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## **PRACTICE GUIDELINE FOR THE PERFORMANCE OF NEUROSONOGRAPHY IN NEONATES AND INFANTS**

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### **PREAMBLE**

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to these guidelines will not assure an accurate diagnosis or a

successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

### **I. INTRODUCTION**

The clinical aspects contained in specific sections of this guideline (Introduction, 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, documentation, and quality control vary among these organizations and are addressed by each separately.

This guideline has been developed to assist physicians performing sonographic studies of the brain in neonates and infants. For the purpose of this guideline, infants are defined primarily as those in whom the anterior fontanelle remains open. Neurosonography should be performed only when there is a valid medical reason, and the lowest possible ultrasonic exposure settings should be used to gain the necessary diagnostic information. In some cases, additional or specialized examinations may be necessary. While it is not possible to detect every abnormality, adherence to the following guideline will maximize the detection of most abnormalities of the brain in neonates and infants that can be imaged with ultrasound.

## II. INDICATIONS/CONTRAINDICATIONS

Indications for neurosonography in preterm or term neonates and infants include, but are not limited to:

- To screen for hemorrhage or parenchymal abnormalities in preterm infants.
- To evaluate for hemorrhage.
- To evaluate for hydrocephalus.
- To evaluate for the presence of vascular abnormalities.
- To evaluate for possible or suspected hypoxic ischemic encephalopathy.
- To evaluate for the presence of congenital malformations.
- To evaluate patients with signs and/or symptoms of central nervous system disorder, e.g., seizures, facial malformations.
- For follow-up or surveillance of previously documented abnormalities, including prenatal abnormalities.
- Screening prior to surgical procedures.

There are no contraindications to neurosonography.

## III. QUALIFICATIONS OF PERSONNEL

See the [ACR Practice Guideline for Performing and Interpreting Diagnostic Ultrasound Examinations](#).

## IV. WRITTEN REQUEST FOR THE EXAMINATION

The written or electronic request for neurosonography should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state's scope of practice requirements. (ACR Resolution 35, adopted in 2006)

## V. SPECIFICATIONS OF THE EXAMINATION

(Also see section VII, Equipment Specifications)

## Standard Imaging Examination of the Neonate and Infant

The coronal view, by convention, should have the patient's right side on the left side of the image. The right or left side of the patient should be clearly annotated on the images. Representative coronal views angling from anterior to posterior are performed through the anterior fontanelle and should include, sequentially:

- The frontal lobe and frontal horns of the lateral ventricles.
- The septum pellucidum, corpus callosum, and portions of the frontal, parietal, and temporal lobes.
- The caudothalamic groove and basal ganglia.
- The bodies of the lateral ventricles.
- The posterior portions of the temporal lobes, occipital lobes, fourth ventricle, cerebellum, and cisterna magna.

The transducer may be tilted from side to side to image as much of the superficial peripheral surfaces of the cerebral hemispheres as possible. The frequency of the transducer should be selected so as to ensure that the superficial and deep structures are well depicted. This may necessitate using more than 1 frequency setting, a linear transducer, or a standoff pad to aid in imaging of the superior sagittal sinus and superficial central cerebral structures.

The sagittal view, by convention, should place the anterior aspect of the brain on the left side of the image. The right side, midline, or left side should be clearly annotated. Sequential representative sagittal views are obtained with appropriate degrees of left and right transducer angulation. On each side these views should include the caudothalamic groove, the lateral ventricle with demonstration of the occipital horn and its choroid plexus, the periventricular white matter, the Sylvian fissure, and the middle cerebral artery branches (angiographic Sylvian triangle equivalent). A midline sagittal view should include the corpus callosum, the cavum septum pellucidum 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.

Additional views, if necessary, may be taken through the posterior or mastoid fontanelles, the foramen magnum, any open suture, or thin areas of the temporoparietal bone. The transtemporal approach may also be used to visualize the circle of Willis and its major branches. Cine loop software, when available, can be useful in demonstrating real-time information.

When clinically indicated, spectral, color and/or power Doppler may be useful to evaluate vascular structures through any fontanelle or via the transcranial technique.

