

Association of placental MRI imaging heterogeneity in pre-eclampsia with neonatal birth weight and clinical outcomes

Weizeng Zheng, Liqun Sun, Qiong Luo Institution: Women's Hospital School of Medicine Zhejiang University, Hangzhou, Zhejiang, China.



1. Introduction

Preeclampsia (PE) is a progressive multisystem disorder that significantly increases perinatal morbidity and mortality due to complications like eclampsia, placental abruption, and severe fetal growth restriction (FGR).

Objective: We hypothesized that imaging heterogeneity in routine clinical placental MRI could serve as a non-invasive biomarker for evaluating placental function and predicting birth weight and adverse perinatal outcomes in PE.

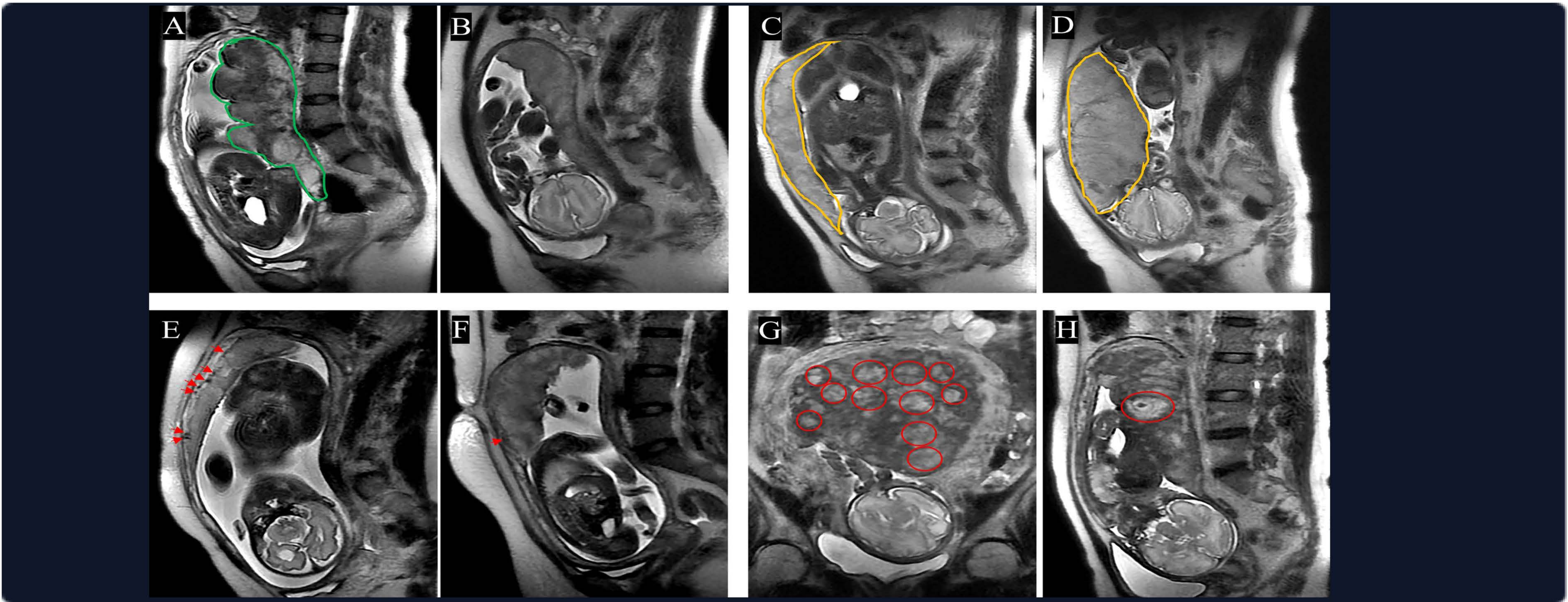
2. Methods

Cohort: Retrospective placental MRI analysis of 376 cases with PE pregnancies.

Conventional T2WI images: A. Irregular shape with serrated fetal surface; B. Regular morphology; C. Normal crescent shape; D. Abnormal shuttle shape; E. Red arrow: "flow void effect" in maternal placental vessels; F. Reduced maternal placental vascularity; G. multiple high signal areas in placenta; H. "Bull's-eye sign" describes specific lesion morphology with layered placenta: low central signal (ischemia/infarction) and surrounding high signal ring (edema/inflammation/fibrogenesis) (Fig 1).

Analysis Pipeline: Univariate/multivariable logistic regression for risk factors; model visualized via nomogram and DCA.

Figure 1: Placental MRI characteristics



3. Results

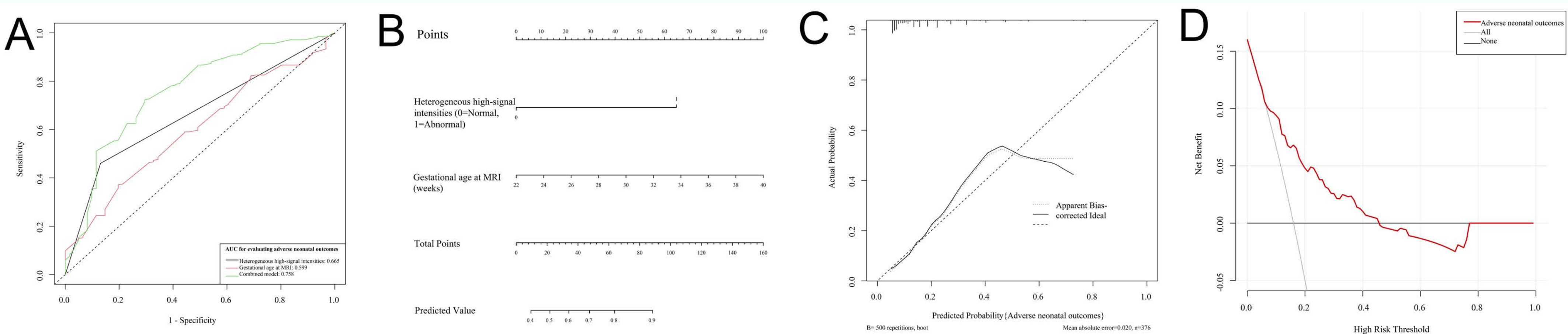
Features: Placental MRI in PE pregnancies demonstrated notable heterogeneity in both morphology (more than 30%) and signal intensity (more than 50%).

Correlation: Between placental length and birth weight ($r = 0.550$, $P < 0.01$). The placental signal heterogeneity and placental length identify severe FGR, with AUC of 0.850 (95% CI: 0.809-0.892).

Outcomes: 16.22% (61/376) of cases involved a composite of adverse neonatal events such as RDS, moderate to severe HIE, severe IVH, cPVL, NEC of >Grade 2, and ROP necessitating clinical intervention. The placental MRI imaging features yielded an AUC of 0.758 (95% CI: 0.690-0.827) for predicting adverse neonatal outcomes (Fig 2).

Validation: Calibration and decision-curve analyses substantiated the validity and clinical applicability of the constructed nomogram.

Figure 2: Clinical relevance and verification



A, Combined ROC from multivariable logistic-selected risk factors
B, Nomogram, neonatal outcomes + placental MRI risk scores
C, Bootstrap validation: MAE 0.020, good calibration; mild mid-high risk deviation
D, DCA: favorable clinical net benefit

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4. Conclusion

Our findings suggest that placental signal heterogeneity and relatively diminutive placental morphology may serve as potential imaging biomarkers for anticipating severe FGR and adverse neonatal outcomes.