AIUM Practice Parameter for the Performance of

Peripheral Venous Ultrasound Examinations

Parameter developed in collaboration with the American College of Radiology, the Society of Pediatric Radiology, and the Society of Radiologists in Ultrasound.
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 of Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU) this AIUM Practice Parameter for the Performance of Peripheral Venous Ultrasound Examinations. 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, this multidisciplinary organization has promoted the safe and effective use of ultrasound in clinical medicine for more than 50 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 parameter (Introduction, Indications, Specifications of the Examination, and Equipment Specifications) were developed collaboratively by the American Institute of Ultrasound in Medicine (AIUM), the American College of Radiology (ACR), the Society of 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 three organizations and are addressed by each separately.

These parameters are intended to assist practitioners performing noninvasive ultrasound evaluation of peripheral venous structures. Occasionally, an additional and/or specialized examination may be necessary. While it is not possible to detect every abnormality, adherence to the following parameters will maximize the probability of detecting most of the abnormalities that occur in the veins of the extremities.

II. Qualifications and Responsibilities of the Physician


III. Indications

The indications for peripheral venous ultrasound examinations include but are not limited to:

1. Evaluation of possible venous thromboembolic disease or venous obstruction in symptomatic or high-risk asymptomatic individuals.
2. Serial evaluation may be necessary in some high-risk individuals (e.g., based on history, pretest probability, and/or D-dimer test) whose initial examination is negative for deep venous thrombosis.
3. Assessment of venous insufficiency, reflux, and varicosities.
4. Postprocedural assessment of venous ablation or other interventions.
5. Assessment of dialysis access.
7. Evaluation of veins before venous access.
8. Follow-up for patients with known venous thrombosis at or near the anticipated end of anticoagulation to determine if residual venous thrombosis is present.
9. Follow-up of patients with known calf (distal) deep venous thrombosis who are not being treated but are being monitored for progression. 

10. Follow-up of patients with known venous thrombosis on therapy and who undergo a clinical change and where a change in the response will alter treatment.

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 other appropriately licensed health care provider or under their direction. The accompanying clinical information should be provided by a physician or 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 of the Examination

The requesting health care provider should be encouraged to provide the pretest probability of acute deep venous thrombosis and/or the results of a D-dimer assay if known.

Note: The words proximal and distal refer to the relative distance from the attached end of the limb, per Gray’s Anatomy. For example, the proximal femoral vein is closer to the hip, and the distal femoral vein is closer to the knee. The longitudinal or long axis is parallel to or along the length of the vein. The transverse or short axis is perpendicular to the long axis of the vein. Compression can be documented using cine clips or without and with compression images.

A. Venous Thromboembolic Disease: Lower Extremity

1. Technique
   a. Compression ultrasound: The fullest visualized extent of the common femoral, femoral (formerly known as the superficial femoral), and popliteal veins must be imaged using an optimal gray scale compression technique. The popliteal vein is examined distally to the tibioperoneal trunk. The proximal deep femoral and proximal great saphenous veins should also be examined. Venous compression is applied every 2 cm or less in the transverse (short axis) plane with adequate pressure on the skin to completely obliterate the normal vein lumen.
   b. Focal symptoms will generally require evaluation of those areas.
c. At a minimum (even if the examination is otherwise unilateral), right and left common femoral or right and left external iliac venous spectral Doppler waveforms should be recorded to evaluate for asymmetry or loss of respiratory phasicity. Both sides should be assessed with similar patient posture so symmetry can be assessed. A popliteal venous spectral Doppler waveform of the symptomatic leg should also be obtained. All spectral Doppler waveforms should be obtained from the long axis.

d. Color or spectral Doppler evaluation can be used to support the presence or absence of an abnormality.

