Prenatal Visualization of the Pituitary Gland Using 2- and 3-Dimensional Sonography

Comparison to Prenatal Magnetic Resonance Imaging

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The pituitary gland is a small structure measuring about 140 mm³ at birth, situated at a unique groove in the midbase of the skull called the sella turcica, and is crucially important in the function of the endocrine axis. This brain element is located behind the optic chiasm and surrounded by the circle of Willis (Figure 1). It is divided into the anterior pituitary and the posterior pituitary, two regions distinctive in their embryology, anatomy, and function.

Antenatal depiction of the pituitary gland has been possible to date only using magnetic resonance imaging (MRI). The pituitary stalk can be identified on T2-weighted sequences (Figure 2A), and the gland can be recognized as a hypersignal structure on T1-weighted sequences (Figure 2B). It is difficult to clearly define the gland shape prenatally, and no distinction can be made between the anterior and the posterior parts of the gland.2–4

So far, it has not been possible to show the gland on sonography, but the development of high-frequency 2-dimensional (2D) and 3-dimensional (3D) modalities has made it possible. The absence or hypoplasia of the pituitary gland may be associated with other endocrine organ malformations as well as face and brain anomalies such as facial clefting, malformation of the tongue, palate, and pharynx, agenesis of the corpus callosum, anomalies of the circle of Willis, and anomalies of the olfactory bulbs and tracts.5,6
When an anterior brain abnormality such as septal agenesis is detected during a fetal morphologic examination, assessment of the presence and normality of the pituitary gland has essential prognostic implications. We describe our preliminary experience with visualization of the fetal pituitary gland in the third trimester using 2D and 3D sonography modality and comparison to prenatal MRI.

A 24-year-old healthy woman, gravida 1, was referred to our department at 28 weeks' gestation for further evaluation because of nonvisualization of the cavum septi pellucidi on a routine fetal morphologic examination performed at 23 weeks' gestation. The fetus was in a breech presentation; therefore, we used a transabdominal transducer.

Morphologic evaluation showed a normally growing fetus with biometric measurements compatible with the gestational age and normal organ scan findings. Targeted sonographic examination of the fetal central nervous system (fetal neurosonogram), confirmed the absence of the cavum septi pellucidi with a normal ventricular system, a normal corpus callosum, a normal posterior fossa, normal sulcation, and an adequate skull size and shape.

To distinguish between isolated septal agenesis from more complicated and severe forms such as septo-optic dysplasia, efforts were made to depict the pituitary gland. The posterior branches of the optic tract were measured and found to be within the normal range for the gestational age. The unique shape of the pituitary gland was identified on 2D (Figure 3A), and 3D (Figure 3B) sonography in an axial plane of the skull, parallel to and slightly below the biparietal diameter plane, showing the circle of Willis. The insertion of the stalk in the posterior part of the gland can be seen. The circle of Willis is an excellent marker for the gland location (Figure 3C).

The steps for achieving images of the pituitary gland using 3D sonography are described below. Using a Voluson E8 ultrasound system (GE Healthcare, Zipf, Austria)

Figure 2. Antenatal visualization of the pituitary gland on magnetic resonance imaging. A. T2-weighted coronal plane. The stalk can be identified (arrow). B. T1-weighted coronal plane showing a hypersignal appearance of the gland (arrow). It is difficult to define the clear shape of the gland.
equipped with a transabdominal multifrequency 4- to 8-MHz probe, volume acquisition was performed as follows:

Step 1 (Figure 4A)—This approach started from an axial plane parallel to and slightly below the biparietal diameter plane, showing the circle of Willis. An acquisition box was placed over the circle of Willis and the upper part of the cerebral trunk, within the limits of the perimeter of the skull. The volume was obtained with the surface pro-

Figure 3. Sonographic appearance of the normal pituitary gland. A, Two-dimensional view. B, Three-dimensional view. C, The gland is located in the middle of the circle of Willis (arrows in all images).
gram set on maximum quality with the surface-rendering mode at 70% and surface smoothing at 30%. The reference dot was located above the expected anatomic location of the gland.

Step 2 (Figure 4B)—The region of interest was chosen by viewing plane A from the top and rotating 90° around the x-axis in plane A.

Step 3 (Figure 4C)—The region of interest was reduced with curvature of the green line. The benchmark was the brain stem (arrows). The pituitary gland was located in front of the brain stem and below the anterior branches of the chiasm.

Step 4 (Figure 4D)—A slight rotation was made around the z-axis in plane A with a very slight translation of the region of interest down to visualize the pituitary gland just near the reference dot.

Two fetal brain MRI scans (Figure 5) were performed at 24 and 32 gestational weeks to confirm the sonographic diagnosis, to distinguish between isolated septal agenesis and more complicated and severe forms such as septo-optic dysplasia, and to rule out associated brain anomalies. The coronal plane is considered superior for depicting the pituitary gland in prenatal imaging.

A 3205-g female neonate was born by normal vaginal delivery at 39 weeks’ gestation. Postnatal imaging and endocrine evaluation confirmed the presence of normal pituitary gland anatomy and function. Neurologic development at 1 year was consistent with expected milestones.
To our knowledge, antenatal visualization of the pituitary gland using sonography has not been reported previously. With prenatal MRI, it is difficult to clearly define the gland shape. The images of the gland obtained with sonography seemed superior compared to T2- and T1-weighted MRI.

In this case, the fetus was in a breech presentation during the sonographic scan; therefore, we used the transabdominal approach. The transvaginal approach may be advantageous when the fetus is situated in a vertex presentation or with maternal obesity. In cases with midline anomalies of the brain, face, or cranium, depiction of the pituitary gland, which is an essential endocrine gland, is feasible and recommended.

Figure 5. Fetal brain appearance on magnetic resonance imaging in the coronal plane at 24 (A and B) and 32 (C) gestational weeks. A, T2-weighted scan. The appearance of the ventricles confirms the absence of the cavum septi pellucidi (asterisk). B, T1-weighted scan. A hyperintense structure is depicted at the base of the skull at the expected location of the gland (arrow). C, T2-weighted scan. The stalk is identifiable (arrow).
References