Fetal Gastrointestinal Imaging with MRI

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Introduction:
Although magnetic resonance imaging (MRI) of the fetus was sometimes used for the fetal imaging in the past, its usefulness was limited by the fetal motion arising from long acquisition times of MRI. The recent prevalence of prenatal MRI has been associated with the developments of ultrafast MR technique such as single-shot fast spin-echo sequence (SSFSE, GE). The SSFSE sequence is basically immune to motion artifact. With this technique, the heavily T2-weighted images of the fetus are obtained in 1-2 seconds per slice without image degradation. Ultrasound (US) is a method of choice in evaluating fetus because of its real-time display and non-invasive nature. However, MRI seems to be superior to US in the objectivity in general. Although there have been several papers regarding fetal CNS and respiratory disorders using MRI (1, 2), the reports of fetal gastrointestinal disorders with MRI are limited. In this study we focused on the fetal gastrointestinal MRI and compared with US.

Materials and Methods:
Thirteen fetuses suspected gastrointestinal abnormalities on US (four GI tract obstruction or stenosis, three omphalocele, three gastroschisis, one duodenal atresia, one diaphragmatic hernia, one hepatic mass) were referred for MRI. All studies were performed on a SIGNA advantage echo speed system (1.5T, version 5.7, GE) using a torso array coil. After a scout scan was done, a series of fetal images with axial, sagittal and coronal planes were performed using SSFSE. The scan parameters were TR/TE = 2.0/98 ms, 31.2 kHz, 0.5 NEX and scan time was approximately 20 seconds, which allowed for maternal breath-hold studies. Tl-weighted fast spin echo (FSE) or IR-prepared SSFSE (TI= 800-1000 ms) were also used to obtain Tl-weighted fetal images.

Results:
In all fetuses with omphalocele, gastroschisis and duodenal atresia, the MRI diagnoses agreed with US diagnoses. In the cases of GI tract obstructions and diaphragmatic hernia, MRI added additional information to US in terms of obstructive sites and prolapsed structures. The proximal small bowel appeared hyperintense on SSFSE and hypointense on T1-weighted FSE. In contrast, the distal small bowel and colon appeared intermediate- to hypointense on SSFSE and hyperintense on T1-weighted FSE. These signal differentiation made MRI diagnoses more clear than US. In one case of hepatic mass, only MRI revealed the exact delineation of mass. MRI helped further characterization of fetal gastrointestinal lesions in 6 cases of 13.

Discussion and Conclusion:
The usefulness of the fetal MRI has been described in terms of CNS and chest lesions. In our study, we showed the diagnostic utility of fetal MRI in gastrointestinal lesions. The small bowel and colon were easily differentiated according to the signal intensity differences. The small bowel showed hyperintensity on SSFSE and hypointensity on T1-weighted FSE owing to the presence of amniotic fluid. The colon showed hypointensity on SSFSE and hyperintensity on T1-weighted FSE owing to the meconium (Fig.1). These characteristic MR appearances were useful to evaluate fetal gastrointestinal disorders and provided additional information to US.

Fig. 1: SSFSE (upper) and T1-weighted FSE (lower) images of small bowel stenosis. The operation showed two stenotic sites of small intestine, making the dilated bowel loops different signal intensities. Note the colon shows hypointensity on SSFSE and hyperintensity on T1-weighted FSE.

References: