Lecture 1: Basic and Advanced Gallbladder Sonography

Question 1: A sonographic wall-echo-shadow complex in the right upper quadrant is associated with what diagnosis?
A. Cholelithiasis (correct answer)
B. Cholesterolosis
C. Adenomyomatosis
D. Sludge
E. Gas filled bowel

A gallbladder completely filled with stones is harder to recognize than when it is filled with bile. All that is apparent is an echogenic shadowing structure in the right upper quadrant that could potentially be confused with a gas-filled loop of bowel. If an identifiable gallbladder is seen elsewhere, then the problem is solved. If not, the character of the shadow is important. In most cases stones produce a clean shadow and gas produces a dirty shadow. Exceptions to this rule occur occasionally and are probably a result of differences in the surface characteristics of gallstones. Another sign that can assist in differentiating a stone-filled gallbladder and gas-filled bowel is the wall-echo-shadow (WES) complex. This consists of three, arc-shaped lines followed by a shadow (Fig. 2-10). The first line is echogenic and represents pericholecystic fat as well as the interface between the gallbladder wall and the liver. The second line is hypoechoic and represents the gallbladder wall itself. The third is echogenic and arises from the stones. Although a WES complex is a very reliable sign of a stone filled gallbladder, it is not possible to demonstrate it in every case. Therefore it is a useful finding when seen but it is not useful when absent.

Cholelithiasis of the gallbladder may cause polyps but will not produce shadowing. Adenomyosis will produce wall thickening and comet tail artifacts but will not produce shadowing. Sludge will produce echoes within the gallbladder lumen but will not produce shadowing. Gas filled bowel will produce shadowing but will generally not consist of multiple layers as is seen in the wall-echo-shadow complex.

Reference:
Ryubicki FJ. The WES sign. Radiology 2000; 214:881-882

Question 2: What is the appropriate management of a patient who has multiple gallbladder polyps less than 5 mm in size?
A. No further treatment or evaluation (correct answer)
B. Follow-up ultrasound in 6 months
C. MR cholangiography
D. Endoscopic ultrasound
E. Cholecystectomy

Cholesterol polyps are by far the most common type of gallbladder polyp. They are not true neoplasms but rather enlarged papillary fronds filled with lipid laden macrophages and they are attached to the wall via a slender stalk. The stalk is rarely seen so they typically appear as a mass that is adjacent to the wall but barely attached to the wall. This is referred to as the “ball on the wall” sign. There are usually multiple polyps, although it is not uncommon to detect only the largest one sonographically. Cholesterol polyps are usually 5 mm or less in size and only rarely get bigger than 10 mm. They can be distinguished from gallbladder stones by their lack of a shadow and nonmobile nature, and from sludge balls by their lack of mobility. Their small size and multiplicity help to distinguish them from true neoplasms of the gallbladder wall. Other types of gallbladder polyps occur but are less common than cholesterol polyps. These include adenomas, papillomas, leiomyomas, lipomas, and neumomas. These lesions are true neoplasms and are almost always solitary and are usually larger than cholesterol polyps. Larger polyps may have detectable blood flow on color Doppler. Metastatic disease to the gallbladder is very uncommon but can produce multiple polypoid lesions. Melanoma has the greatest tendency to spread to the gallbladder and detection of gallbladder polyps should be viewed with a high level of suspicion in patients with a history of melanoma. Generally there will be other evidence of metastatic disease in the liver, lymph nodes, or elsewhere in the abdomen.

It has been well established that polypoid lesions of the gallbladder wall that are 5 mm or less require no further evaluation or therapy. Lesions that are between 5 and 10 mm should be monitored to ensure their stability, realizing that the yield of follow-up studies will be very low. If small polyps are multiple, they are almost certainly cholesterol polyps and can be ignored. Lesions that are larger than 10 mm should probably be removed because of the possibility of cancer and the low risk of cholecystectomy. It should be recognized that most polyps that are just slightly larger than 10 mm will still be benign, but as polyps enlarge, the risk of malignancy increases progressively.