2. Recording
   a. For normal examinations, at a minimum:
      i. Gray scale images (or cine loops) should be recorded without and with compression at each of the following levels, at a minimum:
         a. Common femoral vein;
         b. Junction of the common femoral vein with the great saphenous vein;
         c. Proximal deep femoral vein separately or along with the proximal femoral vein;
         d. Proximal femoral vein;
         e. Distal femoral vein;
         f. Popliteal vein.
      ii. Color and Spectral Doppler waveforms from the long axis should be recorded at each of the following levels, at a minimum:
         a. Right common femoral or external iliac vein;
         b. Left common femoral or external iliac vein;
         c. Popliteal vein on symptomatic side or on both sides if the examination is bilateral.
   b. Abnormal symptoms or findings generally require additional images to document the complete extent of the abnormalities:
      i. Symptomatic areas such as the calf generally require additional evaluation and additional images if the cause of the symptoms is not readily elucidated by the standard examination.
      ii. The extent and location of sites where the veins fail to compress completely should be clearly recorded and generally require additional images. Long-axis views without compression may be helpful to characterize the abnormal vein.
   c. The patient presentation, clinical indication, or clinical management pathways may require protocol adjustments such as more detailed evaluation of the superficial venous system, evaluation of the deep calf veins, or a bilateral study.
   d. Other vascular and nonvascular abnormalities, if found, should be recorded but may require additional imaging for diagnosis or further characterization. Anatomic variations such as duplications should be noted.
B. Venous Insufficiency: Lower Extremity

1. Technique
   a. When evaluating for venous insufficiency, the location and duration of reversed blood flow should be determined during the performance of accepted maneuvers.\textsuperscript{17,18}
   b. Duplex interrogation should be performed at as many levels as necessary to ensure a complete examination based on the clinical indications.\textsuperscript{18–21} Veins in the superficial and deep systems should be evaluated.
   c. Augmentation with squeezing of the calf musculature should generally be used. The Valsalva maneuver may be used at the groin. A cuff inflator may also be used.
   d. The patient should be situated in the erect position for the detection or exclusion of reflux. The reverse Trendelenburg position can be used if erect scanning is not possible. The examined leg should be in a non–weight-bearing position. The patient should not be studied for reflux in the supine position.
   e. All spectral Doppler waveforms should be obtained from the long axis.

2. Recording
   a. Recordings should document the presence, absence, and location of reflux. Varicosities and abnormal perforating veins should generally also be documented. At a minimum, abnormal reflux times should be measured and reported.
   b. Recording the size of vessels may be helpful for clinical management.
   c. Anatomic variations such as hypoplastic or aplastic segments, significant accessory veins, or duplications should be noted.
   d. The patient presentation, clinical indication, or clinical management pathways may require protocol adjustments such as more detailed evaluation of the deep venous system or a bilateral study.
   e. Other vascular and nonvascular abnormalities, if found, should be recorded but may require additional imaging for diagnosis or further characterization.

C. Venous Thromboembolic Disease: Upper Extremity\textsuperscript{22–24}

1. Technique
   a. Upper extremity duplex evaluation consists of gray scale and color and spectral Doppler assessment of all the accessible portions of the internal jugular, subclavian, axillary, and innominate veins, as well as compression gray scale ultrasound of the brachial, basilic, and cephalic veins in the upper arm to the elbow. All accessible veins should be scanned using optimal gray scale and Doppler techniques as well as appropriate positioning. Venous compression is applied to accessible veins in the transverse plane with adequate pressure on the skin to completely obliterate the normal vein lumen. Supine position, if possible, is preferred. Symmetrical posture to prevent false asymmetry, if possible, is preferred.
   b. Symptomatic areas, such as the forearm, may require additional evaluation if the cause of the symptoms is not already elucidated by the standard examination.
2. Recording
   a. For each normal examination, at a minimum:
      i. Gray scale images or cine loops should be recorded without and with
         compression at each of the following levels:
         a. Internal jugular vein;
         b. Peripheral subclavian vein;
         c. Axillary vein;
         d. Brachial vein in the upper arm;
         e. Cephalic vein in the upper arm;
         f. Basilic vein in the upper arm;
         g. Focal symptomatic areas, if present.
      ii. Color and spectral Doppler images are recorded at each of the following levels
          using the appropriate color technique to show filling of the normal venous lumen:
          a. Internal jugular vein;
          b. Subclavian vein;
          c. Axillary vein;
          d. If seen, the innominate vein should be recorded with color Doppler imaging.
      iii. At a minimum (even if the examination is otherwise unilateral), the right and
          left subclavian venous spectral Doppler waveforms should be recorded to
          evaluate for asymmetry or loss of cardiovascular pulsatility and respiratory
          phasicity. All spectral Doppler should be obtained from the long axis:
          a. Right subclavian vein;
          b. Left subclavian vein (from the same location in the vein and in the same
             patient position as the right one).
   b. Abnormal examinations generally require additional images. The extent and location
      of sites where the veins fail to compress or fill with color completely should be clearly
      recorded and generally require additional images. Long-axis views without compres-
      sion may be helpful to characterize the abnormal vein.
   c. The patient presentation, clinical indication, or clinical management pathways may
      require protocol adjustments such as imaging the forearm veins or performing a bilat-
      eral study.\(^{1–6}\)
   d. Other vascular and nonvascular abnormalities, if found, should be recorded but may
      require additional imaging for diagnosis or further characterization.

