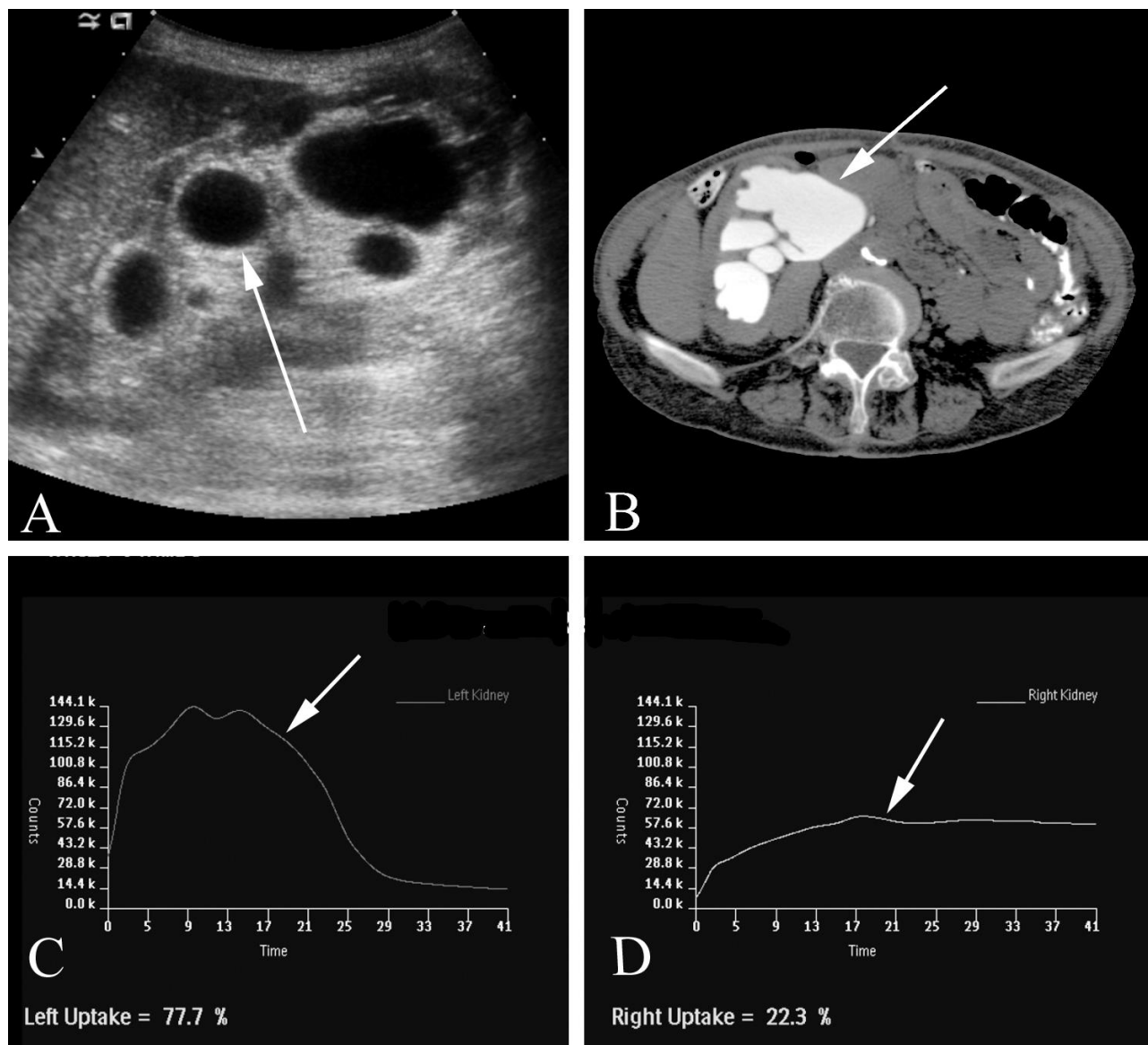


Figure 10. Ureteropelvic junction obstruction in a 57 year old woman with intermittent right upper quadrant pain. A. RUQ ultrasound examination showed a dilated right renal collecting system (arrow). B. Axial CT shows a dilated right collecting system (arrow). Both ureters (not shown) were of normal size. C. Nuclear medicine time activity curve for the left kidney (arrow) shows a normal appearance, with 77% of the measured excretion of injected radionuclide exiting the left side. D. Nuclear medicine time activity curve for the abnormal right kidney (arrow) shows a flattened appearance, with 23% of the measured excretion of injected radionuclide exiting the left side.

