Risk Assessment of Fetuses for Hypoxic-Ischemic Encephalopathy using Antepartum Clinical Data

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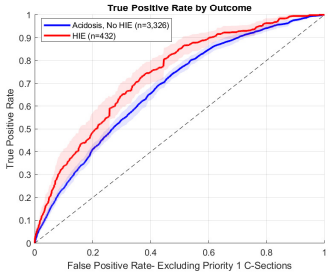
Introduction: During labour, uterine contractions can reduce oxygenated blood flow to the fetal brain leading to intermittent hypoxia. Severe, prolonged, or frequent hypoxia can result in hypoxic-ischemic encephalopathy (HIE), leading to permanent brain injury or even death.

Objective: To identify fetuses at risk of HIE based on antepartum clinical data, before consideration of intrapartum cardiotocography (CTG) monitoring.

Methods: Maternal, pregnancy, labour, outcome, and infant data from a retrospective cohort of singleton infants ($\geq$ 35 weeks) born at 16 Northern California Kaiser Permanente Hospitals between 2011 and 2019 were analysed. Three outcome classes were defined based on umbilical or early infant blood gas assessment, neurological exams, and clinical interventions: (1) HIE (n=432), (2) Acidosis, No HIE (n=3,326), and (3) Healthy (n=229,770). A multivariate logistic regression classifier was trained on the binary classes of healthy and abnormal (HIE and Acidosis, No HIE groups). During the training phase, healthy outcomes from emergency priority 1 cesarean section (c-section) were excluded as an appropriate intervention may have prevented adverse outcomes. Backward feature elimination was performed based on the Akaike information criterion to determine relevant clinical risk factors.

Results: Leave-one-out hospital cross-validation results are presented in the figure. HIE group area under the receiver operating characteristic curve was significantly greater than Acidosis, No HIE group. Notable risk factors in the final model included: parity, prior c-section, pre-pregnancy weight, pre-existing diabetes, intrauterine growth restriction, infant sex, maternal and gestational age, and hypertension or anxiety diagnosis during pregnancy.



Logistic Regression Results with 95% Confidence Interval

Conclusion: The trained model can generate prior probabilities of risk, which can be used as input with risk factors within CTG analysis to assist clinical decision-making.