Hepatobiliary ultrasonography

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Abstract. Ultrasound is one of the most widely used imaging technologies in medicine. It is portable, free of radiation risk, non-invasive and relatively inexpensive when compared with other imaging modalities, such as magnetic resonance and computed tomography. Ultrasound is a useful procedure for evaluating many structures organ in our body. An examination may include the entirety of the abdomen and retroperitoneum from a single organ to several organs. An abdominal ultrasound examination survey would include the liver, gallbladder, biliary tree, pancreas, spleen, kidneys and retroperitoneal structures. It needsperforming when there is a valid medical reason.

1. Introduction

Ultrasound has been used to image the human body for over half a century. Dr. Karl Theo Dussik, an Austrian neurologist, was the first to apply ultrasound as a medical diagnostic tool to image the brain.[1] Ultrasound is non-audible sound energy used for applications in a frequency range of 2 to 20 MHz, frequencies that have been found to provide the best combination of penetration and resolution in the body.[2] Ultrasound is the term used to describe thesound of frequencies above 20000 Hertz (Hz), beyond the range of human hearing. Frequencies of 1–30 megahertz (MHz) are typical for diagnostic ultrasound. Diagnostic ultrasound imaging depends on the computerized analysis of reflected ultrasound waves, which non-invasively build upimages of internal body structures. Different ranges of frequency are for examination of parts of the body, for example 3–5 MHz for abdominal areas, 5–10 MHz for small and superficial, 10–30 MHz for the skin or the eyes.[3]

Sonography is an evident and helpful procedure for assessing the many structures of anatomic areas. Depending on the clinical indications, an examination may include the entirety of the abdomen and/or retroperitoneum, a single organ, or several organs. A combination of structures may be imaged because of location(eg, upper abdominal scan or right upper quadrant organs) or function (eg, biliary system, liver, gallbladder, and bile ducts] or both kidneys). Patients need focused examinations that are fit for assessing specific clinical indications or following-up an abnormality. In some cases, additional and/or specific examinations are necessary (eg, spectral, color, and/or power Doppler). Although it is not possible to detect every abnormality using an ultrasound examination of the abdomen and/or retroperitoneum, adherence to the following practice parameter will maximize the probability of detecting abnormalities.[4]

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2. Scanning Technique of Upper Abdominal

Ultrasound is the dominant first-line investigation for an enormous variety of abdominal symptoms because of its non-invasive and comparatively accessible nature. Its success, however, regarding a diagnosis, depends upon numerous factors, the most important of which is the skill of the operator.[5]

Scanning technique is not somethinglearned from a book. There are, however, some general approaches which help to get the best from the scanning procedure. Scan systematically to ensure the whole of the upper abdomen has been thoroughly interrogated. Always scan any organ in at least two planes, preferably at right angles to each other. This technique reduces the risk of missing pathology and helps to differentiate artifact from true pathology. Scan in at least two patient positions (oblique, decubitus or erect position). Use a combination of sub- and intercostal scanning for all upper-abdominal scanning. The different angles of insonation can reveal pathology and eliminate artifact.Don't limit yourself to longitudinal and transverse sections. Use a variety of planes and angulations. Trace ducts and vessels along their courses. Deep inspiration is useful in a proportion of patients, but not all. Sometimes it can make matters worse by filling the stomach with air and obscuring large areas. An intercostal approach with the patient breathing gently often has far more success.Positioning patients supine, particularly if elderly or very ill, can make them breathless and uncomfortable. Raise the patient's head as much as necessary; a comfortable patient is much easier to scan.[5,6]

3. Indication of Abdominal Ultrasonography

There are several indications for an ultrasound examination of the abdomen and/or retroperitoneum in our patients. The specific indicationis abdominal, flank and back pain. Other indications include signs or symptomsreferred from the abdominal and/or retroperitoneal regions, such as jaundice or hematuria, palpable abnormalities such as an abdominal mass or organomegaly, abnormal laboratory values or abnormal findings on other imaging examinations suggestive of abdominal and/or retroperitoneal pathology. We can apply ultrasonography to find for metastatic disease or a primary neoplasm, for assessment of portal hypertension, cirrhosis, and transjugular intrahepatic portosystemic shunt (TIPS) stents, screening for hepatoma and evaluation of the liver in conjunction with liver elastography, hydronephrosis, abdominal trauma and to evaluate of urinary tract infection, suspected renal artery stenosis. Search for the presence of free or loculated peritoneal and/or retroperitoneal fluid, evaluation of suspected hypertrophic pyloric stenosis, intussusception, necrotizing enterocolitis, or any other bowel abnormalities, pretransplantation and post-transplantation evaluation, planning for and guiding an invasive procedure.[7]

