USING AI TO PROVIDE BIOLOGICAL INSIGHTS AND UNDERSTANDING OF WHICH OF THESE INSIGHTS HAVE CLINICAL APPLICATIONS

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Background: Transitioning from time-lapse image to embryo selection for transfer, freezing or discard involves annotation: the action of converting image to numerical data. Numerical data can be used as input to models quantifying embryo viability. Currently, it is not possible to annotate all the relevant time-lapse biomarkers because it is time-consuming. It is important to assess which biomarkers are associated with clinical applications. AI may help solve this challenge.

Objective: To understand the implications of AI-derived biomarkers on embryo viability

Materials and Methods: Single center retrospective comparative study assessing 478 embryos cultured in a time-lapse incubator between January and December 2022. CHLOE-EQ, an AI embryologist support tool, automatically annotated: Blast Score, embryo viability score (EQ-Score), AI embryo ranking, blastulation, embryo area (μm^2) and diameter (μm), Zona pellucida (ZP) thickness (μm), perivitelline space (μm), ICM centeredness and ICM-TE ratio. These biomarkers were compared between utilized (frozen and transferred vs discarded) and transferred embryos (t-test). Efficacy of prediction of blastulation and utilization was assessed (AUC). Centeredness: closer to 0 = more centered, circularity closer to 0=flat ellipse, closer to 1=circle.

Results: A bigger diameter was found among embryos that were utilized (utilized vs discarded: 159 ± 21, n=310 vs 120 ± 12 n=63, p<0.001) and blastulated (blastocyst vs non-blastocyst: 149.9 ± 21, n=460 vs 123±6, n=171, p<0.001) compared to those that did not.

Embryos area at 116hpi utilized embryos was bigger (20700 ± 6300, n=310 vs 11700 ± 2700, n=63, p<0.001) than non-utilized embryos. Utilized embryos had a thicker ZP (22.1 ± 2.9, n=379 vs 21.5 ± 3, n=133, p=0.01) at 0hpi. Perivitelline space did not differ among utilized and non-utilized embryos (13.6 ± 4.41 vs 13.7 ± 5.7, p=NS), nor did embryo centeredness (0.50 ± 0.14 vs 0.5 ± 0.15) or ICM centeredness (0.41 ± 0.2 vs 0.3 ± 0.14, p=NS).

Transferred embryos had a more circular ICM than non-transferred embryos (0.79 ± 0.08 vs 0.73 ± 0.14, p<0.05) and had a lower ICM-TE ratio (0.14 ± 0.05 vs 0.19 ± 0.08, p=0.006). ICM was more centered in the x-axis (0.38 ± 0.14 vs 0.5 ± 0.17, p=0.01) and less centered in the y axis (0.61 ± 0.16 vs 0.5 ± 0.14, p=0.059) in embryos that were transferred, y-axis analysis did not reach significance. Perivitelline space did not differ among transferred embryos (12 ± 3). Neither did, ZP thickness (21 ± 3, p=NS)

EQ Score and AI embryo Rank were predictive of utilization (AUC=0.98; AUC= 0.77, n=458, p<0.001). EQ score was higher among embryos that were utilized (0.88 ± 0.19 vs 0.14 ± 0.21, n=458, p<0.001) and transferred (0.95 ± 0.08 vs 0.75 ± 0.34, n=478, p<0.001). AI Blast Score was predictive of overall blastulation and Blastulation at 116hpi (AUC=0.88, n=734, baseline=72.9%, p<0.001).

Conclusions: Utilized and transferred embryos possess unique biomarkers associated with embryo viability. Manually annotating these biomarkers is time consuming. AI tools can allow to assess specific biomarkers to support embryo selection process based on embryo datapoints.