



## **AIUM Practice Parameter for the Performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum**

Parameter developed in conjunction with the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU).

The American Institute of Ultrasound in Medicine (AIUM) is a multidisciplinary association dedicated to advancing the safe and effective use of ultrasound in medicine through professional and public education, research, development of parameters, and accreditation. To promote this mission, the AIUM is pleased to publish, in conjunction with the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU), this AIUM Practice Parameter for the Performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum. We are indebted to the many volunteers who contributed their time, knowledge, and energy to bringing this document to completion.

The AIUM represents the entire range of clinical and basic science interests in medical diagnostic ultrasound, and, with hundreds of volunteers, the AIUM has promoted the safe and effective use of ultrasound in clinical medicine for more than 65 years. This document and others like it will continue to advance this mission.

Practice parameters of the AIUM are intended to provide the medical ultrasound community with parameters for the performance and recording of high-quality ultrasound examinations. The parameters reflect what the AIUM considers the minimum criteria for a complete examination in each area but are not intended to establish a legal standard of care. AIUM-accredited practices are expected to generally follow the parameters with recognition that deviations from these parameters will be needed in some cases, depending on patient needs and available equipment. Practices are encouraged to go beyond the parameters to provide additional service and information as needed.

## **I. Introduction**

The clinical aspects contained in specific sections of this practice parameter (Introduction, Indications, Specifications of the Examination, and Equipment Specifications) were developed collaboratively by the American College of Radiology (ACR), the American Institute of Ultrasound in Medicine (AIUM), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU). Recommendations for physician requirements, written request for the examination, procedure documentation, and quality control vary among the organizations and are addressed by each separately.

This practice parameter has been revised to assist practitioners performing ultrasound studies of the abdomen and/or retroperitoneum. Sonography is a proven and useful procedure for evaluating the many structures within these 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). For some patients, more focused examinations may be appropriate for evaluating specific clinical indications or to follow up a known abnormality. In some cases, additional and/or specialized examinations may be 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.

Throughout this practice parameter, references to Doppler evaluation may include spectral, color, or power Doppler ultrasound individually or in any combination. Whenever a long-axis view is indicated, it could be either a sagittal or coronal plane.

## II. Qualifications and Responsibilities of Personnel

See [www.aium.org](http://www.aium.org) for AIUM Official Statements, including *Standards and Guidelines for the Accreditation of Ultrasound Practices* and relevant Physician Training Guidelines.<sup>1</sup>

## III. Indications/Contraindications

Indications for an ultrasound examination of the abdomen and/or retroperitoneum include but are not limited to<sup>2</sup>:

- A. Abdominal, flank, and/or back pain.
- B. Signs or symptoms that may be referred from the abdominal and/or retroperitoneal regions, such as jaundice or hematuria.
- C. Palpable abnormalities such as an abdominal mass or organomegaly.
- D. Abnormal laboratory values or abnormal findings on other imaging examinations suggestive of abdominal and/or retroperitoneal pathology.
- E. Follow-up of known or suspected abnormalities in the abdomen and/or retroperitoneum.
- F. Search for metastatic disease or an occult primary neoplasm.
- G. Evaluation of cirrhosis, portal hypertension, and transjugular intrahepatic portosystemic shunt (TIPS) stents; screening for hepatoma; and evaluation of the liver in conjunction with liver elastography.
- H. Abdominal trauma.
- I. Evaluation of urinary tract infection and hydronephrosis.
- J. Evaluation of uncontrolled hypertension and suspected renal artery stenosis.
- K. Search for the presence of free or loculated peritoneal and/or retroperitoneal fluid.
- L. Evaluation of suspected congenital abnormalities.

- M. Evaluation of suspected hypertrophic pyloric stenosis, intussusception, necrotizing enterocolitis, or any other bowel abnormalities.
- N. Pretransplantation and posttransplantation evaluation.
- O. Planning for and guiding an invasive procedure.

An abdominal and/or retroperitoneal ultrasound examination should be performed when there is a valid medical reason. There are no absolute contraindications.

#### **IV. Written Request for the Examination**

The written or electronic request for an ultrasound examination should provide sufficient information to allow for the appropriate performance and interpretation of the examination. The request for the examination must be originated by a physician or another appropriately licensed health care provider or under the physician's or provider's direction. The accompanying clinical information should be provided by a physician or other appropriate health care provider familiar with the patient's clinical situation and should be consistent with relevant legal and local health care facility requirements.

#### **V. Specifications for Individual Examinations**

Spectral, color, and power Doppler imaging may be useful to differentiate vascular from nonvascular structures in any location. Measurements should be considered for any abnormal area.<sup>3</sup> Additionally, cine clips may be helpful tools in any of these examinations, particularly when screening for malignancy. Ultrasound contrast may have applications in abdominal and retroperitoneal ultrasound.