SMALL BOWEL IMAGING MAY REQUIRE ADDITIONAL EVALUATION AFTER A STANDARD CT STUDY

Most small bowel abnormalities that can be diagnosed with CT will be diagnosed with routine CT studies of the abdomen and pelvis. As noted in Chapter 7, these are performed with barium or iodine containing contrast material, both denser than most body tissues. The bowel will appear as a rim of grey tissue around the white contrast in the lumen of the bowel. Typically, the bowel wall should be quite thin – as if drawn with a pencil. If the bowel wall looks thicker – as if drawn with a brush – then the wall is probably too thick (Figure 11). Bowel wall thickening is not a specific finding and may be seen in any disease which causes inflammation (e.g. Crohn’s disease), hemorrhage (e.g. anticoagulation) or infiltration of tumor cells (e.g. lymphoma) within the bowel wall. Focal tumors may appear as filling defects in the contrast column, rather than diffuse wall thickening.

As noted in Chapter 7, alternatives to positive (dense, white) contrast have been developed for evaluation of the small bowel. These alternatives are usually employed *after* the diagnosis is established in a patient with small bowel disease. The diagnosis is usually established by a combination of features including clinical history, endoscopy, and standard CT of the abdomen and pelvis, so alternatives to the standard CT are generally a “second step” and thus included in this chapter. Note, however, that such studies may be the exam of choice when a patient returns with an exacerbation of symptoms.

The alternatives to positive contrast in evaluation of the small bowel may be performed in one of two ways: an easy way and a hard way. The easy way consists of substituting a lower density oral material for the positive contrast usually given, and having the patient drink approximately 1300 cc of the chosen substance over a one hour period. As noted in Chapter 7, there is a commercially available product for this purpose (VoLumen), but Woo et al⁶ found whole milk to work as well. The main advantages to the lower density contrast material is that it may distend the bowel slightly better, and

that it allows evaluation of bowel wall enhancement with IV contrast. Recall from Chapter 7 that the portal venous phase study is typically performed about two minutes or so after IV injection of contrast material starts, and at this time inflamed loops of bowel will demonstrate abnormal enhancement along the bowel wall. However, the positive contrast usually given for CT will obscure this enhancement. The advantage of the lower density oral contrast is that the enhancement is much easier to see.

Crohn’s disease is one of the most frequent indications for a dedicated small bowel study. In Crohn’s disease, CT performed with low density contrast allows evaluation of enhancement of the bowel wall, bowel wall thickening, detection of fat stranding, abscess formation, and fistula formation. This permits the radiologist to accomplish the specific goals of imaging the small bowel in patients with Crohn’s disease, which are to evaluate the presence, severity, and extent of disease, to evaluate disease activity, and to evaluate extraintestinal complications⁷. As noted above, administration of oral low density contrast material is the “easy way” of doing the study. The “hard way” is adapted from a fluoroscopic/plain film technique called “enteroclysis” which means “bowel washing.” Enteroclysis requires placement of a tube within the small bowel, ideally far enough into the duodenum (or with a specially designed balloon near the tip) to prevent backflow into the stomach (then the esophagus and then the exam room floor). Such reflux will occur because the rate of infusion is fast enough to cause bowel distension. This high rate of infusion (accomplished with a special pump) allows superb small bowel distention and beautiful pictures of the small bowel. However, these exams are not widely available, and consultation with the local radiology department is in order before scheduling such an exam.

Wireless video capsule endoscopy, which involves swallowing a disposable 11 x 26 mm camera which transmits images to receivers outside the patient, may also be used to evaluate the small bowel⁸. Since high-grade bowel stenosis is a contraindication to this study, the patient will probably need to go through a CT scan performed with oral contrast *before* capsule endoscopy.

