Combined use of Artificial Intelligence (AI) algorithms for evaluating embryo viability and embryo genetics improves selection of embryos leading to clinical pregnancy

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Summary: Pre-selection of embryos using genetics AI improved subsequent ranking using viability AI, with fewer cycles needed to achieve pregnancy. Results suggest genetics AI may be used in a similar manner to PGT-A to pre-select embryos that are more likely to be euploid, followed by morphology-based selection for transfer.

Objective

To determine if a non-invasive AI algorithm for evaluating the likelihood of embryo euploidy (genetics AI) from Day 5 images improves selection of viable embryos when used in combination with an AI for evaluating the likelihood of clinical pregnancy (viability AI).

Materials & Methods

1149 embryo images with matched clinical pregnancy outcomes (fetal heartbeat at first scan) were retrospectively obtained from 7 IVF clinics in the USA, Australia, and Malaysia. 670 embryos were known to be euploid using pre-implantation genetic testing for aneuploidies (PGT-A); the remaining 479 embryos had not been biopsied for PGT-A screening.

All images were analyzed by 2 independent AI algorithms: AI genetics (predict embryo euploidy) and AI viability (predict likelihood of clinical pregnancy). The ability to select viable embryos was evaluated using a simulated cohort ranking method [1].

[1] Sonya M. Diakiw, *et al.* "An artificial intelligence model correlated with morphological and genetic features of blastocyst quality demonstrates improved ranking of viable embryos", Reproductive BioMedicine Online (RBMO), August 2022

Results

Both viability and genetics AI scores independently correlated with clinical pregnancy rate (p<0.0001). They also significantly correlated with each other (Figure 1).

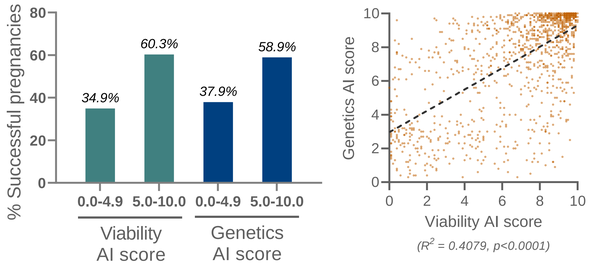

Figure 1: Correlation of viability and genetics AI scores with pregnancy rate and with each other

However, increasing genetics scores identified a higher proportion of pregnancies when applied to embryos with similarly high viability AI scores (≥ 5/10). Therefore, genetics AI provides additional information about the likelihood of pregnancy when used in conjunction with viability AI (Figure 2).

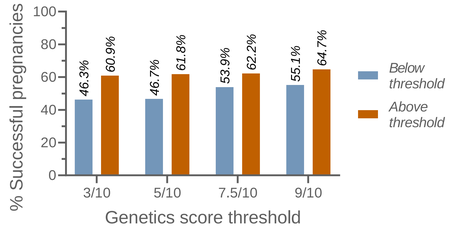

Figure 2: Additional effect of genetics AI score thresholds for identifying viable embryos when applied to embryos with similar viability AI scores

Simulated cohort analyses showed that viability AI score alone reduced the number of cycles needed to achieve pregnancy by ~20% compared to random ranking (Table 1). However, when pre-selecting embryos above a genetics score threshold first, the number of cycles was further reduced by up to 5.4% (for genetics scores ≥ 9/10). Improvement over Gardner-based ranking almost doubled when pre-selecting embryos with genetics scores ≥ 9/10. Ranking using the combined AI score over viability AI alone was only improved for embryos which had not been screened using PGT-A (ploidy status unknown).

Table 1

	Ranking method	*Improvement over random*	*Improvement over Gardner*
Embryos with unknown ploidy status	Viability AI alone	**19.9%**	**5.8%**
	3/10 genetics AI threshold + viability AI	19.3%	4.9%
	5/10 genetics AI threshold + viability AI	20.6%	6.5%
	7.5/10 genetics AI threshold + viability AI	21.9%	8.1%
	9/10 genetics AI threshold + viability AI	**24.3%**	**10.8%**
Embryos with known ploidy status	Viability AI alone	**20.9%**	**ND**
	3/10 genetics AI threshold + viability AI	20.0%	ND
	5/10 genetics AI threshold + viability AI	20.1%	ND
	7.5/10 genetics AI threshold + viability AI	20.3%	ND
	9/10 genetics AI threshold + viability AI	**20.2%**	**ND**

Wider Impact: Euploid embryos display improved clinical outcomes over mosaic/aneuploid embryos. However, randomized controlled trials have not demonstrated a consistent benefit for PGT-A (possibly due to biopsy damage or misinterpretation of results). Alternative non-invasive methods for evaluation of embryo ploidy, like the genetics AI, may improve outcomes when used with other methods for embryo evaluation and selection.