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Opinion

The fetal corpus callosum. 'The truth is out there'

Fifteen years ago, we presented a paper on the normal development of the fetal corpus callosum at a meeting of the Israel Society of Ultrasound in Obstetrics and Gynecology[1]. At the end of the presentation, one of the participants told the audience that his impression was that the lecture was about science fiction since he was not aware of the possibility of visualizing this inconspicuous structure.

Since then, most of us have come to understand the importance of the corpus callosum as a marker of the normal development of the fetal brain and the reasons why it is so difficult to visualize using routine axial planes. On the other hand, it can by depicted easily by two-dimensional (2D) ultrasound, using either the transabdominal or the transvaginal approach[1–3], and the technique for acquisition of the mid-sagittal and coronal planes is quite simple and easy to teach to fellows and residents.

A paper recently published in the Journal demonstrated successful visualization of the corpus callosum using three-dimensional (3D) ultrasound between 16 and 24 weeks' gestation in 84% of the patients in whom an 'acceptable quality of cerebral multiplanar images' were obtained[4]. From the original 202 patients, the corpus callosum was visualized in only 156 (77%); the relatively low percentage of visualization may have been due in part to the inclusion of fetuses at 16–17 weeks. The problem with this study was that what the authors considered to represent the corpus callosum may have actually represented an artifact[5]. Pilu *et al.*, in the same issue of the Journal, found a good correlation between 2D and 3D measurements of the corpus callosum[6]. 3D images were of diagnostic quality, but the 2D image quality was considered better.

In the current issue of the Journal, two groups, from the United Kingdom[7] and Chile[8], describe 3D techniques for visualization of the corpus callosum and their limitations. Plasencia *et al.*[7] found that between 20 and 24 weeks of gestation the possibility to visualize the corpus callosum from reconstructed 3D volumes is entirely dependent on the position of the fetal head. They proved that when it is possible to obtain a good 2D mid-sagittal or coronal image through the anterior or posterior fontanelle or through the sagittal suture, a 3D volume obtained in the same fetal head position will include an image of the corpus callosum suitable for diagnosis. On the other hand, when visualization of the brain was through the calvarium, either they obtained a distorted image, a 'comma shaped echogenic structure', or they were not able to visualize the corpus callosum at all.

Viñals *et al.*[8], studying fetuses between 20 and 33 gestational weeks, reached similar conclusions. When comparing the use of 3D multiplanar and volume contrast imaging from the C-plane (VCI-C) obtained from axial acquisitions versus 3D sagittal multiplanar acquisitions or standard 2D planes, they found the latter to be superior. They also compared the quality of visualization of the cerebellar vermis using the same methods and found 2D ultrasound to be the preferred method of visualization, followed by the transfrontal multiplanar approach. Volume reconstruction from axial planes using either multiplanar images or VCI-C was found to be effective in only a small proportion of the patients.

The authors of both papers believe that, for visualizing the corpus callosum, the multiplanar 3D approach is easier compared with direct visualization by 2D imaging. Based on previous research on 2D transvaginal and tranfundal ultrasound[1–3] and on the two present papers, we believe

Figure 1 Transabdominal ultrasound visualization of the corpus callosum using three different approaches in the same patient, obtained by mobilization of the fetal head: (a) anterior fontanelle approach; (b) sagittal suture approach; (c) posterior fontanelle approach. The full sequence was obtained in 73 s.

that both techniques are suitable, and that their use should depend on head position, the proficiency of the sonographer and the equipment available. While fetal magnetic resonance imaging (MRI) is considered a superb modality for depicting brain anatomy, and some authors claim its superiority over ultrasound[9], we believe that the corpus callosum is better delineated by ultrasound.

It is important to know that the position of the fetal head is dynamic and may be gently manipulated during sonography by the transducer or the physician's free hand (Figure 1). Regardless of the method used for visualization of the corpus callosum, we also need to remember that it will remain in some cases difficult or even impossible to visualize due to maternal habitus or fetal position. It is also worth mentioning that the depiction of an apparently normal corpus callosum is not necessarily a guarantee that it will remain normal, since this does not exclude the possibility of subtle callosal developmental congenital anomalies or callosal pathologies that may develop late in pregnancy or even after delivery due to brain insults such as ischemia or infection.

The challenge for the future will focus on the possibility of diagnosing subtle callosal anomalies and on understanding the wide spectrum of associated anomalies, fundamentally malformations of cortical development, that are commonly present in these patients, in order to improve counseling[10–12]. For this task, we believe that high-definition 2D ultrasound, probably complemented by MRI, will remain the main option.

G. Malinger*, D. Lev and T. Lerman-Sagie
Fetal Neurology Clinic, Wolfson Medical Center, Holon, Sackler School of Medicine, Tel-Aviv University, Tel-Aviv, Israel
**Correspondence. (e-mail: gmalinger@gmail.com)*

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