Real-time sonographic display of caudal spinal anomalies

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Summary. Real-time computerized ultrasonography with 3.5 and 5.0 MHz sector and linear array transducers (Acuson®) depicts spinal anatomy and pathology more clearly than was possible with previous ultrasonic equipment. Split screen (dual image) techniques display increased lengths of spine in a single image. Articulated arm, B-mode sonography remains useful for older patients in whom the pathology lies far from the transducer and in a few post-operative patients in whom dense scar frustrates real-time examination. Sonography is a very useful screening tool for subcutaneous pathology, meningoceles and lipomas, but, thus far, has failed to demonstrate consistently the presence of hydromyelia, intracanalicular (epi)dermoid tumors and dermal sinus stalks ascending toward conus medullaris.

Key words: Hydromyelia – Mylemomeningocele – Spinal dysraphism – Spinal lipoma – Ultrasound, in infants and children – Ultrasound, spine

Sonographic evaluation of spinal anomalies has received increased attention in recent years [1–14]. Equipment of increasing sophistication has permitted display of fine anatomic detail and accurate diagnosis of meningocele and lipoma. This communication addresses the use of new real time computerized sonography (Acuson, Mountain View, California) for evaluating spinal anomalies.

Materials and methods

Real-time computerized sonography (Acuson) with 3.5 and 5.0 MHz sector and linear array transducers was performed in 21 new patients with cutaneous stigmata or known spinal dysraphism to assess the nature of the pathology present. Studies were performed as described previously [3, 4]. Aquasonic 100 transmission gel (Parker Laboratory, Orange, New Jersey) was used as acoustic couplant. Kitecko Ultrasound Standoff Pads (3M Company, St. Paul, Minn) were employed in nearly all cases to fit the flat face of the linear array transducer to the curve of the patient's back. Depth of field was reduced to the minimum that included the area of interest. Improved spacial resolution was achieved in specific areas of interest by use of the Regional Expansion Selection (RES) program. The split screen, dual image feature was used routinely to double the length of the field displayed in a single image. This was achieved by freezing one of the dual images, sliding the transducer along the spine to the adjacent area, and "marrying" the two half fields into a single composite image of double length. In many cases the depth gain compensation, overall gain and other technical factors had to be adjusted separately for each half picture to optimize the image displayed from each of the two anatomic zones. For those using the Acuson scanner, the machine controls were adjusted to the following technical factors: preprocessing program 2, post processing program 0, five-six layers of persistance and sequential focusing.

In all but one case with pilonidal sinus, the ultrasound images were compared with computed tomograms, myelograms and/or magnetic resonance images to understand more completely the sonographic manifestations of the pathology displayed. The accuracy and completeness of the sonographic diagnosis were tested against the findings of other examinations (20 cases) and surgical observations (14 cases).

Results

The study group comprised 10 males and 11 females ranging in age from 2 days to 12 years. Seven (33%) were younger than 6 months. The primary diagnoses
in these patients were pilonidal sinus (2), dermal sinus (3), myelomeningocele (8), lipoma (5), diastematomyelia (1) and sacrococcygeal teratoma (2). Because patients with dysraphism may have multiple concurrent anomalies, the total pathological material consisted of 3 pilonidal sinuses, 4 dermal sinuses, 8 myelomeningoceles, 6 lipomas, 3 diastematomyelias, 2 sacrococcygeal teratomas, 1 dermoid tumor, 1 epidural epidermoid tumor, 2 subdural epidermoid tumors, and 5 examples of hydromyelia. No instance of simple meningocele or myelocystocele was encountered in the study period.

The success of ultrasonic diagnosis was evaluated separately for the primary lesion and for the associated abnormalities. Real-time sonography (Acuson) proved capable of diagnosing the primary condition in all but one patient with diastematomyelia. In that patient, extreme scoliosis with rotation of the laminae and intersegmental fusion of laminae prevented meaningful sonographic access to the spinal canal. Only very short segments of the continuously changing curvature could be imaged at one time.

Meningoceles were detected and diagnosed accurately in all cases (100%). Tethering of the spinal cord was diagnosed correctly in only 13 of 17 cases (76%). In 1 of the 4 cases in which tethering was not diagnosed, absence of nerve root echoes in the ventral half of the subarachnoid space suggested that the cord was tethered posteriorly, but the cord could not be displayed as a separate structure. In 3 other cases, low position of the cord was simply not appreciated on the images obtained. Two of these 3 cases were tethered cords associated with dermal sinuses.

Sonography proved significantly less effective in displaying important associated conditions. For example, sonography failed to display a large subdural dermoid tumor along the course of one sinus tract, failed to display a string of subdural epidermoid tumors along the course of a second sinus tract and failed entirely to demonstrate the intradural portions of any of the dermal sinus tracts that coursed toward the conus medullaris. In these instances, magnetic resonance imaging similarly failed to demonstrate well the epidural/subdural (epi)dermoids or the intradural segments of the dermal sinus tracts.

Sonography depicted successfully the two instances of severe hydromyelia, but failed to demonstrate the presence of mild hydromyelia in three other patients. Sonography failed to display a short segment of diastematomyelia with bone spur deep to a lipoma and failed to demonstrate a small lipoma included in the surgical scar at the site of a post-operative retethered myelomeningocele.

Two of the patients in whom sonography failed to demonstrate the tethered cord were 6 years and 11 years of age. The patient in whom sonography failed to demonstrate the primary diastematomyelia was 12 years of age. The degree of anatomic detail demonstrable within the spinal canal was judged to be reduced in all older patients, even those in whom correct diagnosis was possible. For this reason, we are presently uncertain about the proper role of real-time sonography for diagnosing caudal spine anom-

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Fig. 1. Pilonidal sinus. 9-month-old boy. Transverse 5 MHz sonogram demonstrates the midline dimple (black arrow) and the echogenic tract (white arrowhead) that extends ventrally in the midline.