I. Fetal neurosonography

Ultrasonography of the normal fetal brain

M. E. Pasto and A. B. Kurtz
Department of Radiology, Division of Ultrasound and Radiologic Imaging, Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA

Summary. Since the early 1960s it has been possible to identify the fetal head using A-mode ultrasound. The introduction of high-resolution, real-time, grayscale ultrasound in the mid-to-late 1970s first enabled the routine display of subtle internal anatomy. Using presently available equipment, the fetus can be imaged from 7 weeks after the last menstrual period until term and the internal anatomy of the fetal head can be detected after 11-12 weeks. The ultrasonic anatomy of the normal fetal head throughout the second and third trimesters is discussed, as are the normal changes taking place with growth.

Key words: Ultrasonography – Fetal head

A-mode ultrasound has been able to identify the fetal head since the early 1960's. With the A-mode, however, sonographers could outline only the calvarium and the midline echo. B-mode sonography imaged more intracranial structure. However, routine display of subtle internal anatomy awaited development of high resolution real-time gray scale ultrasound in the mid to late 1970's.

With present equipment, the fetus can be imaged routinely from seven weeks after the last menstrual period until term. The fetal head can be identified and distinguished from the fetal body by approximately 9 weeks, but the internal anatomy of the fetal head can be detected only after 11 to 12 weeks. This paper discusses the ultrasonic anatomy of the normal fetal head throughout the second and third trimesters, and the normal changes that take place with growth.

Transaxial views

The anatomy will be discussed from the vertex to the base of the skull. Starting at the vertex, a bright midline echo is seen as a continuous line (Fig. 1). This is termed the interhemispheric fissure or the falx echo. Paralleling this line on both sides are the lateral walls of the bodies of the lateral ventricles. In the early second trimester, between 12 and approximately 18 weeks, the choroid plexuses completely fill the bodies of the lateral ventricles and normally appear as large hyperechoic areas (Fig. 1 and 2) [1, 2]. The atria and the occipital regions of the lateral ventricles are somewhat more prominent. Choroid plexus can be seen within these regions, but there the choroid plexus does not extend all the way to the edges of the ventricular wall (Fig. 3). For this reason, particularly on oblique views, it is important (a) not to confuse the normal choroid plexus with a mass or blood clot, and (b) not to assume that the choroid plexus is inappropriately small in size. This appearance of the atrial and occipital region may persist up to 20-21 weeks and is partly accentuated by the very hypoechoic surrounding white matter in the occipital and parietal regions (Fig. 3). By adjusting the angle of the scan plane to a complete transaxial position, symmetrical choroid plexuses will be easily identified.

Throughout the second and third trimesters, the size of the lateral ventricles can be measured to rule out hydrocephalus. The most commonly used measurement is taken at the level of the lateral walls of the bodies of the lateral ventricles and is termed the lateral ventricle/intracranial hemidiameter ratio (LV/ICH)(Fig. 2). This ratio has been shown to be quite large in the early second trimester, up to approximately 70% of the head at 15 weeks. Thereafter, this ratio decreases rapidly due to rapid growth of brain parenchyma. It is a maximum of 43% by 21 weeks and decreases to 33% at term [2, 3]. The ratio may be measured most accurately when the gain is decreased to allow visualization of the near wall of the proximal lateral ventricle.

At a slightly more caudal level, the brain stem is easily identified. The falx/midline echo now becomes discontinuous. Anterior to the brain stem, the falx/midline echo is disrupted by the oblong an-
Fig. 1. Transaxial view in the early second trimester showing the large symmetrical choroid plexus (C) completely filling the bodies of the lateral ventricles, note the lateral ventricular walls are bright lines paralleling the midline. A = anterior (and will be used as such throughout the captions)

Fig. 2. Standard transaxial view to measure the lateral ventricular width. LV = lateral ventricle, measured between the arrowheads. HD = intracranial hemidiameter measured from the midline echo to the inner table of the skull

Fig. 3. An oblique view through one occipito-parietal region imaging the relatively large choroid plexus (C) which could possibly mimic a mass or a blood clot

Fig. 4. Transaxial image at the level of the thalami (T). The frontal horns (arrowheads) are seen anteriorly with the cavum septi pellucidi (*) between them and the thalami. Posteriorly the midline echo is formed by the posterior falx (curved arrows) near the insertion of the leaves of the tentorium

echoic cavum septi pellucidi (Fig. 4). More posteriorly, sonograms display the posterior aspect of the falx and the confluence of the falx with the roof of the tentorium along the straight sinus.

The thalami are visualized as paired paramedian structures that can be seen over several millimeters in cranio-caudal extent (Fig. 4) [4]. Three thalamic levels are discerned. Cephalically the thalami resemble two small ovoid hypoechoic rounded structures. In their mid portion, the thalami become large and completely rounded. More caudally, the thalami become heart-shaped with the point of the heart projecting posteriorly. Particularly after 30 weeks, the third ventricle is commonly identified as a small, slit-like, 1-2 mm., anechoic space situated between the thalami.