##### **1. Liver**

The examination of the liver should include long-axis and transverse views. Liver measurement may be performed on longitudinal images. The liver parenchyma should be evaluated for focal

and/or diffuse abnormalities. If possible, the echogenicity of the liver should be compared with that of the right kidney. In addition, the following should be imaged<sup>4-9</sup>:

- a. The major hepatic and perihepatic vessels, including the inferior vena cava (IVC), the hepatic veins, the main portal vein, and, if possible, the right and left branches of the portal vein.
- b. The hepatic lobes (right, left, and caudate) and, if possible, the right hemidiaphragm and the adjacent pleural space.
- c. The liver surface may be imaged with a high-frequency transducer to evaluate possible surface nodularity in patients at risk for cirrhosis.
- d. For vascular examinations, Doppler evaluation should be used to document blood flow characteristics and the blood flow direction. The structures that may be examined include the main and intrahepatic arteries, the hepatic veins, the main and intrahepatic portal veins, the intrahepatic portion of the IVC, collateral venous pathways, and TIPS stents. Transplant liver evaluation is covered in detail in the *AIUM-ACR-SPR-SRU Practice Parameter for the Performance of an Ultrasound Examination of Solid Organ Transplants*.<sup>10</sup>

In addition, in patients predisposed to or suspected of having hepatic fibrosis, hepatic elastography may be performed.<sup>11</sup>

## **2. Gallbladder and Biliary Tract**

A routine gallbladder examination should be conducted on an adequately distended gallbladder whenever possible. In most cases, fasting before an elective examination will permit adequate distension of a normally functioning gallbladder. For infants and children, the fasting period should be age appropriate. The gallbladder evaluation should include long-axis and transverse views obtained in the supine position. Decubitus imaging should be performed when feasible. Other positions such as erect or prone imaging may be helpful to evaluate the gallbladder and its surrounding areas completely. Measurements may aid in determining gallbladder wall thickening. If the patient presents with pain, tenderness to transducer compression over the gallbladder should be assessed.

The intrahepatic ducts may be evaluated by obtaining views of the liver showing the right and left branches of the portal vein. Doppler imaging may be used to differentiate hepatic arteries and portal veins from bile ducts. The intrahepatic and extrahepatic bile ducts should be evaluated for dilatation, wall thickening, intraluminal findings, and other abnormalities. The bile duct in the porta hepatis should be measured and documented. When visualized, the distal common bile duct in the pancreatic head should be evaluated.<sup>12–15</sup>

### **3. Pancreas**

Whenever possible, all portions of the pancreas—head, uncinate process, body, and tail—should be identified. 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 should be assessed in the examination of the pancreas<sup>15–18</sup>:

- a. Parenchymal abnormalities, such as masses and calcifications.
- b. The distal common bile duct in the region of the pancreatic head.
- c. The pancreatic duct for dilatation and any other abnormalities, with dilatation confirmed by measurement.
- d. The peripancreatic region for adenopathy and/or fluid.

### **4. Spleen**

Representative views of the spleen in long-axis and transverse planes should be obtained. 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.<sup>3,19–21</sup>

### **5. Bowel**

When there is concern for bowel pathology, the bowel may be evaluated for wall thickening, dilatation, muscular hypertrophy, masses, vascularity, and other abnormalities. Sonography of the pylorus and surrounding structures may be indicated in the evaluation of the vomiting infant. Graded compression sonography aids in the visualization of the appendix and other bowel

loops. Measurements may aid in determining bowel wall thickening, and color or power Doppler imaging may be helpful in assessing hypervascularity.<sup>22-30</sup>

## **6. Peritoneal Fluid**

Evaluation for free or loculated peritoneal fluid should include documentation of the extent and location of any fluid identified. Assessment for ascites should include limited images of the pelvis for an examination otherwise focused on the abdomen.

In the setting of trauma, particularly blunt trauma, the examination known as a focused abdominal sonography for trauma (FAST) assessment (or focused assessment with sonography for trauma) may be performed to evaluate the peritoneal spaces for bleeding.<sup>31</sup> The objective of the abdominal portion of the FAST examination is to screen the abdomen for free fluid.

Longitudinal and transverse plane images should be obtained in the right upper quadrant through the area of the liver, with attention to fluid collections peripheral to the liver and in the subhepatic space. Longitudinal and transverse plane images should be obtained in the left upper quadrant through the area of the spleen, with attention to fluid collections peripheral to the spleen. Longitudinal and transverse images should be obtained at the periphery of the left and right abdomen in the areas of the left and right paracolic gutters for evidence of free fluid. Longitudinal and transverse midline images of the pelvis are obtained to evaluate for free pelvic fluid. Analysis through a fluid-filled bladder (which may be filled through a catheter, when necessary) may help in the evaluation of the pelvis.

## **7. Abdominal Wall**

When there are signs or symptoms referable to the abdominal wall, an ultrasound examination may be performed to evaluate for hernia, masses, or other abnormalities. The examination should include images of the abdominal wall in the location of symptoms or signs. The relationship of any identified mass with the peritoneum should be demonstrated. Any defect in the peritoneum and abdominal wall musculature should be documented. The presence or absence of bowel, fluid, or other tissue contained within any abdominal wall defect should be noted. For detection of hernias, Valsalva maneuvers and upright positioning may be helpful. A Doppler examination may be useful to define the relationship of blood vessels to a detected mass.

