Comparison of US and MR measurement of fetal biometrics at 28-32 weeks with a real-time MR sequence

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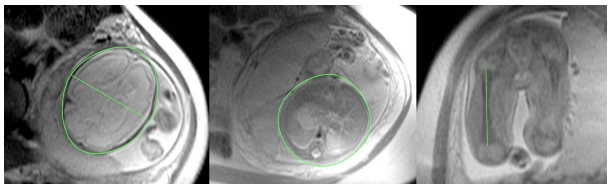
Target audience

This abstract is relevant to those with an interest in obstetric imaging with MRI.

Purpose

Quantification of standard elements of fetal biometry is important in the routine ultrasound assessment of fetal growth and development. Ultrasound based nomograms for values such as head and abdominal circumference (HC, AC), biparietal diameter (BPD) and femur length (FL) are well established, and used to aid clinical decision making. Fetal MRI is increasingly used for investigating suspected fetal abnormalities but there are relatively few publications on non-cranial biometry[2, 3], although a standard chart has been proposed for cranial MRI biometry.[1]

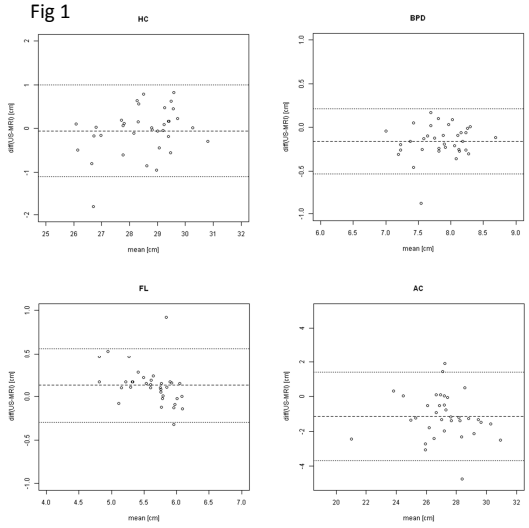
Accurate measurements require precise positioning of image sections within the fetal abdomen, brain and aligned with the femur, which can be challenging given both fetal and maternal motion. This is achieved relatively easily with real-time ultrasound but is more difficult with MRI. Current MR methods rely on the operator being quick enough to position and capture a stack of static 2D images using fast sequences such as balanced SSFP or single shot RARE. This adhoc approach has become more practical with faster user interfaces, but remains sub-optimal. In this work we investigate the feasibility of using a previously developed real-time SSFSE sequence[4] to obtain fetal biometric measurements and compare these for accuracy and bias with same day routine ultrasound measurements.



Methods

Participants were recruited from the Maternal Ultrasound Unit between 28 and 32 weeks of pregnancy, with a single gestation and no concerns for the fetal development. MR examinations were performed using a 1.5 T MR system (DV450, GEHC, Wisconsin) with 8 channel body array and a left decubitus position. A real-time SSFSE sequence, providing on the fly modification of FOV, section thickness and TR was implemented with image plane navigation using a proprietary interface (iDRIVE, GEHC). Real time MR sequences were acquired by an MR trained radiographer to optimise the required locations for abdominal circumference, biparietal diameter and femur length measurement. Ultrasound (Voluson, GEHC) examinations, including routine biometric measurements were performed on the same day by a single experienced operator. The MR images were subsequently reviewed on a workstation (Osirix) by two operators (blinded to the US findings) who made AC, FL, HC, and BPD measurements. A one-way intra-class coefficient (ICC) was derived to assess inter-rater agreement. Bland-Altman plots are used to assess bias between MR and US.

Fig 1



Results

Acceptable image locations for all the required measurements were obtained in 35 patients. The Bland-Altman graphs shown in Figure 1 compare the MR and US measurements for AC, HC, BPD, and FL. The ICC for HC, BPD, FL and AC was 0.874, 0.894, 0.713 and 0.687 respectively.

The average time to assess the biometry for each patient was 613±145.6s and the time to first image was 242±115.9s.

Table 1: Bland Altman Statistics (cm)

	Bias	lower 95% CI	upper 95% CI
HC	-0.054	-1.106	0.998
BPD	-0.160	-0.532	0.211
AC	0.133	-0.299	0.564
FL	-1.134	-3.688	1.419

Discussion

The results indicate that it is possible to obtain fetal biometric measurements with MR, with good inter-observer agreement and minimal bias for HC measurement. Measurements for AC and BPD were also reasonable with a slight overestimation bias on BPD which may relate to the skull appearances on MRI. FL measurements proved less accurate; on MR it can be difficult to clearly identify the entirety of calcified femur. The length of time to acquire the real-time images was acceptable when compared with routine US biometry examinations (in our institution 20 minutes).

Conclusion

This study demonstrates that fetal biometry using a real-time MRI technique is feasible and enables acquisition of images that can provide biometric information equivalent to ultrasound. Use of a real-time technique can compensate for the positional difficulties implicit in fetal imaging. This technique could be extended to evaluate pathology where accurate sizing or pre-operative planning is important.

References

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