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Study finds automated embryo assessment system more accurate than that of embryologists

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Embryo quality has long been considered the main determinant of implantation and pregnancy in IVF. Morphology - a visual assessment of an embryo's shape and development - has since the very first days of IVF been the key to measuring this embryo quality, and only in recent years has this morphological grading been made somewhat more scientific with the introduction of time-lapse imaging. Yet the fact remains that many morphologically "good quality" embryos in IVF - between 30 and 60% in various studies - fail to implant in the uterus and make a pregnancy. What's going wrong?

There is a strong case that chromosomal abnormalities in the embryo, which are not detectable by morphological assessment, carry some responsibility. Studies over several years have confirmed that the rate of chromosomal anomalies (aneuploidy) in embryos increases with patient age, which may explain a higher rate of implantation failure and miscarriage in older IVF patients. But even with embryo testing for chromosomal anomalies, embryos destined for transfer are still assessed morphological.

"The issue is that morphological grading by humans leads to wide inter- and intra-operator variation," said investigator Professor José Celso Rocha from São Paulo State University, Brazil. A study presented today at the 33rd Annual Meeting of ESHRE in Geneva will suggest that these long-standing difficulties may now be improved by using advances in

artificial intelligence. Thus, mathematical variables derived from time-lapse images of embryo development may now be used such that an algorithm can classify images of an embryo's development automatically - and so remove the human variable from the crucial task of morphological assessment. "To classify images automatically will increase the predictive value of our embryo assessment," said Professor Rocha. "By increasing objectivity and repeatability in embryo assessment, we can improve the accuracy of diagnosing embryo viability. Clinics can use this information as 'artificial intelligence' to customise treatment strategies and better predict a patient's chance of pregnancy."

Behind the claims lies an analysis of images taken from the development of 482 seven-day-old bovine embryos, which were used to "train" the artificial intelligence system. This analysis identified 36 assessment variables, 24 of which formed the input of the artificial network architecture. It was notable that during this initial set-up phase only "serious errors" occurred in only 6% of the assessments. Overall, the artificial intelligence system had a 76% accuracy.

Moreover, says Professor Rocha, artificial intelligence demonstrated an improved inter-operator variation (embryologist accuracy score lower than the artificial intelligence score) and improved consistency and overall accuracy of results.

Professor Rocha notes that this work has now moved on to its early stages of development in human embryos, which is being carried out at the São Paulo State University (Dr Marcelo Nogueira) in collaboration with the Boston Place Clinic in London (Dr Cristina Hickman).

Professor Rocha described the main sources of error in morphological assessment by embryologists as their degree of professional experience, emotional stress, physical fatigue, and laboratory routine. "Those features will cause subjectivity in classification of the embryo," he said.

However, because the artificial intelligence system is a technique which analyses the embryo through mathematical variables, it offers low subjectivity and high repeatability, making embryo classification more consistent. "Nevertheless," said Professor Rocha, "the artificial intelligence system must be based on learning from a human being - that is, the experienced embryologists who set the standards of assessment to train the system."

He described morphology as a "key parameter" in judging the health of an embryo, whose predictive accuracy may be even further improved by the addition of other assessment techniques, such as preimplantation genetic screening. Professor Rocha said that "if things go well" embryo assessment led by artificial intelligence could be ready for routine clinical use "in a year or so" - at least as a controlled and test version. To what extent it will improve embryo grading - and thus outcome in IVF - will depend on how thoroughly the system is "trained" and how wide the sampling of embryo images is in that training. However, for a real benefit on IVF birth rates, Professor Rocha said that artificial intelligence about the embryo would need the complementary support of artificial intelligence about the patient.

More information: Abstract O-162, Tuesday 4 July 2017: Using artificial intelligence to improve blastocyst morphology evaluation

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