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Extrafetal Findings on Fetal Magnetic Resonance Imaging: A Pictorial Essay

Monica Epelman, MD,* Arnold C. Merrow, MD,† Carolina V. Guimaraes, MD,‡ Teresa Victoria, MD, PhD,§ Maria A. Calvo-Garcia, MD,† and Beth M. Kline-Fath, MD†

Although US is the mainstay of fetal imaging, magnetic resonance imaging (MRI) has become an invaluable adjunct in recent years. MRI offers superb soft tissue contrast that allows for detailed evaluation of fetal organs, particularly the brain, which enhances understanding of disease severity. MRI can yield results that are similar to or even better than those of US, particularly in cases of marked oligohydramnios, maternal obesity, or adverse fetal positioning. Incidentally detected extrafetal MRI findings are not uncommon and may affect clinical care. Physicians interpreting fetal MRI studies should be aware of findings occurring outside the fetus, including those structures important for the pregnancy. A systematic approach is necessary in the reading of such studies. This helps to ensure that important findings are not missed, appropriate clinical management is implemented, and unnecessary follow-up examinations are avoided. In this pictorial essay, the most common extrafetal abnormalities are described and illustrated.
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Introduction

Ultrasound (US) is widely accepted as the standard imaging modality for evaluating the fetus and the extrafetal structures. However, in recent years, magnetic resonance imaging (MRI) has played an increasing role in the armamentarium of fetal imaging, where it is used to either improve the confidence level of the US diagnosis or to enable the discovery of additional pathology.

After its initial clinical introduction in the 1980s, fetal MRI was primarily used to evaluate maternal conditions, such as ovarian torsion, molar pregnancies, and maternal spinal abnormalities, without exposing the developing fetus to ionizing radiation.[1,2] However, with the unveiling of ultrafast T2-weighted sequences in the 1990s and the simultaneous expansion of potential fetal interventions, MRI has been used more frequently as a valuable adjunct to US for the diagnosis and evaluation of fetal conditions. Because of its high soft tissue contrast capability, MRI is advantageous when compared with US for depicting pathology of the central nervous system, estimating fetal lung volumes, and evaluating conditions associated with reduced amniotic fluid or maternal obesity, in which US would be nondiagnostic.[1,3] Given pediatric radiologists' familiarity with congenital or neonatal anatomy and pathology, as well as their knowledge of MRI, they have been at the forefront of fetal MRI interpretation. However, many pediatric radiologists are less familiar with the extrafetal anatomy and conditions one may encounter when interpreting these studies. In this article, we aim to illustrate the clinical and imaging features of a variety of extrafetal abnormalities that pediatric radiologists should be aware of in the daily interpretation of fetal MR images. The purpose of this pictorial essay is to serve as a quick pattern-recognition guide of common and uncommon extrafetal findings that a pediatric radiologist may encounter while using fetal MRI. The literature pertaining to common extrafetal findings is summarized with a focus on recently published data.

*Department of Medical Imaging/Radiology, Nemours Children's Hospital, Orlando, FL.
†Department of Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH.
‡Department of Pediatric Radiology, Texas Children's Hospital, Houston, TX.
§Department of Radiology, The Children's Hospital of Philadelphia, Philadelphia, PA.
Address reprint requests to Monica Epelman, MD, Department of Medical Imaging/Radiology, Nemours Children's Hospital, 13535 Nemours Parkway, Orlando, FL 32827. E-mail: monica.epelman@nemours.org

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Placenta

The placenta is the organ that ensures appropriate exchange of respiratory gases, nutrients, and waste across the fetal and the maternal compartments, thus allowing for fetal nutrition and maternofetal gas exchange. Despite the recent increase in attention to fetal MRI in the literature, the placenta and its pathology remain relatively forgotten. Methodological research on the topic is scarce, and placental pathology is easily overlooked in clinical practice, even though several maternal or fetal disorders begin or end in the placenta, such as maternal hypertension, intrauterine growth restriction (IUGR), and triploidy and its placental manifestations, including gestational trophoblastic disease (GTD). While evaluating the placenta on routine fetal MRI, one should give attention to its location, thickness, signal intensity, and contour, similarly to how one would evaluate the placenta on fetal US.[4-8] In addition, a search for placental tumors should be performed.

