

Ultrafast Magnetic Resonance (MRI) in Fetal Diagnosis

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Summary

The aim of this study is to see how the ultrafast fetal MRI can help ultrasound (US) in the diagnosis of fetal anomalies. US and MRI were reviewed and compared with postnatal findings. 84 women (87 fetuses) with complicated pregnancies (24 – 37 weeks' gestation) were studied with US and 1.5T MRI. MRI better documented three complete agenesis of the corpus callosum, two cases of suspected hypoplastic kidney by US, had turned out to be normal by MRI, renal agenesis (3), diaphragmatic hernia (8), lymphangioma (1); bronchopulmonary sequestration (1); Chiari III malformation (1) and cerebral tumor (1). US better documented cardiac malformations such as rhabdomyoma (1), ventricular septal defect (2), hypoplastic left heart syndrome (1); and skeletal anomalies such as radius agenesis (1). MRI seems to help US in the evaluation of central nervous system anomalies and urinary abnormalities in cases of severe oligohydramnios, and helped to exclude other anomalies associated. US was better in the evaluation of cardiac defects.

Introduction

Obstetric imaging techniques should be safe, noninvasive and capable of providing good tissue definition. The potential use of MRI in the fetus was first described in 1983 by Smith et al. It was proved to be a useful, non-invasive technique for examination of the fetus, and has also been proposed for prenatal diagnosis of congenital abnormalities. The absence

of ionizing radiation and of known adverse effects in vivo and in vitro make it acceptable for use in pregnancy (Mattison et al, 1988). It appears to be a promising technique complementary to US in difficult cases. We report our three year experience with MRI in malformed fetus after US evaluation.

Material and Methods

The study involved 84 women with 87 fetuses (3 sets of twins) between 24 and 37 weeks. Most of the patients were recruited into the study after abnormal fetal US findings and clinical obstetric indication. US was performed with a GE (GENERAL ELECTRIC) LOGIC 500 with 3,5 and 5,0 MHz transducers. MRI was performed within 1 week of US. Informed consent was obtained before the examination in each case. Maternal pre-medication was given (a tablet of Rohpnl) in 6 cases of extremous maternal anxiety. MRI was performed with a Magnetom Vision 1.5T (SIEMENS) and Signa Horizon 1.5T (GE-Mewalk-USA), with T2 weighted (HASTE and SSFSE). Patients were in the supine position with the head entering the magnet bore first. Initial fetal localization was carried out and further imaging were obtained in planes that gave optimum fetal visualization. The time for complete fetal imaging was around 20 minutes.

Results

All MRI exams were well tolerated. There were no complaints of claustrophobia. Artifacts caused by movement were minimal and did not disturb the images. No maternal or fetal adverse effects associated with MRI were reported. MRI better documented three complete agenesis of the corpus callosum (Fig. 1), two cases of suspected hypoplastic kidney by US

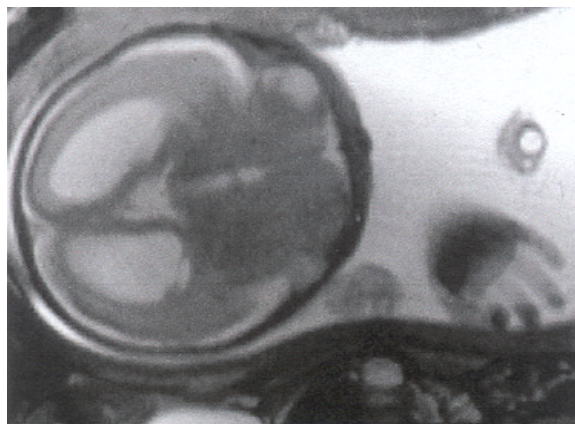


Figure 1: Head T2 axial plane MRI scan at 34 weeks of gestation, demonstrating colpocephaly in the agenesis of the corpus callosum.



Figure 2: Left-sided congenital diaphragmatic hernia at 32 weeks gestation. Coronal T2w SSFSE shows gastric organoaxial volvulus. Note greater curvature is superior to lesser curvature

turned out to be normal by MRI, renal agenesis (3), diaphragmatic hernia (8) (Fig. 2), lymphangioma (1); bronchopulmonary sequestration (1); Chiari III malformation (1) (Fig. 3) and cerebral tumor (1). MRI excluded other fetal anomalies associated with anencephaly (1); Chiari II (9); hydrocephaly (8); microcephaly (1); Dandy-Walker (3); hydranencephaly (1); intracranial hemorrhage (3); holoprosencephaly (1); encephalocele (3); cystic