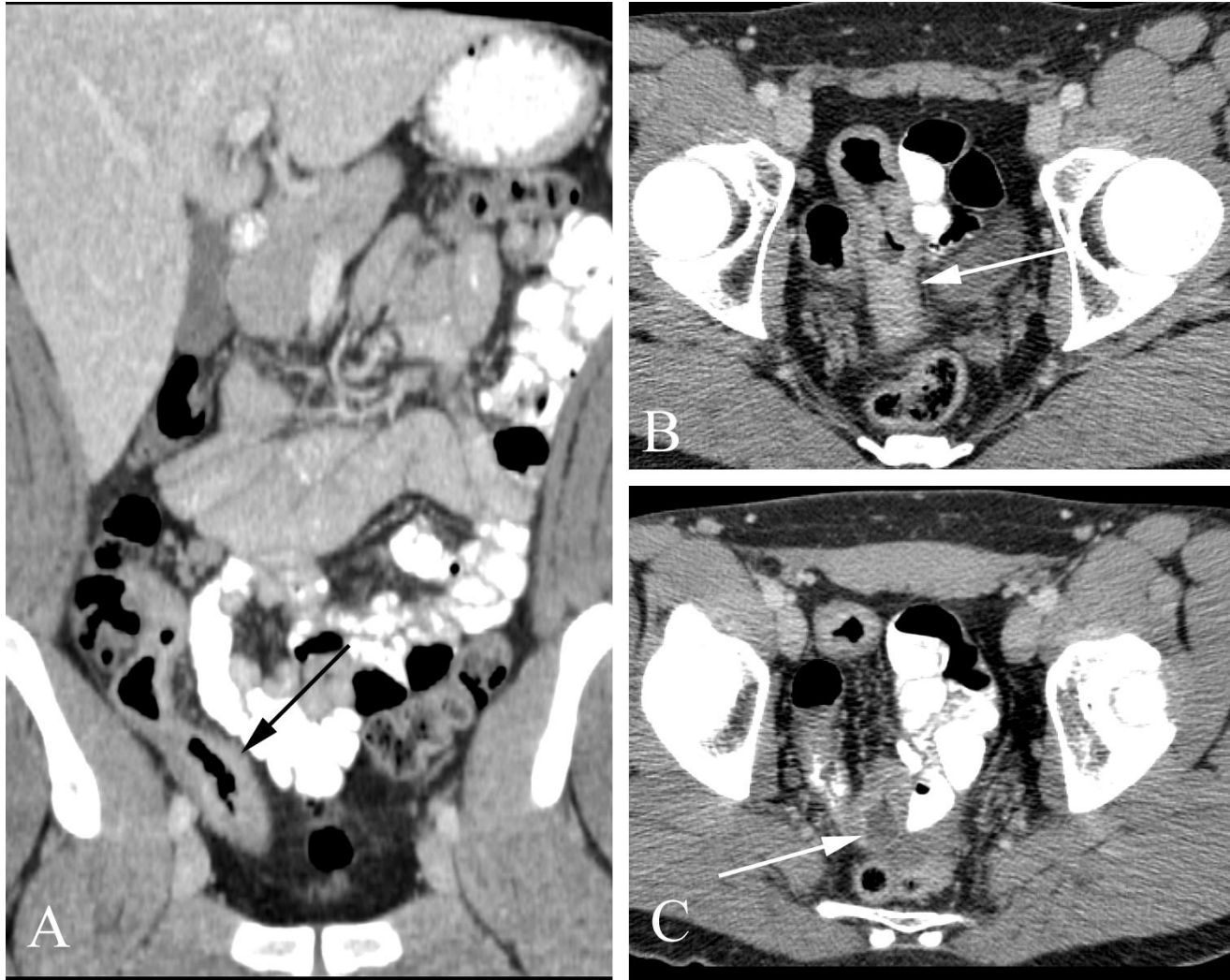


Figure 11. Crohn's disease in a 24 year old man with acute onset of abdominal pain and bloody diarrhea. A. CT coronal reformatted image performed with standard oral and intravenous contrast material demonstrates that the terminal ileum has a thick wall (arrow). B. Axial CT study also demonstrates the thick walled terminal ileum (arrow). Compare to the adjacent bowel loops, which have a normal, thin bowel wall. C. A lower CT cut shows free fluid in the pelvis, an abnormal finding in a man and an indication of intraperitoneal inflammation.

