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ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF AN ULTRASOUND EXAMINATION OF THE NEONATAL SPINE

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 on 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, Indications, Specifications of the Examination, and Equipment Specifications) were developed collaboratively by the American College of Radiology (ACR) and the American Institute of Ultrasound in Medicine (AIUM). Recommendations for physician requirements, written request for examination, procedure documentation, and quality control vary between the two organizations and are addressed by each separately.

This guideline has been developed to assist practitioners performing a sonographic examination of the infant spine. In some cases, an additional or specialized examination may be necessary. While it is not possible to detect every abnormality, following this guideline will maximize the detection of abnormalities of the infant spine.

In experienced hands, ultrasound of the infant spine has been demonstrated to be an accurate and cost-effective examination that is comparable to MRI for evaluating congenital or acquired abnormalities in the neonate and young infant.

II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

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

III. INDICATIONS/CONTRAINDICATIONS

The indications for ultrasonography of the neonatal spinal canal and its contents include visible stigmata known to be associated with congenital cord anomalies that lead to dysraphic anomalies and tethering of the cord, such as midline masses, skin discolorations, skin tags, hair tufts, or hemangiomas; or pinpoint midline or paramedian deep dimples often associated with hyperpigmentation or hypertrichosis indicative of dorsal dermal sinus tract. The spectrum of caudal regression syndrome, including anal atresia and cloacal extrophy, may be associated with cord anomalies, and constitutes an established indication for sonography. Ultrasonography is also used to detect sequelae of injury, such as hematoma following spinal tap or birth injury, or leakage of central spinal fluid (CSF). Ultrasound can also visualize blood products within the spinal canal in patients with intracranial hemorrhage.

Ultrasound is not indicated to visualize the neural placode and meninges in patients with spina bifida aperta and meningocele or meningomyelocele due to the risk of injury and infection. However, it may be useful post-operatively in evaluation of cord retethering and associated defects, such as diastematomyelia, hydromyelia, and syringomyelia.

Other than evaluation of spina bifida aperta, there are no contraindications to this examination. Infants with simple, low-lying sacrococcygeal dimples typically have normal spinal contents, and in this group of patients the examination is of low yield.

IV. WRITTEN REQUEST FOR THE EXAMINATION

The written or electronic request for a neonatal spine examination 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 scope of practice requirements. (ACR Resolution 35, adopted in 2006)

V. SPECIFICATIONS OF THE EXAMINATION

The examination should be performed with the infant preferably lying in the prone position. A small bolster, such as a rolled blanket, may be placed under the pelvis to help position and immobilize the patient. An infant who has previously been fed will generally lie quietly during the examination. If feeding is not possible, a pacifier dipped in glucose solution will often be helpful in attaining an appropriately still infant for an optimal examination. If there is difficulty placing the child prone, the examination can also be performed with the infant on his or her side. It is important to note that babies, particularly if not full term, have difficulty maintaining body temperature. Therefore, the examination should be performed in a warm room. The child can be covered by warm blankets, and the transducer placed under the blankets. Use of a radiant lamp can also be considered. The sonographic gel should be warmed. If in the neonatal intensive care unit, the examination can be performed under the warmer.

The examination may be limited to the lumbosacral region in specific cases, such as in patients being evaluated for a sacrococcygeal dimple, or in those patients being scanned to look for the presence of hematoma after unsuccessful or traumatic spinal tap. The cord should be assessed in the longitudinal and transverse planes, with image documentation. A stand-off pad may be used, if needed, to follow a tract from the skin surface. The entire spinal canal, from the craniocervical junction to the coccyx, may be included in selected cases. However, this may not be feasible in older infants.

The normal cord morphology should be assessed and documented. Accurate labeling or numbering of vertebral bodies needs to be accomplished. Once the vertebral bodies are labeled, the level of the conus can be determined. The configuration and level of termination of the conus should be documented, as well as any deviations from normal. In normal patients, the conus should lie at the L2-L3 interspace or above, although occasionally the normal cord may extend midway to L3, particularly in preterm infants.

The vertebral level can be determined in a number of ways. These include:

- Assessment of the normal lumbosacral curvature, determining the last lumbar vertebra, or L5, and counting cephalad to the level of the conus.

