Prediction of Live Birth in a Matched Cohort of Elective Single Embryo Transfers

Authors : Mohsen Bahrami, Banafsheh Nikmehr, Yueqiang Song, Anuradha Koduru, Ayse K. Vuruskan, Hongkun Lu, Tamer M. Yalcinkaya

Abstract : In recent years, we have witnessed an explosion of studies aimed at using a combination of artificial intelligence (AI) and time-lapse imaging data on embryos to improve IVF outcomes. However, despite promising results, no study has used a matched cohort of transferred embryos which only differ in pregnancy outcome, i.e., embryos from a single clinic which are similar in parameters, such as: morphokinetic condition, patient age, and overall clinic and lab performance. Here, we used time-lapse data on embryos with known pregnancy outcomes to see if the rich spatiotemporal information embedded in this data would allow the prediction of the pregnancy outcome regardless of such critical parameters. Methodology—We did a retrospective analysis of time-lapse data from our IVF clinic utilizing Embryoscope 100% of the time for embryo culture to blastocyst stage with known clinical outcomes, including live birth vs nonpregnant (embryos with spontaneous abortion outcomes were excluded). We used time-lapse data from 200 elective single transfer embryos randomly selected from January 2019 to June 2021. Our sample included 100 embryos in each group with no significant difference in patient age (P=0.9550) and morphokinetic scores (P=0.4032). Data from all patients were combined to make a 4th order tensor, and feature extraction were subsequently carried out by a tensor decomposition methodology. The features were then used in a machine learning classifier to classify the two groups. Major Findings—The performance of the model was evaluated using 100 random subsampling cross validation (train (80%) - test (20%)). The prediction accuracy, averaged across 100 permutations, exceeded 80%. We also did a random grouping analysis, in which labels (live birth, nonpregnant) were randomly assigned to embryos, which yielded 50% accuracy. Conclusion—The high accuracy in the main analysis and the low accuracy in random grouping analysis suggest a consistent spatiotemporal pattern which is associated with pregnancy outcomes, regardless of patient age and embryo morphokinetic condition, and beyond already known parameters, such as: early cleavage or early blastulation. Despite small samples size, this ongoing analysis is the first to show the potential of AI methods in capturing the complex morphokinetic changes embedded in embryo time-lapse data, which contribute to successful pregnancy outcomes, regardless of already known parameters. The results on a larger sample size with complementary analysis on prediction of other key outcomes, such as: euploidy and aneuploidy of embryos will be presented at the meeting.

Keywords : IVF, embryo, machine learning, time-lapse imaging data