CT MAY BE PERFORMED IN SOME ASYMPTOMATIC PATIENTS

Incidentalomas and “Full Body CT”

The expanded use of imaging – particularly CT scanning – has created a new class of lesion. The term “incidentaloma” refers predominantly to lesions of the adrenal incidentally found when scanning the patient (and this section reviews these lesions first), but this term also applies to those other

incidentally discovered lesions found when scanning the patient produces a finding not related to the reason for getting the scan. The most commonly encountered such lesions are in the adrenal, liver, and lung. This chapter covers the first two, whereas Chapter 10 deals with incidentally discovered lung lesions. One of the main things to keep in mind when dealing with incidentally discovered lesions is that the CT scan functions as a screening tool for whatever body part is scanned – indeed, many entrepreneurs have opened up centers

for “CT screening” to evaluate asymptomatic or largely asymptomatic patients for occult but significant disease⁹. Such practice has engendered much interest on the part of the press and lay public, but at this time is not approved by the FDA¹⁰; the FDA notes “. . . the FDA has never approved CT for screening of any part of the body for any specific disease, let alone for screening the whole body when there are no specific symptoms of disease at all. No manufacturer has submitted data to the FDA to support the safety and efficacy of screening claims for whole-body CT screening”. While a full review of such issues is beyond the scope of this chapter, H. Gilbert Welch has written an excellent book on the topic of cancer screening called *“Should I Be Tested for Cancer? Maybe Not and Here’s Why”* (University of California Press, 2006). As the book notes, it is difficult to show the efficacy of screening, including screening with imaging. Indeed, there is even controversy about such widely accepted screening studies as mammography and the use of prostate specific antigen. These issues are good to keep in mind when dealing with incidentally found lesions on imaging studies, because even if these lesions are malignant, they may represent “pseudodisease” or “cancers that will never matter to patients”. With respect to “Full Body CT”, as noted by Jackson et al⁹, “Primary providers, who may not have ordered or discussed the study with the patient before it was done, are expected by the patient to provide management recommendations and education without clear supporting evidence”.

Adrenal “incidentalomas”

Adrenal incidentalomas are lesions greater than 1 cm in diameter incidentally discovered on an abdomen CT performed for reasons other than investigation of possible adrenal abnormality. There are two sets of issues regarding these lesions: clinical and imaging. From the clinical standpoint, patients with incidentalomas (even small, definitely benign ones – which will generally be the majority of them) need to undergo endocrine evaluation because some

of these incidentalomas will actually be functioning, even though the symptoms are mild enough to escape detection¹¹. The common tumor types determine the symptoms and laboratory abnormalities, but since the tumor type is unknown prior to full evaluation, it is necessary to screen for all three possibilities: cortisol producing, adrenaline producing (pheochromocytomas), and aldosterone producing. The cortisol producing tumors may produce clinical or subclinical Cushing’s disease and be associated with obesity, hypertension, glucose intolerance or diabetes, or hypercholesterolemia. The pheochromocytomas may produce paroxysmal hypertension or flushing and anxiety. Aldosteronomas may produce hypertension and sodium retention. Recommendations for laboratory testing include a dexamethasone suppression test for Cushing’s, a 24 hour catecholamine test (urine collection) for pheochromocytoma, and evaluation of serum sodium and (if there is hypertension) measurement of serum rennin and aldosterone for suspected aldosteronoma.

Regarding imaging, algorithms have been devised to guide work-up¹² (see Table). Radiologists may differ in their recommendations as to which additional test to perform, but in general the patient will need to return to the radiology department for either an unenhanced CT (Figure 12) (likely followed by an additional enhanced study, even if one has already been performed, because of timing differences between the “routine” CT and the optimal adrenal protocol work-up) or an MR. CT is cheaper, more available, and (with “washout” tests based on contrast clearance from the adrenals) very effective in differentiating benign from malignant adrenal incidentalomas¹². These tests are done to evaluate the size and fat content, which are the imaging features which determine further work-up. In addition to this imaging evaluation, most of these patients will need to return again on a periodic basis to evaluate incidentaloma growth, because an increase in size is an indication for removal.

