Radiology

ORIGINAL RESEARCH • OBSTETRIC IMAGING

Reproducibility of MRI Features for the Diagnosis of Placenta Accreta Spectrum Disorders

Benjamin Parnes, MD • Sara Lewis, MD • Barak Friedman, MD • Michael King, MD • Caroline Kubiak, MD • Kara Ho, MD • Kamran Ali, MD • Samantha Platt, MD • Himanshu Sharma, MD • Jackie Xiang, MD • John Doucette, PhD • Konstantin Zakashansky, MD • Bachir Taouli, MD • Amita Kamath, MD, MPH

From the Department of Diagnostic, Molecular, and Interventional Radiology (B.P., S.L., B.F., M.K., C.K., K.H., K.A., S.P., H.S., B.T., A.K.), BioMedical Engineering and Imaging Institute (S.L., B.T.), Department of Obstetrics, Gynecology, and Reproductive Science (J.X., K.Z.), and Department of Environmental Medicine and Climate Science (J.D.), Icahn School of Medicine at Mount Sinai, 1 Gustave L. Levy Pl, Box 1234, New York, NY 10029-6574. Received February 21, 2024; revision requested March 27; final revision received August 6; accepted August 13. **Address correspondence to** B.P. (email: *parnes.benjamin@gmail.com*).

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Placenta accreta spectrum (PAS) disorders are rising in incidence and are potentially life-threatening pregnancy complications (1). Placental MRI is increasingly being used for diagnosis when US findings are equivocal and to guide delivery planning. A recent meta-analysis demonstrated a sensitivity of 85% and specificity of 89% for an MRI model for predicting PAS; however, it reported variable interreader agreement for features of PAS (κ value range, 0.55–1.0) (2). Here, we report the agreement for MRI features of PAS among three readers with varying levels of experience in a large series with diagnoses confirmed surgically or histopathologically.

Materials and Methods

This retrospective study within a single health system was compliant with the Health Insurance Portability and Accountability Act and was approved by the local institutional review board, with exemption of the requirement for informed consent. A total of 131 pregnant women (mean age, 36 years [range, 21–54 years]; mean gestational age, 28 weeks [range, 12–37 weeks]) who underwent MRI for placental (n = 122) or fetal indication (controls, n = 9) between 2016 and 2021 were included. Women who underwent MRI for maternal indications were excluded. Three independent radiologists with variable experience (two faculty with 3 and 19 years of experience [observers 1 and 2, respectively] and one trainee with 1 year of experience [observer 3]) analyzed the MRI scans for the presence of seven features endorsed in an expert consensus statement (3) and placenta previa (Table). The reference standard for PAS was histopathologic examination (n = 120) or intraoperative findings at delivery (n = 11). The readers underwent a training session with two expert readers (with >10 years of experience) using examinations not included in this study. The readers evaluated all MRI scans blinded to the reference standard results. Interreader agreement was assessed using Fleiss κ or generalized linear mixed model–based ordinal κ (4).

Results

PAS was present in 54 of 131 (41%) women. The Figure presents findings from an example case. Interreader agreement for the MRI features demonstrated a wide range of variability (κ value range, 0.11–0.63), with the highest agreement observed for placenta previa, uterine-placental bulge, and intraplacental T2 dark bands. The lowest agreement was observed for focal exophytic placental mass, loss of T2-hypointense retroplacental line, and abnormal vasculature of the placental bed (Table). Overall, placenta previa and one of the seven MRI features from the consensus statement (3) had at least moderate agreemen St (κ ≥ 0.41).

Discussion

MRI features that are reproducible across readers with variable experience are essential for developing a viable diagnostic algorithm for PAS disorders. Our study included readers with varying levels of experience (including trainee and faculty experience), assessment of eight MRI features, histopathologic or surgical confirmation of PAS, and a large sample size in a North American population.

Previous studies that assessed interreader agreement on MRI features of PAS also included a range of reader experience and clinical or pathologic correlation, but had smaller sample sizes (5,6). Studies that included expert readers (>7 years of experience) demonstrated fair to almost perfect agreement (κ value range, 0.38–1.0), with lower agreement reported in studies with less experienced readers (<3 years of experience; κ value range, 0.19–0.68) (2,5–8), as in our study. These results and the results of our study indicate greater reproducibility for certain features, such as T2 dark bands and uterine-placental bulge. The features with the lowest agreement in our study were abnormal vasculature of the placental bed, loss of T2-hypointense retroplacental line, and focal exophytic placental mass, possibly due to the subjective nature and ambiguity of the feature definitions.

The use of readers with variable experience is representative of real-world experience. Our findings have implications for the generalizability of PAS diagnostic algorithms: Only MRI features with reasonable to high agreement should be considered, although an acceptable threshold has yet to be established in the context of PAS (4). In addition, training and education on the subject are required, feature definitions require clarification, and approaches such as double

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Interreader Agreement for Three Readers with Variable Experience for MRI Features Used to Diagnose Placenta Accreta Spectrum Disorders

MRI Feature*	κ Value†
Placenta previa	0.63 (0.59, 0.67)
Uterine-placental bulge	0.43 (0.31, 0.54)
Intraplacental T2 dark bands	0.38 (0.26, 0.49)
Myometrial thinning or disruption	0.34 (0.22, 0.46)
Bladder wall interruption	0.27 (0.07, 0.47)
Focal exophytic placental mass	0.18 (0.05, 0.31)
Loss of T2-hypointense retroplacental line	0.17 (0.06, 0.27)
Abnormal vasculature of the placental bed	0.11 (−0.002, 0.22)

Note.—Data in parentheses are 95% CIs.

* MRI features (other than placenta previa) are as described in the Society of Abdominal Radiology and the European Society of Urogenital Radiology joint consensus statement (3).

