A tool based on artificial intelligence for the evaluation of fresh donor oocytes and the prediction of blastulation: a prospective investigation

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Introduction

In recent years with the increase of the maternal age, many couples decide to start IVF treatments with donated oocytes. However, despite the fertility of donors, not all oocytes possess the capacity to develop properly, with many failing to reach the blastocyst stage. Visual assessment of oocyte morphology remains a prevalent practice, but it is subject to limitations, being subjective and ineffective in predicting competence. Recent advancements in Artificial Intelligence (AI) have emerged as a promising solution to standardize oocytes' analysis, thereby opening new perspectives in predicting their development potential. In this context, the AI-Based Image analysis system, which gives a score as a result, may enhance the management of treatments involving donated oocytes. The Score provided by the AI-Based Tool is represented by a number between 0 and 10, where 0 is associated with the lowest morphologic quality while 10 with the highest.

Objectives

This retrospective analysis has as purpose to evaluate the prediction capacity of the AI tool by determining the association between the AI-Based Score and the blastulation rate of fresh donated oocytes. The implication of the AI in the oocyte donation may help IVF clinics by assisting in the assignment of a suitable number of eggs to each couple, eliminating unnecessary overproduction of blastocysts.

Results

The analysis was conducted at 3 IVF clinics in Spain (Ginefiv Barcelona, Ginefiv Madrid, Ginemed Seville) on 1275 MII-oocytes' images collected from 145 donors and distributed to 171 recipient couples. The images were taken after oocytes' denudation and before ICSI, observed under optical microscopy, along with documented fertilization and embryo development outcomes up to the blastocyst stage, was compiled. The 7.5% of the oocytes considered (N=96/1275) were not assessed because of image defects (blurred images, CC surrounding the oocyte, dark images, stripes). Granularity, abnormal shape and refractile bodies were significatively associated with lower AI-Based Score. 2PN fertilization (OR:1.08) and blastocyst formation (OR:1.19) had a significant correlation with the AI-Based Score, even after adjusting with donor age, sperm motility, and culture medium (AUC:0.646). The AI software showed a tendency to overestimate the number of blastocysts obtained in 43% of cycles. In 82% of the cases the number of blastocysts obtained was within the predicted range or was higher (N=140), while in 18% (N=31) it was lower. The predicted probability of achieving ≥1 live birth was significantly associated with the actual cumulative live birth rate (OR:1.55 per 10% increase; AUC:0.691). In 6% of cases no blastocysts were obtained in the IVF cycles while the tool predicted from 2 to 8.

Conclusions

As demonstrated in this study, an AI-based evaluation of donor oocyte quality correlates with blastocyst formation and cumulative live birth outcomes in a multicenter cohort.

The findings indicate that the integration of AI in IVF cycles may provide an advantage in the objectivity and standardisation of the clinical management process. In addition, the incorporation of supplementary data and confounding factors has the potential to yield future enhancements to the prediction model.

Recommended reading

- *Cimadomo D, Capalbo A, Dovere L, et al. Leave the past behind: women's reproductive history shows no association with blastocysts' euploidy and limited association with live birth rates after euploid embryo transfers. Hum Reprod. 2021;36(4):929-40.*
- *Rienzi L, Cimadomo D, Maggiulli R, et al. Definition of a clinical strategy to enhance the efficacy, efficiency and safety of egg donation cycles with imported vitrified oocytes. Hum Reprod. 2020;35(4):785-95.*
- *Bartolacci A, Intra G, Coticchio G, et al. Does morphological assessment predict oocyte developmental competence? A systematic review and proposed score. J Assist Reprod Genet. 2022;39(1):3-17.*