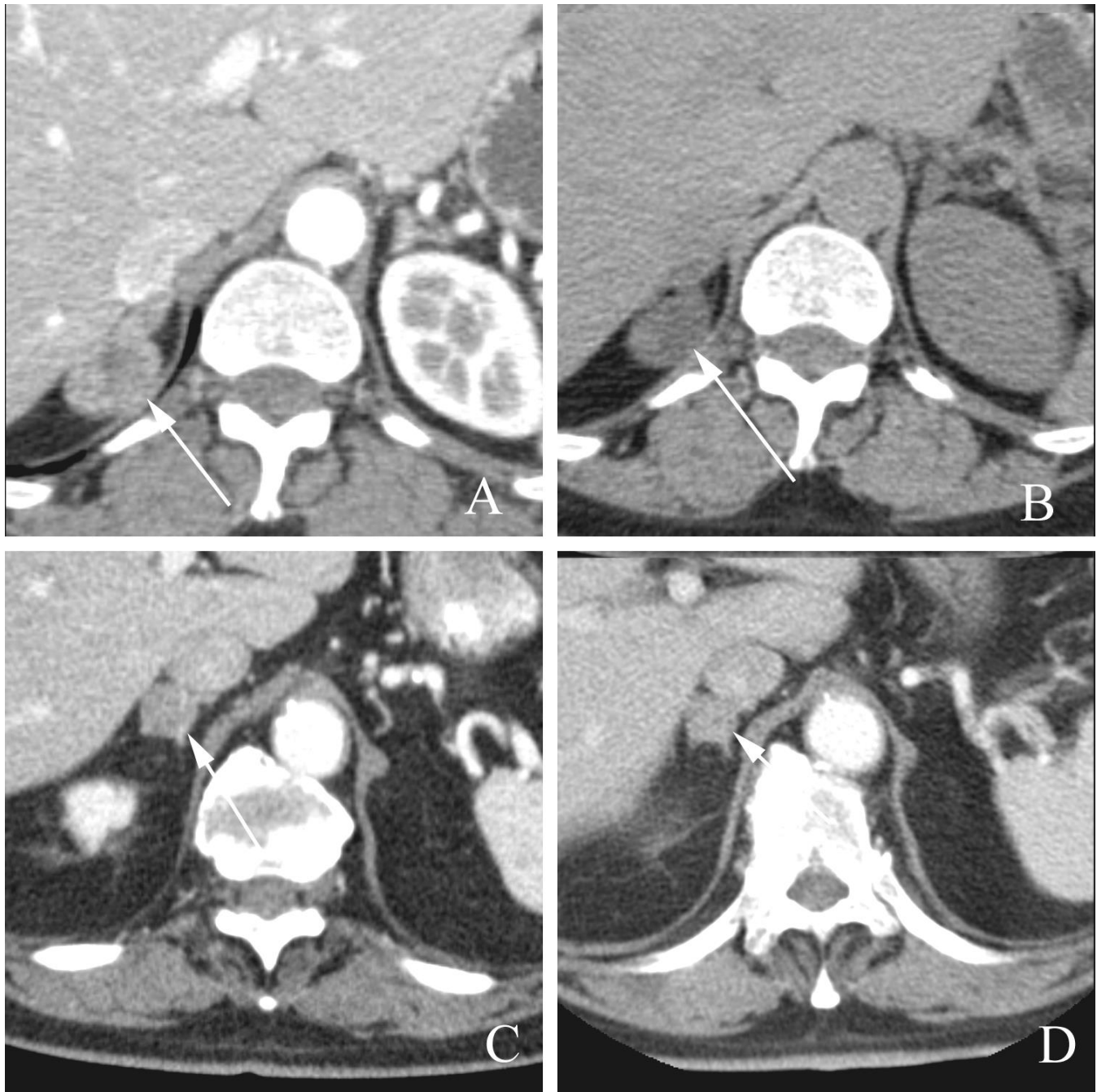


Figure 12. Adrenal incidentalomas where additional images demonstrated features of definitely benign adenoma. A. An axial CT done during the arterial phase of a CT performed for hematuria in a 60 year old woman shows a mass of the right adrenal (arrow). B. A noncontrast study performed at the same level shows the adrenal lesion to be hypodense ($HU < 0$), establishing the diagnosis as a benign adenoma. C. An axial CT done during work-up for esophageal carcinoma in a 78 year old man shows an adrenal lesion (arrow). D. Comparison with a study done eight years earlier shows that the lesion has undergone no interval change, diagnostic of a benign adrenal adenoma.

Size			Category
< 3 cm			Probably benign adenoma
3 – 5 cm	CT w/o contrast – density evaluation	< 0 HU	Benign adenoma
		0 - 10 HU	Probably benign adenoma
		10-43 HU	Indeterminate
		> 43 HU	Suspicious for cancer
	CT contrast dynamics (done with contrast)	% relative washout >40% or enhancement washout >60%	Probably benign adenoma
		% relative washout <40% or enhancement washout <60%	Indeterminate
	MRI	Lipid present	Probably benign adenoma
		Lipid not present	Indeterminate
> 5 cm			Suspicious for cancer
Recommendations			
All nodules		Endocrinologic evaluation	
Benign adenoma		Done	
Probably benign adenoma		f/u CT at 6 and 18 months	
Indeterminate		f/u CT at 6 and 18 months or biopsy	
Suspicious for cancer		Biopsy or surgery	

Table. Evaluation of incidentalomas, courtesy of Dr. Timothy Seline, Radiology Associates of the Fox Valley. The table assumes that an adrenal lesion has been found on imaging. For most incidental lesions of less than 3 cm in patients without cancer, endocrinologic work-up and follow-up CT scanning at 6 and 18 months are usually all that is necessary (if negative). Otherwise, the patient will return earlier for specific additional imaging, with recommendations as noted above.