## VI. DOCUMENTATION

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Comparison with prior relevant imaging studies may prove helpful. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should generally be accompanied by measurements. Images should be labeled with patient identification, facility identification, examination date, and image orientation. An official interpretation (final report) of the ultrasound examination should be included in the patient's medical record. Retention of the ultrasound examination images should be consistent both with clinical need and with relevant legal and local health care facility requirements.

Reporting should be in accordance with the [ACR Practice Guideline for Communication of Diagnostic Imaging Findings](#).

## VII. EQUIPMENT SPECIFICATIONS

Neurosonographic examinations should be conducted with sector or curved linear transducers that can fit within and image through the anterior fontanelle. Linear transducers are useful in evaluating superficial structures such as the superior sagittal sinus. If the anterior fontanelle is not available, imaging may be performed through available sutural openings or by using a transcranial approach via the thinner squamosal portion of the temporal bone. This approach may require a lower frequency transducer in order to penetrate through the bone. The transducer should be adjusted to operate at the highest clinically appropriate frequency, realizing that there is a trade-off between resolution and beam penetration. Higher frequencies are used in younger premature infants and lower frequencies in older or full term neonates.

Doppler power output should be as low as reasonably achievable (ALARA) to answer the diagnostic question.

## VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

Equipment performance monitoring should be in accordance with the [ACR Technical Standard for](#)

[Diagnostic Medical Physics Performance Monitoring of Real Time Ultrasound Equipment](#).

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This guideline was revised according to the process described in the ACR Practice Guidelines and Technical Standards book by the Guidelines and Standards Committees of the Commissions on Ultrasound and Pediatric Radiology in collaboration with the AIUM, SPR, and SRU.

### Collaborative Committee

#### ACR

Lori L. Barr, MD, FACR, Chair  
Lynn A. Fordham, MD  
Laurence Needleman, MD, FACR

#### SPR

Marta Hernanz-Schulman, MD, FACR  
Beth Kline-Fath, MD  
Vesna Martich Kriss, MD

#### SRU

Dorothy I. Bulas, MD, FACR  
Brian D. Coley, MD

### ACR Guidelines and Standards Committee - Ultrasound

Mary C. Frates, MD, FACR, Chair  
Debra L. Acord, MD  
Mustafa Bashir, MD  
Helena Gabriel, MD  
Ruth B. Goldstein, MD  
Robert D. Harris, MD, FACR  
Leann E. Linam, MD  
Michelle L. Melany, MD  
Laurence Needleman, MD, FACR  
Suhas, G. Parulekar, MD, FACR  
Maitray D. Patel, MD  
Philip W. Ralls, MD, FACR  
Michelle L. Robbin, MD, FACR  
Robert M. Sinow, MD  
Deborah Levine, MD, FACR, Chair, Commission

### ACR Guidelines and Standards Committee – Pediatric

Marta Hernanz-Schulman, MD, FACR, Chair  
Taylor Chung, MD  
Brian D. Coley, MD  
Kristin L. Crisci, MD  
Eric N. Faerber, MD, FACR  
Lynn A. Fordham, MD  
Lisa Horton Lowe, MD  
Marguerite T. Parisi, MD  
Laureen M. Sena, MD  
Sudha P. Singh, MD, MBBS  
Donald P. Frush, MD, Chair, FACR, Commission

### Comments Reconciliation Committee

Edward I. Bluth, MD, FACR, Chair  
Lori L. Barr, MD, FACR  
Dorothy I. Bulas, MD, FACR  
Harris L. Cohen, MD, FACR  
Brian D. Coley, MD  
Michael DiPietro, MD  
Kate A. Feinstein, MD, FACR  
Lynn A. Fordham, MD  
Mary C. Frates, MD, FACR  
Donald P. Frush, MD, FACR  
Marta Hernanz-Schulman, MD, FACR  
Alan D. Kaye, MD, FACR  
Beth Kline-Fath, MD  
Vesna M. Kriss, MD  
David C. Kushner, MD, FACR  
Paul A. Larson, MD, FACR  
Deborah Levine, MD, FACR  
Lawrence A. Liebscher, MD, FACR  
Laurence Needleman, MD, FACR  
Harriet Paltiel, MD  
David M. Paushter, MD, FACR  
Michael I. Rothman, MD  
Carol M. Rumack, MD, FACR  
Robert M. Sinow, MD

### Suggested Reading

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