Standards for Performance of the Ultrasound Examination of the Infant Brain

american institute of ultrasound in medicine

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Foreword

The American Institute of Ultrasound in Medicine (AIUM) is a multidisciplinary organization advancing the art and science of ultrasound in medicine for the benefit of the public. To promote this mission, the AIUM is pleased to publish these updated *Standards for Performance of the Ultrasound Examination of the Infant Brain.* This important clinical standard has been developed under the auspices of the Education Committee with the assistance of many dedicated individuals. We are indebted to the many volunteers who contributed their time, knowledge, and energy bringing this important document to completion, and offer particular thanks to Harris L. Cohen, MD, who was instrumental in the revision of this document.

With more than 11,000 members representing the entire range of clinical and basic science interests in medical diagnostic ultrasound and hundreds of volunteers actively participating, the AIUM has promoted the safe and effective utilization of ultrasound in clinical medicine for close to 50 years. This document, and others like it, will continue to contribute to this record.

—Wesley Lee, MD, Chair, Education Committee

Standards for Performance of the Ultrasound Examination of the Infant Brain

The following are recommended standards for ultrasound evaluation of the infant brain. The document consists of two parts:

PART I: Equipment and Documentation

PART II: Ultrasound Examination of the Infant Brain

- Ventricular System and Brain Parenchyma

These standards have been developed to provide assistance to practitioners performing ultrasound studies on the infant brain. In some cases, additional and/or specialized examinations may be necessary. While it is not possible to detect every anomaly, adherence to the following standards will aid in the detection of those abnormalities of the infant brain that can be evaluated by ultrasound.

PART I

Equipment and Documentation

Equipment

Pediatric neurosonographic examinations should be conducted with a real-time scanner, preferably with a high-resolution transducer suitable to the size of the anterior fontanelle. The transducer or scanner should be adjusted to operate at the highest clinically appropriate frequency, realizing that there is a trade-off between resolution and beam penetration. With modern equipment, these frequencies are usually between 5.0 MHz and 7.5 MHz. Occasionally, a frequency of 10 MHz may be preferable. Doppler ultrasonography or color-flow imaging may be used to evaluate intracranial blood flow in selected cases. Doppler power output should be kept as low as possible to gain necessary diagnostic information. Scanning equipment should be cleaned after each use.

Documentation

Adequate documentation is essential for high-quality patient care. A permanent record of the ultrasound examination and its interpretation should be kept by the facility performing the study. Images of all appropriate areas, both normal and abnormal, should be recorded in an image or storage format. Variations from normal should be assessed and compared with previous examinations, if any. Images are to be labeled appropriately with the examination date, facility name, patient identification, and image orientation. A report of the ultrasonography findings should be included in the patient's medical record. Retention of the permanent record of the ultrasound examination should be consistent both with clinical need and relevant legal and local healthcare facility requirements.

PART II

Ultrasound Examination of the Infant Brain

The following standards describe the complete ultrasonographic examination to be performed for the infant brain. It is recognized that some examinations, particularly those performed in a neonatal intensive care unit, may be technically limited by patient condition, intravenous site placement near the fontanelles, or by the presence of life-support equipment.

Imaging should be performed primarily through the anterior fontanelle. If the anterior fontanelle cannot be used, imaging may be performed through alternate acoustic windows, such as the posterior fontanelle and other sutural openings, or directly through the squamosal portion of the temporal bone. Appropriate positioning of the transducer over the scanning window is essential. Imaging should be performed using the minimum transducer pressure necessary to acquire diagnostic information.

Ventricular System and Brain Parenchyma

Representative coronal and sagittal views should be obtained of the brain parenchyma and extraaxial fluid spaces. When imaged through the anterior fontanelle, the transducer should be angled systematically from the periphery of the right side of the calvarium to the periphery of the left side of the calvarium in sagittal and parasagittal planes and from the anterior to the posterior calvarium in coronal planes, in order to image as much of the brain parenchyma, ventricular system, and extraaxial spaces as possible.

Representative sagittal images are obtained with appropriate degrees of leftward or rightward angulation. The most peripheral views should include the Sylvian fissures. The more medial parasagittal views should include the lateral ventricles, each with their contained choroid plexus, including the surrounding white matter, and germinal matrix region, including the caudothalamic groove between the head of the caudate nucleus and the thalamus. A midline sagittal view should, when possible, include the corpus callosum, cavum septi pellucidi and cavum vergae extension (if present), the third ventricle, the area of the aqueduct of Sylvius, the fourth ventricle, the vermis of the cerebellum, and the cisterna magna.

Representative coronal images are obtained by systematically angling the transducer from the front to back of the calvarium. Anteriorly angled images should include the frontal lobe and frontal horns of the lateral ventricles. Nonangled images should include the imageable portions of the frontal, parietal, and temporal lobes; the basal ganglia; and the body and atria of the lateral ventricles. Posteriorly angled images should attempt to include the posterior portions of the temporal lobes, the occipital lobes, and the posterior portions of the ventricular system, as well as the cerebellum and other subtentorial structures. The presence or absence of subependymal, intraventricular, or parenchymal hemorrhage; other parenchymal abnormalities, such as calcification or infarction; ventricular dilatation; and extraaxial fluid collections should be noted. The presence or absence of any congenital anomalies should be noted.

Doppler ultrasonography can be used to analyze the presence of vascular flow. For example, spectral and color Doppler ultrasonography provide information about blood flow velocity and direction. Power Doppler ultrasonography may offer greater sensitivity for detecting slow vascular perfusion and is relatively angle-independent when compared with mean velocity-based Doppler methods. Venous structures, such as the superior sagittal sinus, straight sinus, internal cerebral vein, and the Vein of Galen, can also be evaluated by these techniques. Doppler ultrasonography can help the examiner differentiate between vascular structures (e.g., normal vessels and arteriovenous malformations) from nonvascular lesions (e.g., congenital and postdestructive cysts) that have no detectable flow within them.

Additional images, if necessary, may be taken through the posterior fontanelle, any open suture, or through thinner areas of the temporoparietal bone. Transcranial views through bone rather than suture may require the use of a lower frequency transducer.

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for additional ultrasound practice standards and other publications on ultrasonography.