- Counting the five sacral segments to S1. The first coccygeal segment has variable ossification at birth but, if ossified, can be distinguished by its more rounded shape compared with the square or rectangular shape of the sacral bodies. Counting cephalad from S1 again can help determine the vertebral level of the conus.
- The last rib-bearing vertebra can be identified as T12 and the sequential lumbar level determined.
- In equivocal cases, a radiopaque marker can be placed on the skin and correlated with a spine radiograph.

The normal position of the cord within the spinal canal, and deviation from normal, such as apposition to the dorsal aspect of the spinal canal as seen in tethering, should be documented. The integrity of the cord should be documented. Also, areas of abnormal fluid accumulation, such as hydromyelia or syringomyelia, should be documented and their level identified. Transverse images are essential to identify and document diastematomyelia, with off-center scanning for confirmation to avoid the potential pitfall of duplication artifact.

Normal motion of the cord and nerve roots of the cauda equina should be evaluated, and documented on M-mode or cine images where available.

The subarachnoid space should be evaluated for a normal anechoic appearance, interrupted by normal nerve roots and dentate ligaments. The subarachnoid space, dura, and epidural space should be evaluated; abnormalities such as hematoma, lipoma, or other masses should be documented.

The termination of the thecal sac should be documented, and an abnormally echogenic or thickened filum terminale identified and measured. The nerve roots of the cauda equina should be delineated within the thecal sac. In cases of failed lumbar puncture, additional imaging with the child supported in a seated position, bending forward, may be useful to allow gravity to distend the lower thecal sac.

The vertebral bodies should be evaluated for deformities, including the posterior elements. Dysraphic defects with open posterior elements should be documented on transverse views.

Sonographic examination of the infant spinal canal is accomplished by scanning through the as yet poorly ossified posterior elements. Therefore, it is most successful in the newborn period. In older infants above 6 months of age, the examination can be very limited, although the level of termination of the cord may be identified. Imaging may be enhanced with supplemental paramedian scans.

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 the 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 the relevant legal and local healthcare facility requirements.

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

VII. EQUIPMENT SPECIFICATIONS

Ultrasound of the infant spine should be performed with real-time scanners using high-frequency linear array transducers. Center frequencies between 7 and 10 MHz are usually best. Where available and when possible, panoramic views of the entire spinal canal are very helpful in providing an overview of the anatomy and termination of the cord and thecal sac. Images of the craniocervical junction often need to be performed with a small vector transducer, operating at 5-8 MHz frequency, in order to obtain adequate detail.

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

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 Concerns 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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REFERENCES

1. Austin MJ, Gerscovich EO, Fogata M, Gillen MA, Bijan B. Sonographic duplication artifact of the

spinal cord in infants and children. *J Ultrasound Med* 2004;23:799-803.

2. Henriques JG, Pianetti G, Henriques KS, Costa P, Gusmao S. Minor skin lesions as markers of occult spinal dysraphisms: prospective study. *Surg Neurol* 2005;63:S8-S12.
3. Hill CA, Gibson PJ. Ultrasound determination of the normal location of the conus medullaris in neonates. *AJNR* 1995;16:469-472.
4. Kriss VM, Desai NS. Occult spinal dysraphism in neonates: assessment of high-risk cutaneous stigmata on sonography. *AJR* 1998;171:1687-1692.
5. Kriss VM, Kriss TC, Babcock DS. The ventriculus terminalis of the spinal cord in the neonate: a normal variant on sonography. *AJR* 1995;165:1491-1493.
6. Robinson AJ, Russell S, Rimmer S. The value of ultrasonic examination of the lumbar spine in infants with specific reference to cutaneous markers of occult spinal dysraphism. *Clin Radiol* 2005;60:72-77.
7. Rudas G, Almassy Z, Papp B, Varga E, Meder U, Taylor GA. Echodense spinal subarachnoid space in neonates with progressive ventricular dilatation: a marker of noncommunicating hydrocephalus. *AJR* 1998;171:1119-1121.
8. Rudas G, Varga E, Meder U, Pataki M, Taylor GA. Changes in echogenicity of spinal subarachnoid space associated with intracranial hemorrhage: new observations. *Pediatr Radiol* 2000;30:739-742.
9. Unsinn KM, Geley T, Freund MC, Gassner I. US of the spinal cord in newborns: spectrum of normal findings, variants, congenital anomalies, and acquired diseases. *Radiographics* 2000;20:923-938.

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