References:
Question 3: What is the most common finding in gallbladder cancer?
A. Diffuse wall thickening
B. Focal wall thickening
C. Polypoid intraluminal mass
D. Polypoid extraluminal mass
E. Mass obliterating gallbladder lumen (correct answer)

The most common sonographic appearance for gallbladder cancer is a soft tissue mass centered in the gallbladder fossa that completely or partially obliterates the lumen. Identification of gallstones within the mass can help to confirm that the origin of the mass is the gallbladder rather than adjacent organs. Approximately 15% to 30% of gallbladder cancers appear as focal or diffuse gallbladder wall thickening. In the vast majority of these cases the thickening is irregular, asymmetric, and eccentric. The least common form of gallbladder cancer is a polypoid intraluminal mass. This form is almost always larger than a centimeter (usually much larger). Size is therefore a good way to distinguish cancer from gallbladder polyps.

References:

Lecture 2: Ultrasound Artifacts

Question 4: Of the structures listed below, which is most likely to produce a mirror image artifact on grey-scale imaging?
A. Trachea (correct answer)
B. Rectus muscle
C. Bone
D. Stent grafts
E. Common carotid

Acoustic mirrors can be compared to optical mirrors. With optical mirrors, a smooth, flat surface that reflects a large amount of light causes a visual duplication of structures. Surfaces that reflect more light (like a silvered piece of glass) act as better mirrors than surfaces that reflect less light (like a sheet of metal). Flat surfaces produce a mirror image that is identical in size and shape to the original object, but curved surfaces (like mirrors at the carnival) produce a distorted mirror image. Since gas reflects almost 100% of the sound that hits it, gas is the best acoustic mirror in the body. This is particularly true where there are large, smooth gas interfaces—such as in the lung. Therefore, mirror images are very common on sonograms that include the interface between lung and adjacent soft tissues.

The base of the right lung serves as a mirror on right upper quadrant scans and produces a number of well-recognized mirror images. Although not always appreciated, the liver itself is duplicated above the diaphragm, and this accounts for the supradiaphragmatic echogenicity seen on right upper quadrant scans. The diaphragm is also commonly duplicated, and this becomes apparent in areas where the diaphragm is thick enough to be resolved sonographically. Focal hepatic lesions that contrast markedly with the normal liver parenchyma (such as the echogenic mass in the first image) are also frequently duplicated above the diaphragm. The trachea is another structure with a large, smooth gas interface that can act as a mirror. On scans of the neck the thyroid gland, neck muscles, and cartilage rings of the trachea can all be duplicated, as on the second image.

References

Question 5: Of the structures listed below, which is most likely to produce a refractive duplication artifact on grey-scale imaging?
A. Larynx
B. Rectus muscle (correct answer)
C. Bone
D. Stent grafts
E. Common carotid

Sound waves bend when passing obliquely through an interface between two substances that transmit sound at different speeds. This is called refraction and is analogous to redirection of light by an optical lens. Since the speed of sound is least in fat (approximately 1450m/sec) and greatest in soft tissues (approximately 1540m/sec), refraction artifacts are most prominent at fat-soft tissue interfaces. The most widely recognized refraction artifact occurs at the junction of the rectus abdominis muscle and adjacent abdominal wall fat. Since the ultrasound computer assumes that sound travels in a straight line, structures that produce echoes after the sound pulse has been refracted will be incorrectly localized on the image. In fact, structures are typically duplicated because they reflect not only the sound pulse that has been refracted but also a sound pulse that has not been refracted. The end result is a duplication of deep abdominal and pelvic structures seen when scanning transversely through the abdominal midline.

Soft tissue and fluid interfaces can also produce refraction artifacts because the speed of sound in body fluids (1480 m/sec) is slower than in soft tissues. This can produce duplication of structures deep to the refracting interface just as with soft tissue–fat interfaces.

References: