



UPDATE IN RADIOLOGY

Complementary role of magnetic resonance imaging in the study of the fetal urinary system[☆]



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Abstract Urinary system birth defects represent the abnormality most often detected in pre-natal studies, accounting for 30–50% of all structural anomalies present at birth. The most common disorders are urinary tract dilation, developmental variants, cystic kidney diseases, kidney tumors, and bladder defects. These anomalies can present in isolation or in association with various syndromes. They are normally evaluated with sonography, and the use of magnetic resonance imaging (MRI) is considered only in inconclusive cases. In this article, we show the potential of fetal MRI as a technique to complement sonography in the study of fetal urinary system anomalies. We show the additional information that MRI can provide in each entity, especially in the evaluation of kidney function through diffusion-weighted sequences.

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PALABRAS CLAVE

Resonancia magnética;
Feto;
Sistema urinario;
Riñón

Papel complementario de la resonancia magnética en el estudio del sistema urinario fetal

Resumen La patología urinaria es la anomalía que se detecta con mayor frecuencia en el estudio prenatal y representa del 30 al 50% del total de las anomalías estructurales en el nacimiento. Los trastornos más frecuentes son la dilatación del tracto urinario, las variantes del desarrollo, las enfermedades quísticas renales, la patología neoplásica renal y anomalías de la vejiga. Estas entidades pueden presentarse aisladas o asociadas a síndromes. Su evaluación se

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realiza con ecografía de forma rutinaria, y solo en aquellos casos en los que no sea concluyente se considera el estudio adicional con resonancia magnética (RM) fetal. Nuestro objetivo es exponer el potencial de la RM fetal como complemento a la ecografía en las enfermedades del sistema urinario fetal, analizando sus principales indicaciones y la información adicional que aporta en cada entidad, especialmente en la valoración de la funcionalidad renal mediante las secuencias de difusión.

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Introduction

Urinary system abnormalities are common and they represent 30–50% of all structural abnormalities at birth¹ and 14–40% of the abnormalities detected by ultrasound.² The main conditions are divided into urinary tract dilation (UTD), cystic kidney disease, variations of normal development, neoplastic disease and fetal bladder abnormalities. The method of choice for its study is prenatal ultrasound,^{1,3–6} which allows its screening⁷ and establishes a basis for its follow-up.² It is useful in the detection of dilation of the collecting system and in parenchymatous diseases.^{1,3–6} In certain circumstances, ultrasound is insufficient and additional evaluation through fetal MRI is required.

In our hospital center, suspicions of renal pathology detected through routine obstetric ultrasound are referred to the Fetal Medicine Unit of the Obstetrics and Gynecology Services for a new ultrasound evaluation. If insufficient the patient is referred for a complementary fetal MRI.

Several studies support the superiority of fetal MRI in the assessment of cerebral, vertebral and thoracic conditions; however, there are fewer studies comparing both modalities in the study of the urinary system. MRIs are a safe modality⁸ capable of providing a detailed visualization of the anatomy^{9,10} and it is especially useful in complex malformations. Its use has increased exponentially in the last few years due to the development of ultrafast acquisition sequences—responsible for a considerable reduction of artifacts due to fetal movement.^{1,6,9–12}

The goal of our article is to analyze the potential of fetal MRI as a complementary modality to ultrasound in urinary abnormalities, establishing its indications and the additional information that it provides us with in conditions like these, especially in the assessment of functionality due to diffusion sequences.

Indications

Urinary structural problems are usually viewed similarly in ultrasounds and MRIs. Fetal MRIs are reserved for those kinds of situations in which ultrasounds are not enough and cannot provide us with a final diagnosis¹³ or in cases in which it cannot provide us with important information, reducing thus the use of other modalities that use ionizing radiation,¹⁴ as it is established by the Society for Magnetic Resonance Imaging Safety Committee.^{1,13,15,16}

Its indications are:

1. Fetal indications:
 - Conditions limiting ultrasound precision:
 - Anhydramnios or oligohydramnios states associated often with these diseases.^{2,8,17}
 - Unfavorable position of the fetus.
 - Complex abnormalities.
 - Evaluation of the degree of fetal pulmonary maturation.^{8,13}
2. Maternal indications: all those circumstances limiting accessibility^{1,2,5,9,10,12,14}:
 - Obesity.
 - Suspicion of uterine rupture.
 - Placental abnormalities.
 - Myomas, ovarian tumors or abscesses.
 - Pelvimetry.

Contraindications for fetal MRI do not differ from those of other types of MRIs.⁶ MRI is not limited by the volume of amniotic fluid, maternal body habitus, intestinal gas, bone structures or fetal position. Its great advantages are excellent spatial resolution, high contrast in T2 between liquid and solid tissue, a greater field of vision which allows the visualization of other structures such as the perineal region that is important cases of complex abnormalities.⁵ The supplementary value of MRIs lies in the improvement of tissue characterization rather than in the improvement of anatomic characterization.¹⁶ Ultrasound is superior to MRI in the first quarter and it is more limited in advanced pregnancies, when the amniotic fluid is relatively reduced.⁶

Preparation and technical considerations

Before the study, informed consent must be obtained from the pregnant woman, it is also important to know the exact gestational week and have a recent ultrasound study, since it is the basis for the MRI study.¹ It is performed during the second or third quarters, the first one must be avoided¹ since its influence on organogenesis is not clear¹⁴ and its value is limited due to the smaller size of the fetus and the artifacts secondary to fetal movement.^{1,17} No harmful effects have been documented in developing fetuses with field intensities of 1.5 T or less. Not much information is available about biosafety with 3 T field intensities although in the preliminary studies conducted so far, no potential damage has

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