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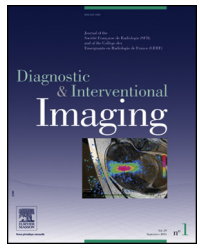

ORIGINAL ARTICLE / *Genitourinary imaging*

Contribution of the foetal uro-MRI in the prenatal diagnosis of uronephropathies

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Abstract
Purpose: To study the complementary diagnostic value and role in the perinatal management of foetal MRI in the prenatal diagnosis of abnormalities of the urinary tract.
Patients and methods: Retrospective monocentric study from November 2002 to June 2011 of foetuses benefiting from an MRI after ultrasound diagnosis of uronephropathy abnormalities. Ultrasound and MRI data were compared with postnatal radiological and/or surgical data or with the foetopathology. The MRI analysis focused on the diagnostic concordance with the ultrasound, the complementary diagnostic contribution and/or a change in perinatal care.
Results: Of the 154 MRI examined, a follow-up was obtained for 108 cases. The indications for MRI were classified into six groups: suspected renal agenesis ($n = 20$, 18.5%), posterior urethral valve ($n = 20$, 18.5%), reflux or megaureter ($n = 14$, 13%), uretropelvic junction syndrome ($n = 24$, 22.5%), enlarged kidneys ($n = 7$, 6.5%) and others ($n = 23$, 21%). The information supplied by ultrasound was confirmed by MRI in 72 patients (67%). MRI provided additional data for 36 patients (33%) and changed the perinatal care for 16 patients (15%).
Conclusion: Foetal uro-MRI is a useful complementary tool in the prenatal diagnosis of some uropathy abnormalities.

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Malformations in the foetal urinary tract are fairly common, found in 0.1 to 1% of all pregnancies and account for about 30 to 50% of the abnormalities found at birth [1]. They are most often detected by obstectrical ultrasound, the examination that remains the screening reference [2]. The spectrum of malformation is wide and the greater the reduction in amniotic fluid and the more the malformation is bilateral, the more unfavourable the prognosis. The ultrasound may be unable to provide an exact diagnosis and prognosis of the uronephropathy, especially when the conditions are unfavourable (maternal obesity, unfavourable position of the foetus, oligohydramnios). In this situation, magnetic resonance imaging (MRI) is of value. With the increasingly fast sequences, it helps assess the foetal anatomy without requiring maternal sedation, and without being disturbed by the aforementioned factors.

In this context, MRI has been validated as an effective technique to assess foetuses suspected of malformations (in particular neurological malformations), although its contribution to the diagnosis of foetal uronephropathies has only been demonstrated in studies carried out with a very limited number of subjects [9—12]. The purpose of this study is to assess the complementary diagnostic contribution and the role in the perinatal care of foetal MRI in the prenatal diagnosis of uronephropathies.

Patients and methods

This retrospective, monocentric study was carried out on pregnant women benefiting from a foetal MRI for suspicion of uropathy or nephropathy abnormalities. A foetal MRI was carried out on all of the patients included, between November 2002 and June 2011, at hôpital de la Timone in Marseille. This MRI followed a so-called diagnostic obstetric ultrasound examination by referring sonographers from a multi-disciplinary prenatal diagnosis centre.

The ultrasound examinations were carried out using several successive sonographs: EUB alpha (Hitashi, Tokyo, Japon), IU 22 (Philips, Amsterdam, Pays-Bas) and Voluson E8 (General Electrics, Milwaukee, USA) by means of a convex 4—8 MHz sound, by a referring obstetrician-gynaecologist or radiologist at the prenatal diagnostic centre. The foetal MRI was indicated in a multi-disciplinary staff meeting in order to better characterize the urinary anomaly, assess the state of the renal parenchyma, as well as in case of technical ultrasound difficulties (oligohydranamnios, maternal obesity, etc.).

All of the MRI was carried out on a 1.5 T machine (Philips Symphony, Erlangen, Germany). The MRI study began with location sequences and continued with HASTE T2 weighted sequences, then TRUFISP sequences, and T1-weighted sequences in the three planes in space [3—5]. Maternal sedation or injection of contract agent was not used in this examination. The MRI was interpreted by two radiologists experienced in this field.

The results of the foetal MRI were compared with those of the obstetric ultrasound as well as the ''gold standard'' grouping postnatal imaging (kidney-bladder ultrasound, cystography, uro-MRI), the surgical findings, or the results of autopsy (in case of uterine foetal death or medical interruption of pregnancy). The analysis of the MRI was used to classify the patients into two groups according whether the foetal MRI confirmed the data of the obstetric ultrasound or whether it specified them (contribution of complementary or contradictory data, verified in the follow-up) into six sub-groups according to the initial ultrasound suspicion: suspected renal agenesis, posterior urethral valve in case of bilateral ureteropyelocalyceal dilatation in the male foetus, possibly associated with bladder anomalies (Fig. 1), bilateral nephromegaly with a renal length exceeding + 2 DS (Fig. 2), suspicion of vesicoureteral reflux or stenotic megaureter in case of unilateral or bilateral ureteropyelocalyceal dilatation or bilateral by very asymmetric dilatation without bladder anomaly, suspicion of a uretropelvic junction syndrome in case of pyelocalyceal dilatation without ureteral dilatation, and other. The ''other'' category includes atypical suspicion of multi-cystic dysplasia (in particular due to their size and/or compressive nature), renal hypotrophy, bladder exstrophy (bladder not seen, parietal sub umbilical irregularities) or hypoperistaltic megabladder/microcolon syndrome.

By consensus, we considered that the MRI had an effect on the management of the rest of the pregnancy or birth when it helped modify the obstetric or perinatal care.

Results

Between November 2002 and June 2011, 150 single pregnancies and four twin pregnancies with suspicion of an uronephropathic twin benefited from a complementary MRI. When the foetal MRI was carried out, the age of gestation varied from 21 to 38 weeks of amenorrhoea (WA) with a mean assessed at 30 WA. The MRI examinations were well tolerated by the patients and the foetal movements did not alter the quality of the image, even without maternal sedation.

The postnatal data, considered as the gold standard, was only found in 108 of the foetuses (70%). The results were put into several categories according to the initial ultrasound suspicion: suspicion of renal agenesis (20 foetuses or 18.5% including 15 suspicions of unilateral renal agnesis and five suspicions of bilateral agenesis), suspicion of posterior urethral valve (20 foetuses or 18.5%), bilateral nephromegaly (7 foetuses or 6.5%), suspicion of vesicoureteral reflux or stenotic megaureter (14 foetuses or 13%), suspicion of uretro pelvic junction syndrome (24 foetuses or 22.5%), and other (23 foetuses or 21%). The renal anomalies were bilateral in 56 cases (52%) and unilateral in 52 cases (48%).

The results of the foetal MRI (combined with the ultrasound follow-up) complied with the neonatal data in 105 of the 108 foetuses, that is, in 97% of the cases, as opposed to 60 out of 108 foetuses, that is, 56% of the cases, with the ultrasound examination alone (Table 1). For three foetuses, the MRI and ultrasound were faulty, finding similar data, and invalidated by the post-natal examinations. As regards the first foetus, the obstetric ultrasound found a dilatation of the pyelocalyceal and bilateral urethral cavities and the MRI confirmed this bilateral but asymmetric dilatation uretheropyelocalyceal dilatation, with a posterior ureter visible without distinct appearance of dilatation. This latter examination concluded as to the possibility of a minor form of posterior urethral valve, a vesicoureteral reflux or stenotic megaureter. The ultrasound carried out at birth was