## 8. Kidneys

A complete examination of the kidneys need not be performed with every abdominal examination that may be targeted to other specific abdominal sites. When a complete examination of the native kidneys is done, this examination should include long-axis and transverse views of the kidneys. A maximum measurement of renal length should be recorded for both kidneys. Decubitus, prone, or upright positioning may provide better images of the native kidneys. When possible, renal echogenicity should be compared to the adjacent liver or spleen. Renal cortical thickness should be assessed.<sup>32</sup> The kidneys, specifically the renal cortices, sinuses, and pelves, as well as the perirenal regions, should be assessed for abnormalities, including collecting system dilatation, calculi, masses, and other abnormalities.<sup>7,33–40</sup> Color Doppler imaging may be helpful in detecting calculi via the twinkling artifact.<sup>41,42</sup>

For a vascular examination of native kidneys, Doppler imaging may be used:

- a. To assess renal arterial and venous patency.
- b. To evaluate suspected renal artery stenosis. For this application, angle-adjusted measurements of the peak systolic velocity should be made proximally, centrally, and distally in the extrarenal portion of the main renal arteries when possible. The peak systolic velocity of the adjacent aorta should also be documented for calculating the ratio of the renal to aortic peak systolic velocity. Spectral Doppler evaluation of the intrarenal arteries may be of value as indirect evidence of proximal stenosis in the main renal artery.
- c. For vascular examinations of transplanted kidney(s), refer to the *AIUM–ACR–SPR–SRU Practice Parameter for the Performance of an Ultrasound Examination of Solid Organ Transplants*.<sup>10</sup>

## 9. Urinary Bladder and Adjacent Structures

When performing a complete ultrasound evaluation of the urinary tract, transverse and longitudinal images of the distended urinary bladder and its wall should be included, if possible. Bladder lumen or wall abnormalities should be noted. Dilatation or other distal ureteral abnormalities should be documented. The acquisition of ureteral jets with color Doppler imaging may be helpful when evaluating hydronephrosis to evaluate for the presence of



obstruction. Transvaginal ultrasound may also be a helpful tool in evaluating distal ureteral calculi in women.<sup>43</sup> Transverse and longitudinal scans may be used to show any postvoid residual, which may be quantitated and reported. In male patients, an attempt to measure the prostate gland may be made. Incidental gynecologic abnormalities in a female patient should be noted.

## **10. Adrenal Glands**

When possible, long-axis and transverse images of the adrenal glands in the newborn or young infant may be obtained. Normal adrenal glands are less commonly seen by ultrasound in older children and adults.<sup>37</sup> Any masses detected should be documented.

## **11. Aorta**

Representative images of the aorta may be obtained. When evaluation of the aorta is specifically requested, see the *AIUM–ACR–SRU Practice Parameter for the Performance of a Diagnostic and Screening Ultrasound Examination of the Abdominal Aorta in Adults*.<sup>44,45</sup>

## **12. Inferior Vena Cava**

Representative images of the IVC may be obtained. When specific evaluation of the IVC is requested, patency and abnormalities may be evaluated with Doppler imaging. Vena cava filters, interruption devices, and catheters may need to be localized with respect to the hepatic and/or renal veins.<sup>46</sup>

## **VI. Documentation**

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should be accompanied by measurements. Images should be labeled with the patient identification, facility identification, examination date, and side (right or left) of the anatomic site imaged. An official interpretation (final report) of the ultrasound findings should be included in the patient's medical record.

Retention of the ultrasound examination should be consistent both with clinical needs and with relevant legal and local health care facility requirements.

Reporting should be in accordance with the *AIUM Practice Parameter for Documentation of an Ultrasound Examination*.<sup>47</sup>

## **VII. Equipment Specifications**

Abdominal and/or retroperitoneal sonographic studies should be conducted with real-time scanners, preferably using curved sector or linear transducers. The equipment should be adjusted to operate at the highest clinically appropriate frequency, realizing that there is a trade-off between resolution and beam penetration. For most preadolescent pediatric patients, mean frequencies of 5 MHz or greater are preferred, and in neonates and small infants, a higher-frequency transducer is often necessary. For adults, mean frequencies between 4 and 6 MHz are most commonly used. Higher frequencies are often used and needed when evaluating the abdominal wall, liver surface, and bowel. Color and power Doppler imaging should be used to characterize vascular structures and masses. When Doppler studies are performed, the Doppler frequency may differ from the imaging frequency. Image quality should be optimized while keeping the total ultrasound exposure as low as reasonably achievable.

## **VIII. Quality Control and Improvement, Safety, Infection Control, and Patient Education**

Policies and procedures related to quality control, patient education, infection control, and safety should be developed and implemented in accordance with the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices*.

Equipment performance monitoring should be in accordance with the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices*.

## **IX. ALARA Principle**

The potential benefits and risks of each examination should be considered. The ALARA (as low as reasonably achievable) principle should be observed when adjusting controls that affect the acoustic output and by considering transducer dwell times. Further details on ALARA may be found in the AIUM publication *Medical Ultrasound Safety*, Third Edition.

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Collaborative Committee: Members represent their societies in the initial and final revision of this parameter.

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