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Prenatal pelvic MRI: Additional clues for assessment of urogenital obstructive anomalies

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Abstract *Objective:* Ultrasound prenatal evaluation of pelvic cystic mass can be challenging. After having ruled out a cloaca anterior to a large hydrocolpos, it is important to differentiate between combined urogenital anomalies such as urogenital sinus and isolated genital anomalies.
Patients and methods: We reviewed the charts of 13 women referred for a third trimester pelvic MRI for cystic pelvic mass discovered in second trimester ultrasound. We evaluated MRI compared with postnatal surgical findings in order to determine clues for improving prenatal diagnoses.
Results: MRI excluded the diagnosis of cloacal malformation in nine cases with no false negative. Once a cloaca is ruled out, a different signal between the bladder and the hydrocolpos on T2 sequences is in favor of an isolated genital obstruction. In contrast, in case of urogenital sinus, the vagina is filled with a mixture of genital secretions and urine, which gives it an MRI signal similar to the bladder on T2 sequences.

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Conclusion: Third trimester fetal MRI is an essential exam for characterization of pelvic cystic mass diagnosed by ultrasound. This exam appears valuable for invalidating the diagnosis of cloacal malformation and for differentiating between isolated genital obstruction and urogenital sinus.

Introduction

Prenatal diagnosis is a difficult exercise. Indeed, once Pandora's box is open, one has to deal with worried parents, expecting clear explanations about their impending child. Despite huge progress, difficult situations remain in which one has to discuss the prognosis of a suspected malformation, this point being the most important one for future parents. Considering pelvic obstructive malformations in female fetuses, this situation is frequently encountered as the panel includes benign situations such as imperforate hymen or more complex defects with a more uncertain prognosis and completely different therapeutic implications such as urogenital sinus, vaginal atresia, blind hemivagina, persistent cloaca or more complex urogenital defects [1—4]. All these malformations can share almost identical prenatal presentations with fetal cystic pelvic or abdominopelvic masses diagnosed on second trimester ultrasound [5—8]. To make the distinction between an isolated hydrocolpos, a urogenital sinus, a megacystis or a cloaca can be challenging by ultrasound only. A major question in this situation remains identification of a cloacal malformation because of the technical surgical challenge it represents and the implication on parental counseling. The introduction of fetal MRI has been a great advance in this field [6,9—11], and numerous studies have now settled on clues to diagnose these cloacal malformations [9,12,13]. Once a cloaca is ruled out, and anterior to a large hydrocolpos on MRI, it is important to differentiate between combined urogenital anomalies such as urogenital sinus and isolated genital anomalies. We report our experience with fetal MRI in these malformations. Our aim was to evaluate MRI compared with postnatal surgical findings, and to reinterpret images in light of postnatal diagnoses in order to determine clues for improving prenatal diagnoses of urogenital obstructive anomalies in female fetuses.

Methods

The institutional ethics committee approved this retrospective study.

Patients

Thirteen women were referred for a third trimester pelvic MRI at our institution between July 2000 and August 2011. Fetal MRI was indicated based on diagnosis of cystic pelvic mass discovered in second trimester ultrasound. MRI studies were performed between 28 and 39 weeks of amenorrhea. We reviewed the charts of these patients and evaluated MRI images in light of the postnatal surgical findings.

MRI technique

No maternal sedation was required. The exam was performed without contrast injection. The women were positioned in the decubitus position. MR images were acquired by T2- and T1 erasme-weighted sequences on a 1.5 T Scanner (PHILLIPS Intera Achieva) and in multiple orthogonal planes with respect, as much as possible, to the fetal orientation.

Data collection

A pediatric surgeon retrospectively reviewed the charts, and images were reinterpreted by a senior pediatric radiologist in a single blind manner. The analysis of fetal MRI images focused on the urinary system and the genital tract, and particularly the content signal of each structure.

Results

All the exams were performed without complications. The 13 fetuses were separated into two groups after prenatal MRI.

Prenatally suspected cloaca group

For four fetuses, the association of the following findings: absence of meconium hypersignal anterior to the sacrum on T1W sequence (normally found at 22 weeks of gestation), abnormal high level of the distal part of the rectum, and a dilated colon (Fig. 1a); had led us to suspect a cloacal malformation. As regards the genitourinary system, a large hydrocolpos that had almost the same content signal as the bladder on T2W sequences (Fig. 1b) was seen in three cases. Postnatally, the cloacal malformation was confirmed in three cases. For two patients this diagnosis was confirmed during endoscopic postnatal evaluation of high cloaca with 4 cm common channel. The third had a pregnancy termination. This fetus had prenatal parameters of associated severe renal failure and the parents wish to terminate the pregnancy was accepted by the multidisciplinary prenatal counseling according to French law. Fetopathologists confirmed the diagnosis of cloaca. The fourth child of this group had no cloaca but a rectal duplication associated to distal rectal stenosis with normal genitourinary system (Fig. 2a and b). The prenatal MRI of this child did not find hydrocolpos and misdiagnosed a cloaca. The pelvic cystic mass seen on ultrasound was the rectal duplication with the meconium hypersignal in T1-weighted sequence (Fig. 2a), whereas no genital retention was seen in T2 sequence (Fig. 2b).

