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Using artificial intelligence to improve blastocyst morphology evaluation

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Study question:

Can time-lapse images of embryos be assessed by an Artificial Intelligence (AI) based on a genetic algorithm associated with an artificial neural network (ANN)?

Summary answer:

AI can be used to reduce inter-operator variation and to acquire additional parameters not detectable by manual optical observation of blastocysts.

What is known already:

Morphological grading of blastocysts can lead to information predictive of the implantation potential of embryos. This information can then be used to determine number of embryos to be transferred, to advise the patient on their chances of pregnancy as well as to assess the quality assurance of a laboratory. The issue is that morphological grading by humans leads to wide inter- and intra-operator variation, a problem that may be resolved using advances in AI that use mathematical variables derived from blastocyst images to automatically classify images with the objective of increasing the predictive value of pregnancy.

Study design, size, duration:

482 early to expanded blastocyst images were assessed by three embryologists and processed for standardisation. 70% of images were used for training the system, 15% were used for validation and 15% for blind testing. Inter (blind classification of 48 images by 3 embryologists) and Intra-operator (thrice evaluation of the same 48 images by each embryologist) variation was compared between the embryologists versus AI.

Participants/materials, setting, methods:

Of the 36 numerical variables extracted from the standardised images and analysed for collinearity, 24 remained which formed the input of the ANN architecture associated with the

genetic algorithm to produce a predictable output of blastocyst grading. This AI was assessed using ROC, confusion matrix and Kappa Index against three experienced embryologists.

Main results and the role of chance:

The confusion matrix (AI as the output class and the embryologists as the target class) demonstrated that serious errors (differing in more than two quality grades) occurred in 6% (4/72) of images, and the AI had a 76% (55/72) accuracy on test data. ROC curves demonstrated an excellent performance of the AI. The AI demonstrated an improved inter-operator variation (embryologist Kappa 0.358 was lower than the AI Kappa 0.757) and improved intra-operator variation (Intra embryologist 0.28, 0.41, and 0.47 Kappa scores leading to a low overall Kappa with 50-54% agreement among embryologists, versus Intra AI 1.0, 1.0, 1.0 Kappa leading to an overall perfect Kappa score and 87.5% of agreement.

Limitations, reasons for caution:

This technology is in its early stages for implementation in human IVF time-lapse practice. Collaborative work between UNESP and Boston Place Clinic is ongoing to establish the evidence-base supporting the already observed benefits of these technologies when used together. The work was supported by FAPESP funding processes # 12/50533-2, 13/05083-1, 06/06491-2 and 12/20110-2.

Wider implications of the findings:

By increasing objectivity and repeatability in embryo assessment, we can improve our efficacy of diagnosing embryo viability. Clinics can use this information to customise treatment strategies and patients can be better informed of their chances of pregnancy.

Trial registration number:

not applicable

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