



Artificial intelligence and multiomics: prediction of perinatal outcome in asymptomatic short cervix

Bahado-Singh R, Sonek JD, Cool D, Yilmaz A, Friedman P, Graham S, Aydas B, Mandal R, Wishart D, Cayuela A
Oakland University William Beaumont School of Medicine, Royal Oak, United States

Objective

To evaluate the accuracy of Artificial Intelligence (AI) analysis of combined metabolomics and proteomic testing for the prediction of perinatal outcome in asymptomatic short cervical length (CCL) patients.

Methods

Amniocentesis was performed on mid-trimester patients with asymptomatic short CL (<15 mm). Combined targeted metabolomics (NMR and LC-MS-MS) and proteomic cytokine analyses were performed on samples. Multiple AI techniques including Deep learning (DL), Random Forest, Support Vector machine, Prediction Analysis for Micro Arrays, and Linear Discriminant Analysis were performed. In addition, Generalized Linear Model (Logistic Regression) were used to predict important outcomes: moderate prematurity (<34 weeks), delivery <28 days after amnio and NICU admission. Omics biomarkers were used alone and then in combination with demographic and clinical factors such as CL. Predictive markers were ranked based on effectiveness.

Results

A total of 26 asymptomatic mid-trimester short CL cases were included. Of these 17/26 (65. 3%) delivered at <34 weeks. DL analysis yielded excellent predictive accuracy using biomarkers only for: delivery < 34 weeks: AUC 0. 883 (0. 783-0. 983) with a 91. 7% sensitivity and 70% specificity; for delivery interval from amniocentesis interval < 28 days: AUC 0. 875 (0. 775-0. 975), and for prediction of NICU admission: AUC 0. 825 (0. 723-0. 928) were achieved. Biomarkers consistently out-performed sonographical (e. g. CL) and other clinical markers with few exceptions. DL appeared superior to regression analysis for predicting outcomes. A lysophosphatidylcholine species known to be an inhibitor of myometrial progesterone receptor was the best biomarker predictor of pregnancy outcome in asymptomatic short cervix and could explain the effect of cervical length shortening on gestational length.

Conclusion

Overall, amniotic fluid biomarkers were consistently superior to CL and clinical predictors such as prior history of preterm birth for predicting perinatal outcomes in asymptomatic short cervix. Finally, we identified a progesterone receptor inhibitor that could potentially explain the mechanism of preterm birth in short cervix.