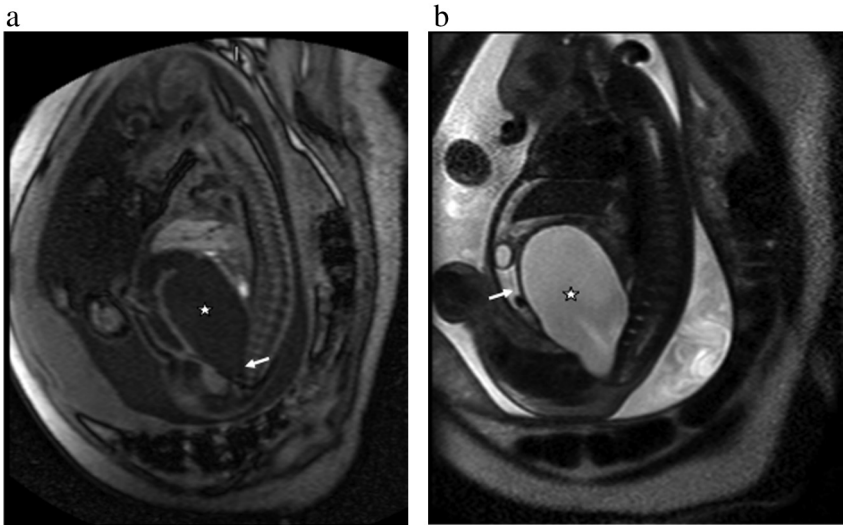

Figure 1 (a) T1-weighted sequence, sagittal view of a fetus with a cloacal malformation. Absence of meconium hypersignal anterior to the sacrum (arrow). A large hydrocolpos (asterisk) is seen posterior to the bladder. (b) T2-weighted sequence, sagittal view of a fetus with a cloacal malformation. A large hydrocolpos (asterisk) having almost the same content signal as the bladder (arrow) on T2W sequences.

Prenatally excluded cloaca group

For the nine remaining fetuses, the visualization of the typical hypersignal on T1W sequences anterior to the sacrum (identifying a normally filled rectum with meconium) excluded the diagnosis of cloacal malformation with no false negative. Prenatal MRI diagnoses were normal urogenital system in one case and obstructive genital anomaly with hydrocolpos in the eight remaining cases. The fetal MRI could not differentiate a simple obstructed vagina from persistent urogenital sinus anomaly. Postnatal diagnoses of these eight children were: large obstructive left megaureter ($n = 1$), urogenital sinus ($n = 4$), and imperforate hymen ($n = 3$). Retrospective analysis of MRI images of these seven fetuses with imperforate hymen or urogenital sinus highlighted a specific sign on fetal MRI that allowed differentiation of urogenital sinus from isolated genital obstruction in all cases. Indeed, all the patients with imperforate hymen had a decreased signal content in the hydrocolpos compared with the bladder signal on T2W sequences, whereas patients with urogenital sinus had the same intense T2W signal content in the bladder and the hydrocolpos. Demonstrations of these findings are shown in Figs. 3 and 4.

Discussion

Overall in our series, MRI rightly excluded the diagnosis of cloaca in all cases with no false negative and suggested a cloacal malformation in four cases with one false positive diagnosis corresponding to an isolated long rectal atresia