† κ values are Fleiss κ for binary variables and generalized linear mixed model–based ordinal κ for the categorical variable placenta previa. κ values are listed in order of decreasing value and were interpreted as follows: less than or equal to 0, no agreement; 0.01–0.20, no agreement to slight agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, substantial agreement; and 0.81–1.00, almost perfect agreement.

reading, expert consensus, and multidisciplinary interpretation should be considered. Limitations of our study include its retrospective design and lack of histopathologic correlation in all cases.

While MRI holds potential to help diagnose PAS, the limited reproducibility of certain features highlights the need for strategies to improve reader agreement.

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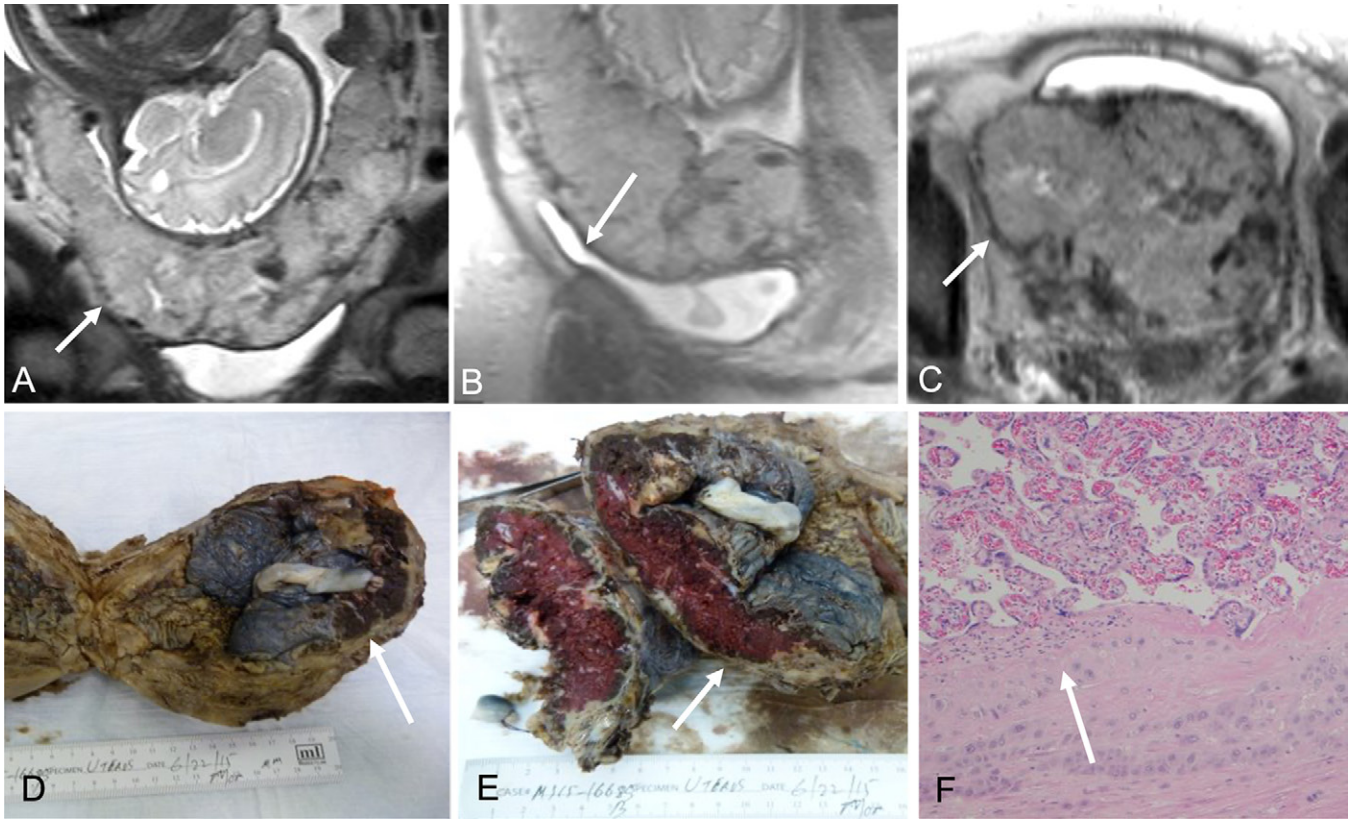

Images and findings in a 34-year-old female patient with two prior cesarean sections who underwent placental MRI at 31 weeks and 5 days of gestation. The patient subsequently underwent a cesarean hysterectomy and was found to have placenta percreta. There was agreement on five MRI signs of placenta accreta spectrum among the three readers, with disagreement for intraplacental T2 dark bands (observer 2 differed), bladder wall interruption (observer 1 differed), and abnormal vasculature of the placental bed (observer 1 differed). **(A)** Coronal and **(B)** sagittal T2-weighted MRI scans demonstrate an abnormal lobulated contour and outward bulging of the placenta (ie, uterine-placental bulge) (arrow). **(C)** Axial T2-weighted MRI scan reveals placental tissue protruding and extending beyond the uterine wall into the right parametrium (ie, exophytic placental mass) (arrow). **(D, E)** Photographs of the hysterectomy specimen. **(D)** Gross examination revealed a postpartum uterus (1063 g) with adherent mature placenta, umbilical cord, and membranes (arrow). **(E)** Sectioning revealed the extent of placental tissue infiltration: Placental tissue had penetrated through the full thickness of the uterine wall, closely abutting the uterine serosa (arrow). **(F)** Photomicrograph (hematoxylin-eosin stain; original magnification, 20×) from histopathologic examination shows that chorionic villi deeply invaded the myometrium (arrow).

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