Liver “incidentalomas”

In addition to the incidentally discovered adrenal lesion, CT may disclose incidental lesions of the liver (or other body parts). In the absence of liver enzyme abnormalities or multiplicity, these lesions are usually benign abnormalities of some sort. The likelihood of primary tumor such as hepatocellular carcinoma or cholangiocarcinoma being found on CT (particularly in a non-cirrhotic patient) is quite small. Of course, multiple liver lesions, particularly with a history of malignancy or clinical features of cancer, need further evaluation, with biopsy often necessary (Figure 6). For isolated, incidentally

discovered liver lesions, the radiologist may recommend further imaging. Similar to the situation with adrenal incidentalomas, imaging consists of additional CT exams done either without or with various phases of intravenous contrast enhancement, or MRI. MRI has the ability to detect smaller lesions and to “fully characterize” (i.e. offer a firm diagnosis) of certain small lesions such as cysts, which is difficult or impossible with CT. Of course, it may ultimately be necessary to sequentially image an abnormality over several months or years or to perform biopsy to establish the benign nature of the lesion. The utility of a diagnosis in such cases must

be weighed against the cost, anxiety, and morbidity of obtaining an answer – which is difficult to do when you don’t know the histology of the lesion. As of this writing, in the U.S., the usual path (perhaps spurred as much by fears of a lawsuit as by the pursuit of good medicine) is to err on the side of over-evaluation rather than under-evaluation. It is a tough call as to how aggressive to be in the work-up of these incidentally found abnormalities, and it may be worth a discussion with the radiologist who finds the incidentaloma and recommends further evaluation to see what particular diagnosis (or what differential diagnosis) he or she has in mind before proceeding with further testing. It may be that upon weighing the options the patient may choose to forego the option of certainty, if the likelihood of potential benefit is small and the costs of certainty are high. Of course, estimation of probabilities in such a case is devilishly difficult and the most that can be said about such lesions is “It is not clear *what* the lesion is for certain, and it *may* be something quite bad”.

CT colonoscopy

Another scenario where asymptomatic patients undergo imaging is the screening study of virtual colonoscopy. This technique involves a complete large bowel prep followed by a CT scan performed with rectally insufflated air. Dedicated software is used to process the resulting data, producing not only the standard axial, coronal, and sagittal reformatted images, but also a “fly through” version simulating the endoscopist’s view. The resulting images and all the technology to produce them are stunning.

As impressive as all this technology is, it is difficult to make any sweeping statements about when to order or use the study. Advocates note a lower perforation rate than with optical colonoscopy, the fact that optical colonoscopy may miss some lesions hidden behind bowel folds, and the lack of a need for sedation (or a driver to take you home). They also note the ability to screen extraintestinal organs for disease, although for this particular “asset”, see the above discussion about CT screening. Advocates of optical colonoscopy point to the facts that optical colonoscopy is the reference standard for

polyp and carcinoma detection, that polyps may be removed and carcinoma biopsied during colonoscopy, and that most patients prefer optical colonoscopy as a procedure. Also of note is that, at least as of 2010, the Centers for Medicare and Medicaid Services (CMS) do not cover most screening virtual colonoscopy, and many insurance companies follow the CMS’s lead in this regard.

Whether to recommend virtual colonoscopy over or as an alternative to optical colonoscopy is therefore a controversial and evolving question, and the best advice is to take into account patient preferences, local expertise, and insurance company stipulations when counseling (and ordering studies on) patients.

SUMMARY

This chapter covers the “second step” in gastrointestinal imaging. Women with low abdomen and pelvic pain may need both CT and US for evaluation, occasionally supplemented by MR. Small bowel imaging may require more than a standard CT study, with additional imaging performed with low density contrast material administered orally or via an intestinal catheter. CT may demonstrate incidental lesions that require additional work-up. Finally, CT colonoscopy is an evolving method of evaluation of the large bowel, often used for screening to find colon polyps prior to malignant transformation.

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