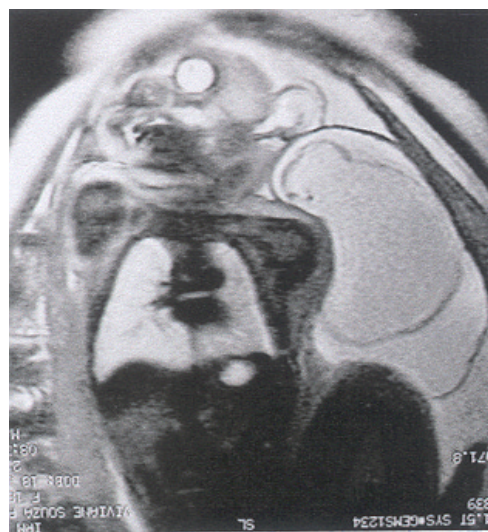


Figure 3: Coronal view T2w MRI scan at 35 weeks of gestation demonstrating a occipital encephalocele in a case of Chiari III.

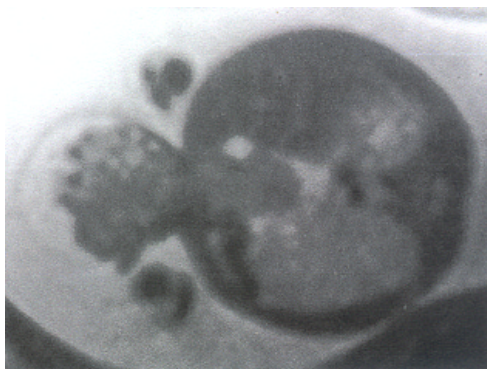


Figure 4: Omphalocele (Fetus at 25 weeks gestation). A axial SSFSE show the small bowel loops into the omphalocele sac.

adenomatoid malformation (1); omphalocele (2) (Fig. 4); gastroschisis (1); limb-body wall complex (2); multicystic dysplastic kidney (4) (Fig.5); hydrotorax (2); hydrops (3); urethral valves posterior (3); hydronephrosis (1), radius agenesis (TAR syndrome) (1); inferior limbs agenesis (1); thanatophoric dysplasia (2); sacrococcygeal teratoma (1) (Fig. 6); malformations related to fetal rubella and toxoplasmosis (3). US better documented cardiac malformations such as rhabdomyoma (1), ventricular septal defect (2), hypoplastic left heart syndrome (1); and skeletal anomalies such as radius agenesis (1).



Figure 5: Multicystic dysplastic kidney (fetus at 32 weeks gestation) – Sagittal T2 SSFSE image demonstrates multiple large cysts of different sizes in the kidney.



Figure 6: Sacrococcygeal teratoma (fetus at 33 weeks gestation). Sagittal T2 SSFSE image show a large multi-locular masse in the sacrococcygeal region.

Discussion

MRI is a valuable complement to US when additional information is needed to confirm diagnosis during pregnancy. Although US remains the modality of choice for routine antenatal imaging because of its low cost, widespread availability, safety, accuracy and real-time capability, MRI is a potential imaging technique in obstetrics (Williamson et al, 1989). In the past, fetal movement artifacts were problematic. Therefore, fetal motion suppression with fetal curarization was recommended (Daffos et al, 1988). More recently, MRI with fast sequences has allowed each set of images to be obtained during maternal breath-holding, without fetal or maternal sedation. It allows clear fetal imaging in such high-risk situations such as maternal obesity and oligohydramnios, where it may be difficult to obtain clear images by US (Werner et al, 1994). It has also proved to be useful for a wide variety of disorders, mainly those involving the central nervous system, when after 33 weeks of gestation, the ossification of the calvarium limits a good visualization by US of the encephalic structures, the posterior fossa in particular (Levine et al, 1997). In our series, we had 7 cases of normal MRI, among which one was a Down syndrome with cardiac septal defect showed only by US, one of each of the two sets of twins, one case of Klinefelter's syndrome and three others with soroconversion for rubella (2) and toxoplasmosis (1) in the first trimester. 37 fetuses were born alive, and the others had their diagnosis confirmed by anatomopathology

study. In 20 cases, MRI showed additional findings to US, such as complete agenesis of the corpus callosum (3); suspected hypoplastic kidney by US turned out to be normal by MRI (2); renal agenesis (3); diaphragmatic hernia (8); lymphangioma (1); bronchopulmonary sequestration (1); Chiari III malformation (1) and cerebral tumor (1). Nevertheless, US better documented cardiac malformations such as rhabdomyoma (1); ventricular septal defect (2); hypoplastic left heart syndrome (1); and skeletal anomalies such as radius agenesis (1). We believe that US and MRI are complementary imaging methods in the evaluation of high-risk pregnancy. The patients' counseling and care can be changed when an anomaly is detected by US and additional findings are offered by MRI.

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