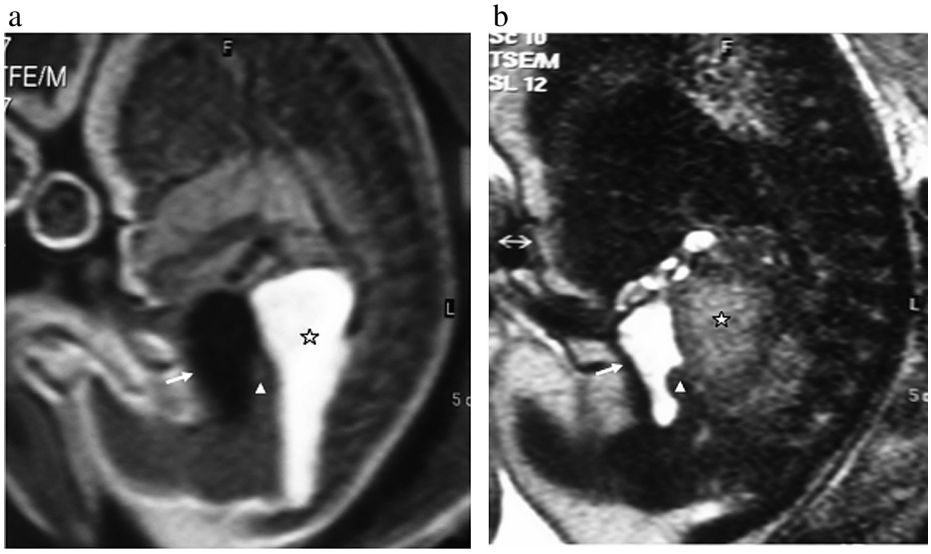

Figure 2 (a) T1-weighted sequence, sagittal view of a fetus with rectal atresia. Dilated rectum (asterisk), bladder (arrow) and genital system (arrowhead). (b) T2-weighted sequence, sagittal view of a fetus with rectal atresia. Dilated rectum (asterisk), bladder (arrow) and genital system (arrowhead).

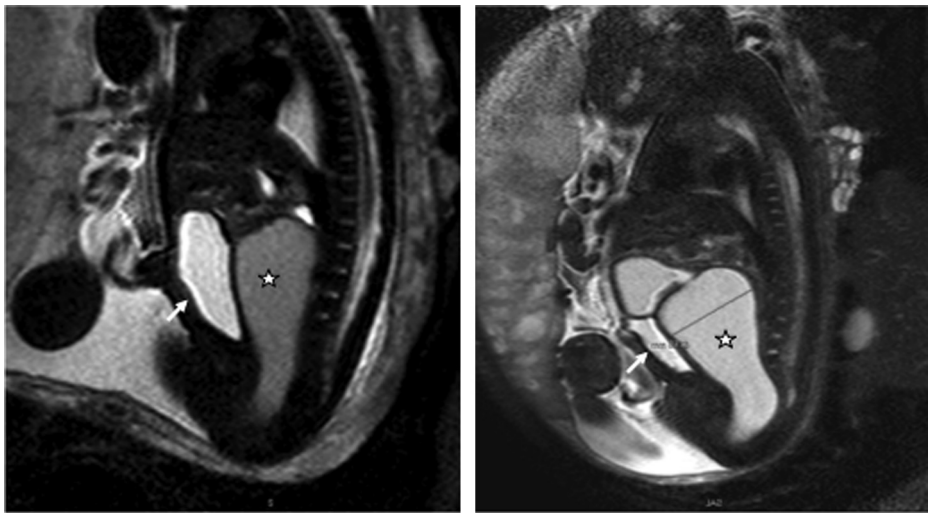

Figure 3 T2-weighted sequence, sagittal view of two fetuses with imperforate hymen. A large hydrocolpos (asterisk) with a decreased signal content compared with the bladder signal (arrowhead) on T2W sequences.

with associated duplicate rectum. Moreover, systematic review of the MRI images allowed differentiation between urogenital sinus and imperforate hymen in all cases. This study confirmed the usefulness of MRI in these situations.

Contribution of fetal MRI to supplement equivocal prenatal ultrasound findings is essential in the field of urogenital malformation in female fetuses. Indeed this situation is frequently associated with large pelvic cystic mass in second trimester ultrasound, which can be related to obstructive uropathy, obstructive genital anomaly, combined obstructive urogenital anomaly or cloaca. Regarding all the possible diagnoses, the accuracy of prenatal ultrasound is rapidly reached [10,11]. With fetal MRI it has become possible to further assess these malformations and even to settle prenatal confident diagnosis.

Obstructive genital anomalies (imperforate hymen, vaginal atresia) or combined obstructive urogenital anomalies (persistent urogenital sinus, cloaca, blind hemivagina) can be responsible for visible fetal hydrocolpos [6,9]. The retention is secondary either to accumulation of genital secretions caused by estrogenic impregnation of the fetus by maternal hormones in the case of mucocolpos of isolated genital obstruction, or to a mixed muco-urocolpos in the case of urogenital obstruction. This difference in vagina content is expected to give a different signal from T2W sequences, and this was confirmed in our study.

Considering cloacal malformation, Calvo-Garcia et al. [12] presented a comprehensive retrospective study of about six patients, that gives all the clues to reach a confident prenatal diagnosis of this anomaly and we were able to confirm this retrospectively in our series. In our work, we tried to further implement the MRI diagnosis algorithm of pelvic cystic mass in a female fetus once a cloacal malformation was ruled out by MRI.

