MV-Flow and LumiFlow: a new Doppler tool for assessing the development of fetal brain vascularization in late-first/early-second trimester of pregnancy

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Early prenatal assessment of the development of cerebral vascularization represents a real challenge in the field of fetal medicine. A detailed identification of those vessels and their formation carries great importance, especially in the late-first/early-second trimester of pregnancy, because an early identification of defects can be largely beneficial for treatment planning. By using transvaginal ultrasonography in the second and third trimesters, Monteagudo et al. described the detailed antenatal visualization of the fetal brain for the first time in 1991(1). Despite several difficulties, such as limited identification of all the brain vessels, subsequent studies that advanced the technique with the use of power Doppler continued to be reported in the 1990s(2).

Pooh et al.(3) and Chang et al.(4) described fetal brain morphology and circulation by transvaginal 3D sonography and power Doppler techniques, thereby improving the identification and management of abnormalities in the central nervous system. The technique also proved to be useful for the assessment of growth-restricted fetuses and demonstrated the “frontal brain sparing effect” when the anterior cerebral artery revealed vasodilatation(5). In 2012, Hata et al.(6) reported the evaluation of fetal brain by 3D transvaginal power Doppler imaging at 10 to 13 weeks of gestation, showing an important assessment of early fetal brain perfusion. The volume of fetal brain and the analysis of structures such as the pericallosal artery are described below; this revolutionary technique expanded the possibilities of neurosonographic studies(7,8).

Recently, Dall’Asta et al.(9) described the application of a new highly sensitive low-velocity flow Doppler technique in the specialized assessment of the posterior fossa. The study reported an indirect evaluation of the insertion of the cerebellar tentorium in the second trimester with images of high quality and resolution. New Doppler technologies have been developed for a better evaluation of microvascularization in the structures that present a slow flow as well as detailed vascular connections.

MV-flow allows a detailed view of blood flow at low speeds with high sensitivity and resolution in relation to the surrounding tissues. In this manner, it is possible to detect the micro-blood flow (microfluidic channel) in the tissues and organs. LumiFlow is an advanced post-processing and shading technique in which the images can be processed by placing a light source in the right position to create shadows and produce a three-dimensional (3D) effect. LumiFlow allows the 3D visualization of the vascular image in real time. The flow limits appear relatively darker and create a clear distinction between the blood vessels. In addition, the technique removes background noise in a highly effective manner.

By using the Hera W10 apparatus (Samsung Co., Seoul, South Korea), the study employed both the MV-Flow and LumiFlow to enable a clear assessment of the vascular anatomy of the fetal brain in the late-first/early-second trimester of pregnancy. These new Doppler technologies clearly visualized the development of midline cerebral vascularization in a fetus at 16 weeks of gestation (Fig. 1), as well as the development of the circle of Willis vascularization in a fetus at 12 + 4 weeks of gestation (Fig. 2).
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Conflict of interest
Authors do not report any financial or personal connections with other persons or organizations, which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

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