

Longitudinal uterine artery pulsatility index trajectories improve prediction of placenta-related adverse outcomes

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Objective To determine whether longitudinal changes in uterine artery pulsatility index (UtA-PI) across pregnancy are independently associated with adverse perinatal outcomes beyond single time-point measurements.

Methods

This retrospective cohort study included singleton pregnancies undergoing serial ultrasound at a tertiary centre (2019–2024). UtA-PI was measured in the first (11–13+6 weeks), second (20–23 weeks), and third trimesters (35–37 weeks) and expressed as multiples of the median. Longitudinal change was quantified using early (first–second trimester) and late (second–third trimester) slopes. Multivariable logistic regression assessed associations with a composite primary severe placenta-related outcome (birthweight <3rd centile or preterm preeclampsia <34 weeks) and a secondary composite outcome (birthweight <10th centile, hypertensive disorders of pregnancy, or intrauterine death). Model performance was evaluated using AUC

Results

Among 13,916 pregnancies, 12,951 (93.0%) had complete longitudinal data. The primary and secondary outcomes occurred in 1.7% and 11.5%, respectively. First-trimester UtA-PI was associated with the primary outcome (OR 2.39, 95% CI 1.80–3.18; AUC 0.722). Addition of early slope strengthened this association (OR 8.13, 95% CI 5.58–11.84), with early slope independently predictive (OR 4.62, 95% CI 3.37–6.32) and improving discrimination (AUC 0.751). For the secondary outcome, first-trimester UtA-PI was associated with risk (OR 1.38, 95% CI 1.22–1.56; AUC 0.670). Early slope remained independently predictive (OR 2.41, 95% CI 2.04–2.85), with modest improvement in discrimination (AUC 0.681). In models including both slopes, T1 PI (OR 5.85), early slope (OR 5.10), and late slope (OR 6.50) were independent predictors, with minimal further improvement in discrimination (AUC 0.686).

Table 1. Prediction of severe placental related outcome*

	Odds Ratio (95% CI)	AUC
First Trimester Uterine Artery PI	2.39 (1.8-3.18)	0.722
Early Slope	4.62 (3.37–6.32)	0.732
First Trimester UtA PI + Early Slope	8.13 (5.58–11.84)	0.751

*Birthweight <3rd centile and pre-term pre-eclampsia < 34 weeks



Conclusion: Longitudinal UtA-PI trajectories, particularly early gestational change, improve prediction of placenta-related adverse outcomes beyond static measurements and may enhance risk stratification.