Novel framework powered by 3-D MRI accurately predicts pregnancies complicated by FGR

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Catherine Limperopoulos, Ph.D., co-director of research in the Division of Neonatology at Children's National Health System. Credit: Children's National Health System

During the millions of pregnancies that occur in the United States every year, expectant moms learn oodles about their developing fetuses over months of gestation. But the placenta, a vital and temporary organ that shelters the fetus—delivering life-sustaining nutrients and oxygen, getting rid of toxic by-products and modulating the immune system to protect the pregnancy—largely remains a mystery. A team of Children's National Health System research scientists is beginning to provide insights about the poorly understood placenta.

Using three-dimensional (3D) magnetic resonance imaging (MRI), the research team characterized the shape, volume, morphometry and texture of placentas during pregnancy and, using a novel framework, predicted with high accuracy which pregnancies would be complicated by fetal growth restriction (FGR).

"When the placenta fails to carry out its essential duties, both the health of the mother and fetus can suffer and, in extreme cases, the fetus can die. Because there are few non-invasive tools that reliably assess the health of the placenta during pregnancy, unfortunately, placental disease may not be discovered until too late—after impaired fetal growth already has occurred," says Catherine Limperopoulos, Ph.D., co-director of research in the Division of Neonatology at Children's National Health System and senior author of the study published online July 22 in *Journal of Magnetic Resonance Imaging*. "Identifying early biomarkers of placental disease that may impair fetal growth and well-being open up brand-new opportunities to intervene to protect vulnerable fetuses."

The Children's research team acquired 124 fetal scans from 80 pregnancies beginning at the 18th gestational week and continuing through the 39th gestational week. Forty-six women had normal pregnancies and healthy fetuses while 34 women's pregnancies were complicated by FGR, defined by estimated fetal weight that fell below the 10th percentile for gestational age. The placenta was described by a

combination of shape and textural features. Its shape was characterized by three distinct 3D features: Volume, thickness and elongation. Its texture was evaluated by three different sets of textural features computed on the entire placenta.

The proposed machine learning-based framework distinguished healthy pregnancies from FGR pregnancies with 86 percent accuracy and 87 percent specificity. And it estimated the birth weight in both healthy and high-risk fetuses throughout the second half of gestation reasonably well.

"We are helping to pioneer a very new frontier in fetal medicine," Limperopoulos says. "Other studies have developed prediction tools based on fetal brain features in utero. To our knowledge, this would be the first proposed framework for semi-automated diagnosis of FGR and estimation of birth weight using structural MRI images of the placental architecture in vivo. This has the potential to address a sizable clinical gap since we lack methods that are both sufficiently sensitive and specific to reliably detect FGR in utero."

The research team writes that its findings underscore the importance of future studies on a larger group of patients to expand knowledge about underlying placenta mechanisms responsible for disturbed fetal growth, as well as to more completely characterize other potential predictors of fetal/placental development in high-risk pregnancies, such as genetics, physiology and nutrition.

More information: Sonia Dahdouh et al, In vivo placental MRI shape and textural features predict fetal growth restriction and postnatal outcome, *Journal of Magnetic Resonance Imaging* (2017). DOI: 10.1002/jmri.25806