In the retrospective analyses of the three patients with imperforate hymen in our series, we found that accumulation of genital secretions (mucocolpos) was visualized as a decreased T2W signal content of the vagina compared with the hypersignal content of the bladder on T2W sequences. On the other hand, in all cases of urogenital sinus, the MRI signal content of the vagina was almost similar to that of the bladder on T2W sequences, a logical finding as the vagina is filled with a mixture of genital secretions and urine (uro-mucocolpos). Moreover, the same findings were seen

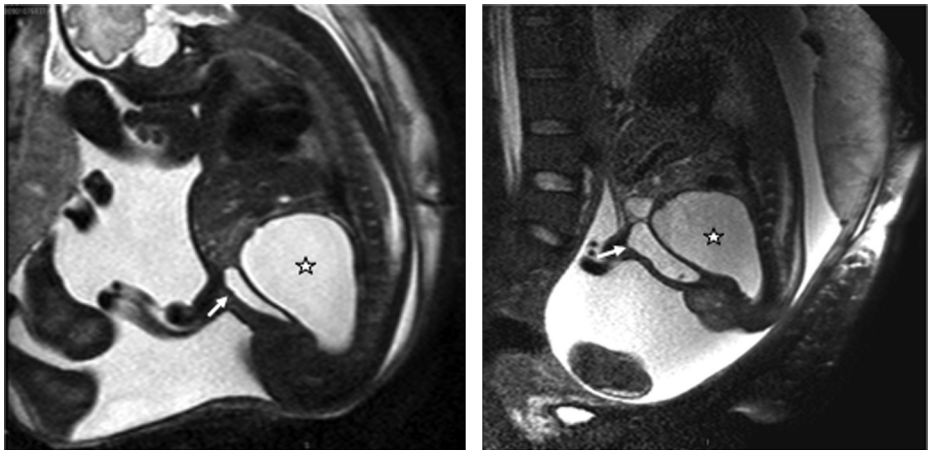

Figure 4 T2-weighted sequence, sagittal view of two fetuses with urogenital sinus. A large hydrocolpos (asterisk) sharing almost the same content signal as the bladder (arrow) on T2W sequences.

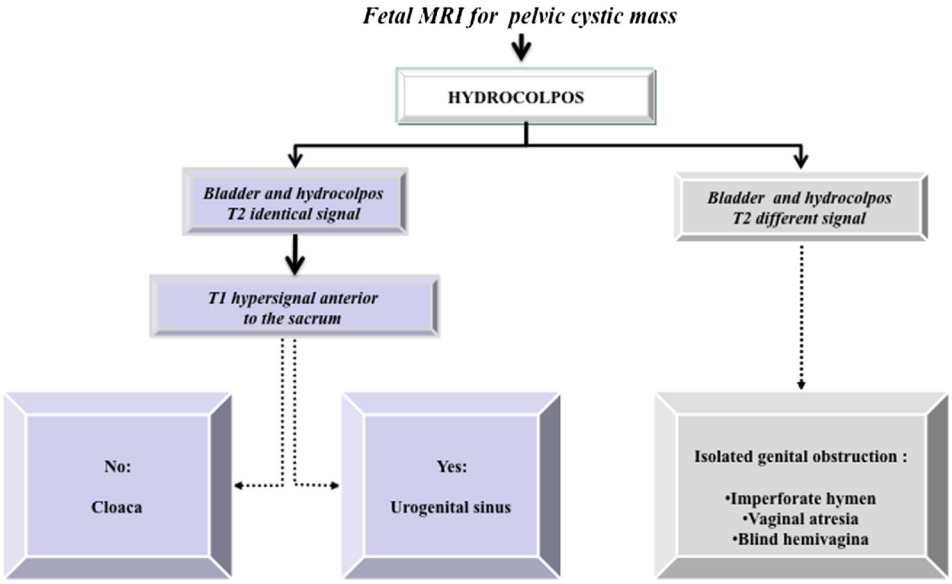

Figure 5 Diagnosis algorithm.

in all the patients with cloacal malformation associated with hydrocolpos in our series. A large review of recent case reports disclosing good-quality images of either cloacal malformation with hydrocolpos [12,14—17] and urogenital sinus [18] or imperforate hymen [9] confirmed the findings of our study, except in one case of suspected imperforate hymen for which the final diagnosis was not clear according to the authors [7]. Our study adds to this literature a diagnosis algorithm (Fig. 5) that will help to differentiate urogenital obstructions to isolated genital obstruction in female fetuses.

Conclusion

Third trimester fetal MRI is an essential exam for characterization of pelvic cystic mass detected by ultrasound. This exam is valuable for invalidating diagnosis of cloacal malformation and for differentiating between isolated genital obstruction and urogenital sinus.

Conflict of interest

None.

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