

The Use of Super Resolution Reconstruction MRI for surgical planning in Placenta Accreta Spectrum Disorder: Case Report

Mufti N, Chappell J, O'Brien P, Attilakos G, Sokolska M, Narayanan P, Gaunt T, Humphries P, Patel P, Whitby E, Jauniaux E, Hutchinson J. C. , Sebire N, Atkinson D, Kendall G, Ourselin S, Vercauteren T, David A. L. , Melbourne A
University College London, London, United Kingdom

Objective

Placenta Accreta Spectrum (PAS) disorders are characterised by the abnormal placental attachment of villous tissue to a scarred uterine wall at birth requiring surgical resection in cases of focal lesions and hysterectomy in large lesions. Uterine remodelling after caesarean section can result in a scar defect with loss of decidua and myometrium structure allowing the placental tissue to develop close to the radial and arcuate arteries. The impact of placentation in PAS is mainly vascular and failure to recognise PAS disorders prior to delivery can lead to catastrophic haemorrhage and maternal death as the placenta fails to detach from the uterine wall and surrounding tissues. Comprehensive imaging is important to correctly manage this disorder. Current ultrasound and MRI imaging are limited to subjective assessment of typical markers. Some structural MRI signs include dark T2 extraplacental bands, placenta heterogenous signal intensity, uterine bulging, and bladder wall interruption but these signs are highly subjective, associated with uterine remodelling after surgery, and dependent on operator expertise. We present a case of PAS where we applied super-resolution reconstruction (SRR) of MRI of the placenta, to mitigate unpredictable maternal motion effects seen with standard 2-dimensional (2D) MRI, for anatomical assessment to improve surgical planning.

Methods

A 38-year old woman known to have PAS related to three previous caesarean sections underwent MRI at 34⁺² weeks of gestation. A volumetric reconstruction with isotropic high-resolution was performed based on rigid motion correction of the acquired 2D MRI slices, combined with robust outlier detection. SRR, unprocessed 2D MRI, and paired data were assessed by gynaecological and fetal radiologists.

Results

Radiologists found higher anatomical clarity of the placental-bladder interface, and were more confident regarding PAS diagnosis using paired images than either 2D MRI, or SRR alone. Additional anatomical markers such as myometrial thinning, abnormal vascularisation of the placental bed, and identification of deep placental attachment to the underlying myometrium were detected using paired images vs 2D MRI, or SRR alone. Caesarean section, performed at 36⁺² weeks' gestation, confirmed the presence of adherent placenta with extreme vascularity requiring lengthy dissection of the bladder from the lower segment, due to multiple vessels in the uterovesical fold. The placenta was manually removed but a small area (5.0x2x2cm) of adherent placenta had to be excised along with the myometrium and underwent histological examination. The uterus was thereafter closed with several haemostatic sutures to the lower segment. Total blood loss was 2.9 Litres. Histopathology confirmed PAS disorder with the villi appearing to implant directly into the scar areas separated from the remaining myometrium by a layer of fibrinoid.

Conclusion

Improved clarity using paired 2D MRI and SRR allowed for more accurate anatomical assessment which would be beneficial for surgical planning. Further cases are however required to assess the clinical utility of volumetric MRI reconstruction.