4. Liver

The liver is located inside the intraperitoneal cavity and under the right hemidiaphragm. The liver examination needs long-axis and transverse views.The liver measurementneeds performing on longitudinal images. The liver parenchyma is a homogeneous, mid-grey organ on ultrasound andneedsan evaluation for focal and/or diffuse abnormalities.[5] If possible, the echogenicity of the liver needscomparing with that of the right kidney.[3,8] In addition, the following necessary image is including the inferior vena cava (IVC), the major hepatic and perihepatic vessels, the main portal vein, the right and left branches of the portal vein, the hepatic veins, the right hemidiaphragm and the adjacent pleural space, the hepatic lobes (right, left and caudate). The liver surface may be imaged with a high-frequency transducer to evaluate possible surface nodularity in patients at risk for cirrhosis. For vascular examinations, Doppler evaluation should be used to document blood flow characteristics and the blood flow direction. The structures examined include the main and intrahepatic arteries, the hepatic veins, the main and intrahepatic portal veins, the intrahepatic portion of the IVC, and collateral venous pathways.[9]

5. Gallbladder and Biliary Tract

A routine gallbladder examination needs leading to an adequately distended gallbladder whenever possible. In most cases, fasting before an elective examination will permit adequate distension of a normally functioning gallbladder. The gallbladder evaluation should include long-axis and transverse views obtained in the supine position. Decubitus imaging needs performing when feasible. Other positions such as erector prone imaging may be helpful to evaluate the gallbladder and its surrounding areas completely.[3,10] The normal gallbladder has a hyperechoic, thin wall and contains anechoic bile. Measure the wall thickness in a longitudinal section of the gallbladder, with the calipers perpendicular to the wall itself.[5] If the patient comes with pain, tenderness when transducer compression over the gallbladder should be assessed.[3,10] The intrahepatic ducts may be evaluated by obtaining views of the liver showing the right and left branches of the portal vein. Doppler imaging is used to differentiate portal veins and hepatic arteries from bile ducts. The extrahepatic and intrahepatic bile ducts need evaluation for wall thickening, dilatation, intraluminal findings, and other abnormalities. The bile duct in the porta hepatis needs measuring and documenting. When visualized, the distal common bile duct in the pancreatic head need evaluating.[3]

Because the size, shape,and position of the gallbladder are infinitely variable, so are the techniques required to scan it. Using the highest frequency possible (5.0 MHZ or higher) especially for anterior gallbladders and a high line density to pick up tiny stone or polyps. Always scan the gallbladder in at least two planes (find the gallbladder'slong axis, incorporating the neck and fundus; sweep from side to side, then transversely from neck to fundus) and two patient positions. The gallbladder may be 'folded' (the so-called Phrygian cap). To interrogate its contents fully,unfold it by turning the patient decubitus (rightside raised), almost prone or erect.[5]

6. Pancreas

The pancreas lies in posterior to the stomach and duodenum, so we need a variety of techniques to examine. The most useful technique is to start scanning the epigastrium in thetransverse plane, using the left lobe of the liver as an acoustic window. Using the splenic vein as an anatomical marker, the body of the pancreas can be identified anterior to this. The tail of thepancreas is slightly cephalic to the head, so the transducer should be obliqued accordingly to display the whole organ. The texture of the pancreas is rather coarser thanthat of the liver. The echogenicity of the normalpancreas alters according to age. In adulthood,the pancreas is hyperechoic compared tonormal liver, becoming increasingly so in the elderly and tending to atrophy.[5]

Whenever possible, all portions of the head pancreas, uncinate processes, body, and tail pancreas need identifying. Orally administered water or a contrast agent and changes in patient positioning such as upright and decubitus positions may afford better visualization of the pancreas. The following needs assessing in the examination of the pancreas, for example, the distal common bile duct in the region of the pancreatic head, parenchymal abnormalities (masses and calcifications), dilatation confirmed by measurement and the peripancreatic region for adenopathy and/or fluid, and the pancreatic duct for dilatation and any other abnormalities.3,11]

7. Spleen

The spleen lies posterior to the splenic flexure and stomach and should be approached from the left lateral aspect (coronal and transverse sections) with patient supine by using an intercostal approach.Lying the patient decubitus, left side raised, may also be successful but sometimes has the effect of causing the gas-filled bowel loops to rise to the left flank, once again obscuring the spleen. The normal spleen has a fine, homogeneous texture, with smooth margins and a pointed inferior edge, it has similar echogenicity to the liver.[5] Representative views of the spleen in long-axis and transverse planes need obtaining. Splenic length measurement may be helpful in assessing enlargement. Echogenicity of the left kidney should be compared to splenic echogenicity when possible. An attempt should be made to show the left hemidiaphragm and the adjacent pleural space.[12]

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