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MRI: Late FGR and reduction in neonatal brain size, maturation and connectivity

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Objective

Fetal growth restriction (FGR) is associated with increased risk of neurodevelopmental impairment. The relationship between fetal oxygenation, brain growth and maturation in late-onset FGR is poorly understood. Novel magnetic resonance imaging (MRI) techniques can provide noninvasive insights into fetal haemodynamics, brain maturation and connectivity. These novel imaging biomarkers may predict adverse neurodevelopment in fetuses with late-onset FGR.

Methods

Prospective observational case-control study comparing haemodynamics and brain development using fetal and neonatal MRI in late-onset FGR and well-grown controls. Late-onset FGR (>34 weeks), defined as at least 2 of the following: birthweight < 3rd centile; 20% drop in centiles; CPR < 5th centile; ponderal index < 2. 2; or placental histology indicative of placental malperfusion. Fetal MRI was used to measure fetal size, brain volume, blood flow, oxygen delivery and consumption. Neonatal MRI was performed to measure brain volume, fractional anisotropy (FA) and apparent diffusion coefficients (ADC). Neurodevelopmental outcome was measured at 4, 8, 12 and 18 months.

Results

60 fetuses underwent both fetal and neonatal MRI (15 late onset FGR, 45 controls). There was no difference in gestational age at fetal or neonatal MRI. FGR fetuses and infants had reduced weight and brain volumes. FGR fetuses showed altered blood flow in major fetal vessels (SVC, DA, UV, PA). Oxygen delivery and consumption was lower in FGR fetuses, but the oxygen extraction fraction was higher. Lower cerebral oxygen delivery was associated with reduced neonatal brain volume. There was reduced FA in white matter and basal ganglia in neonates with FGR, but increased ADC. FGR infants had motor delay at 8 and 12 months, which recovered by 18 months old.

Conclusion

MRI identified changes in fetal circulation, oxygen delivery and consumption in late onset FGR that may lead to altered brain size, maturation and development. These may be novel biomarkers to identify which infants are at risk of neurodevelopment impairment.