The placenta may implant at any location within the uterus; however, it is most commonly positioned along the anterior or posterior walls.[9,10] Some authors have shown that an anterior location of the placenta is associated with higher-risk fetal lies, such as breech presentation.[6]

The normal placental MRI appearance varies with gestational age. On single-shot fast spin-echo (SSFSE) T2-weighted MR images, the placenta is primarily homogeneous and moderately hyperintense in signal during the second trimester (Fig. 1), whereas it becomes more heterogeneous and complex in appearance, with visualization of more distinct, fine vascular channels and demarcation of dominant cotyledons, as it matures in the third trimester (Fig. 2). A fine, dark line of separation between the myometrium and the placenta may be visualized, representing the myometrial-decidual interface, which corresponds to the retroplacental clear space on US.[10,11]

Early in the second trimester, the fetal margin of the placenta appears quite straight and smooth. However, as pregnancy advances, the placenta may display gentle lobulations on the fetal surface, with discrete cotyledons becoming more evident by the third trimester. The placental T1 signal intensity should also be assessed for the presence of more amorphous, irregular-appearing hyperintense foci corresponding to hemorrhage or the less ominous venous lake.

The normal-term placenta is discoid in shape and has an average central thickness ranging from 2-4 cm.[9,12] Using MRI, placental thickness is measured either in the axial or the sagittal plane using a 90° orthogonal plane relating to the placental axis at the site of maximal thickness, as determined by visual inspection (to prevent overestimation of thickness owing to obliquity). Placental thickness should be measured at a central location, preferentially near the insertion of the cord (when the cord is inserted centrally).[6,12] Placental thickness normally increases with increasing gestational age. However, it should be less than 4 cm, as a placental thickness more than 4 cm correlates well with an abnormal placental thickness by US.[4,11,12] Increased placental thickness is a nonspecific finding that may be seen in maternal diabetes; maternal anemia; immune or nonimmune hydrops; and certain congenital infections, such as syphilis, cytomegalovirus, and toxoplasmosis[6] (Fig. 3).

The most common placental conditions one may encounter when performing fetal MRI are illustrated, and a succinct definition of the condition and main criteria for MRI diagnosis are provided.

Anomalies in Placental Shape

The normal placenta is usually discoid in shape, although it may exhibit various morphologies, including bilobed, succenturiate, circumvallate, and placenta membranacea. A bilobed placenta refers to a placenta composed of 2 lobes of fairly equal size that are joined by a thin segment of placental tissue. Bilobed placentas have no known associated risks. A succenturiate placenta (Fig. 4) has an extraplacental lobe that is not contiguous with the main placental body. This condition may be associated with retained placental

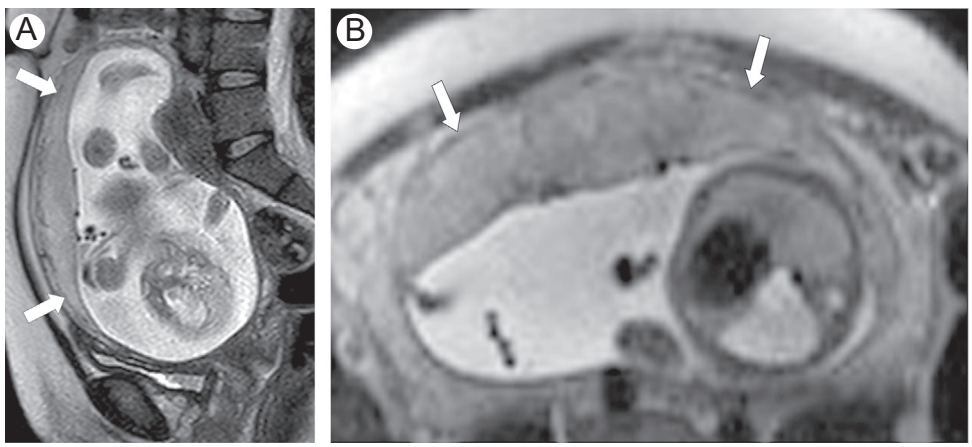

Figure 1 Normal placenta. Sagittal (A) and axial (B) single-shot fast spin-echo (SSFSE) T2-weighted MR images of a placenta at 20 weeks of gestation in 2 different patients show the normal, homogeneous placental signal that is hypointense to isointense relative to the surrounding myometrium. Note the relatively well-defined hypointense line at the myometrial-decidual interface (arrows). It should be noted that the hypointense line cannot always be well delineated, even in normal cases. Incidental note is made of a hyperintense congenital lung lesion in (B).