D. Vein Mapping

Mapping of superficial leg or arm veins is performed to determine the patency, size, condition
(such as calcification or thickening), and course of superficial veins to be used for vein
grafts. The location of the vein may be marked on the skin overlying the veins. Tourniquets
or other methods to accentuate the veins may be used based on the clinical indication (for
instance, mapping before hemodialysis grafts or fistulas).
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.*

VII. Equipment Specifications

Equipment must be capable of duplex imaging: both real-time imaging with compression of the veins and Doppler evaluation of the flow signals originating from within the lumen of the veins. Imaging should be conducted at the highest clinically appropriate frequency, realizing that there is a trade-off between resolution and beam penetration. This should usually be at a frequency of 5 MHz or greater, with the occasional need for a lower-frequency transducer. In most cases, a linear or curved linear transducer is preferable, but sector scanners can be helpful for difficult patients or for the medial subclavian or innominate veins. Evaluation of the flow signals originating from within the lumen of the vein should be conducted with a carrier frequency of 2.5 MHz or greater. A display of the relative amplitude and direction of moving blood should be available.

Imaging and flow analysis are currently performed with duplex sonography, using range gating. Color Doppler imaging can be used to facilitate the examination.

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.*
XI. 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*.

Acknowledgments

This parameter was revised by the American Institute of Ultrasound in Medicine (AIUM) in collaboration with the American College of Radiology (ACR), the Society of Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU) according to the process described in the *AIUM Clinical Standards Committee Manual*.

Collaborative Committee

Members represent their societies in the initial and final revision of this practice parameter.

**AIUM**
- Lisa M. Allen, BS, RDMS, RDCS, RVT
- Chris Moore, MD, RDMS, RDCS

**ACR**
- Laurence Needleman, MD, *Chair*
- Henrietta K. Rosenberg, MD
- Jason M. Wagner, MD

**SPR**
- Monica Epelman, MD
- Shailee Lala, MD
- Sara Marie O’Hara, MD

**SRU**
- Michelle L. Robbin, MD
- Leslie M. Scoutt, MD

**AIUM Clinical Standards Committee**
- Joseph Wax, MD, *Chair*
- John Pellerito, MD, *Vice Chair*
- Susan Ackerman, MD
- Sandra Allison, MD
- Genevieve Bennett, MD
- Bryann Bromley, MD
- Rob Goodman, MB, BChir
- Charlotte Henningsen, MS, RT, RDMS, RVT
- Alexander Levitov, MD, FCCP, FCCM, RDCS
- Resa Lewiss, MD
- Vicki Noble, MD, RDMS
- David Paustner, MD
- Dolores Pretorius, MD
- Tatjana Rundek, MD, PhD
- Khaled Sakhel, MD
- Ants Toi, MD
- Isabelle Wilkins, MD

Original copyright 2006; revised 2015, 2010
Renamed 2015
References


