18th World Congress in Fetal Medicine

Fetal-maternal medicine in the era of machine learning

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Objective

Machine learning has emerged as a promising tool for identifying features in images and analyse large or complex data. The most ubiquitous approach is based on deep learning, where a 'black-box' system learns from a large training dataset to identify features in the data (clinically, from quantifying image features up to predicting outcome). While these systems show high performance, their inherent difficulty to provide an explanation about a calculated/predicted outcome make them difficult to integrate in a clinical scenario where reasoning on a decision rather than recognising it as a 'pattern' in the data, is of high importance.

Methods

We have developed a machine learning approach that is much closer to clinical reasoning where complex data from a patient is integrated in the mind of the physician and compared to knowledge from pathophysiology and evidence-based medicine. This is accomplished through the calculation of similarity of available data (which can be 'clinical' data such as demographics, haemodynamics, lab results, drug treatment or more complex temporal data like a Doppler velocity over a cardiac cycle, a ventricular volume over time, myocardial strain, ECG) and results in ranking patients based on their dissimilarity. Additionally, this allows to monitor a patient's evolution over time or during therapy follow-up.

Results

We illustrate this approach with the prediction of fetal growth restriction based on the integration of maternal baseline data with full Doppler profiles in the umbilical and mid cerebral artery where the complementarity of both type of data can be shown. Additionally, we illustrate the ability for assessing the temporal evolution of data through the assessment of materno-fetal measurements during labour.

Conclusion

Machine learning, based on a similar type of reasoning as clinicians do in clinical practice, offers the possibility to provide meaningful insight in complex data and seems a promising aid in clinical decision making by providing explainable insight in large and temporally evolving information.