Usefulness of BOLD MRI to assess fetal response to maternal hyperoxigenation in IUGR and normal fetuses
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Objective
To characterize foetoplacental response to maternal hyperoxygenation in intrauterine growth restriction (IUGR) and normal growth foetuses by blood oxygenation level dependent (BOLD) MRI imaging.

Methods
These are preliminary data from an ongoing IRB approved case control study. Six fetuses were scanned in a Signa HDxt 3 Tesla MRI scanner (GE Healthcare, Waukesha, WI), five normal growth fetuses with no indication of placental abnormality and 1 IUGR fetus 2th centile with normal Doppler. Whole uterus was imaged by single shot EPI with resolution of ~ 2.5x2.5x3 mm³, TR ~ 9 s. Oxygen was supplied automatically by an offlometer synchronised with the MRI scanner (Borromeo S et al, 2010) from air (21% O2, normoxic), to oxygen (15L/min, hyperoxic), and back to air (normoxic), and delivered to mother via nonrebreathing facial mask. Correction of signal nonuniformity and motion in time series were performed as described in (AbaciTurk et al, ISMRM 2015). The mean signal value of placental and fetal (liver) regions were calculated for each measurement, and normalized to baseline, forming the time activity curve.

Results
Significant BOLD signal increases were observed in whole placenta and fetal liver during hyperoxia (p<0.01). The increases were assessed in normal group: 14.8% ± 10.0 for placenta, 5.28% ± 10.7 for liver, and compared with literature values: 15.2% ± 3.2 for placenta (Sorensen et al 2013a), 6.5% ± 1.6 for placenta and 14.3% ± 3.7 for fetal liver (Sorensen et al 2013b). The IUGR case with normal Doppler showed placenta 22.2%, and liver 37.2% however was not statistically different from the control group (p>0.05).

Conclusion
We have shown foetoplacental response to maternal hyperoxygenation in IUGR and normal pregnancies noninvasively by BOLD MRI. More clinical cases of the placenta are going to be collected to determine the clinical significance of these findings. This new method could represent a promising way to assess placental function and fetal status in the future, and new management protocols or therapeutical strategies can be developed focused on mother hyperoxigenation-BOLD response as a diagnosis/treatment for IUGR.

![Time Activity Curve For Patient with MAQ, GA 23wk+4](image)

**Fig 1:** Average maximum signal intensity data results in fetal liver and placentas during hyperoxia

![Normalized BOLD signal changes during oxygen challenge](image)

**Fig 2:** Results placental signal changes during oxygen challenge