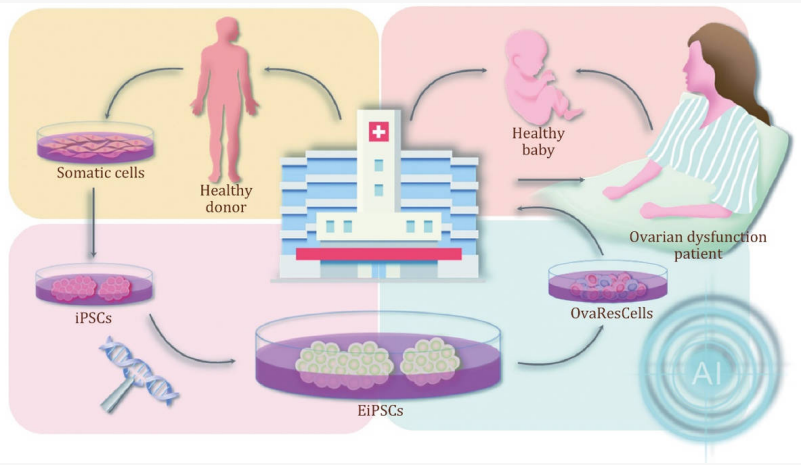
From lab to hope: the cutting-edge science fighting women's biological clocks

GA, UNITED STATES, July 18, 2025 /EINPresswire.com/ -- Recently, a piece of perspective explores the potential of combining artificial intelligence (AI) and engineered stem cells to combat ovarian aging, a major cause of female infertility. By leveraging an innovative AI tool named OvaRePred to predict ovarian reserve and identify molecular hallmarks of aging, researchers developed ovarian rescue cells (OvaResCells)—customized stem cells enhanced with gene editing to rejuvenate ovarian function. This innovative approach addresses the decline in egg quality and quantity, offering personalized treatment strategies. The integration of AI ensures precision in cell production and therapy timing, marking a significant leap toward restoring fertility in aging women.



The generation and application of OvaResCells in rescuing ovarian dysfunction.

Ovarian aging, characterized by diminishing egg reserves and quality, affects millions of women worldwide, often leading to infertility. Traditional treatments like hormone replacement therapy (HRT) and assisted reproductive technologies (ART) lack precision and fail to address root causes. Factors such as oxidative stress, mitochondrial dysfunction, and genetic variations complicate the condition. Recent advances in multi-omics and single-cell transcriptomics have unveiled cellular and molecular mechanisms behind ovarian aging, yet translating these insights into therapies remains challenging. AI has emerged as a critical tool for analyzing complex data and predicting fertility decline. Based on these challenges, there is a pressing need to develop targeted, AI-driven stem cell therapies to restore ovarian function.

Published (DOI: 10.1093/procel/pwae047) on September 3, 2024, in Protein & Cell, researchers from Peking University Third Hospital, etc. unveiled a novel strategy using AI and stem cells to tackle ovarian aging. The study introduces OvaResCells, engineered stem cells generated via CRISPR/Cas9 gene editing and optimized using machine learning. By integrating OvaRePred, an AI tool for ovarian reserve prediction, the team aims to personalize treatments for women with

age-related fertility decline. This approach promises to overcome limitations of conventional therapies by targeting molecular mechanisms underlying ovarian dysfunction.

The paper's core innovation lies in its synergy of AI and stem cell technology. OvaRePred analyzes biomarkers like Anti-Müllerian hormone (AMH) and follicle-stimulating hormone (FSH) to predict fertility milestones, guiding timely interventions. For stem cell production, somatic cells are reprogrammed into induced pluripotent stem cells (iPSCs), then edited to enhance functions related to specific genes (e.g., antioxidant or mitochondrial repair) using CRISPR/Cas9. AI algorithms, including convolutional neural networks, ensure rigorous quality control by screening iPSC clones for undifferentiated traits with 99% accuracy.

Key highlights include:
Precision Targeting: Single-cell transcriptomics identified FOXP1 and other aging-related genes as potential therapeutic targets, guiding future gene edits to rejuvenate ovarian cells.
Delivery Methods: Direct ovarian injection is proposed for OvaResCells based on preclinical evidence, with potential to improve follicle counts and hormone levels.
Scalability: AI automates large-scale cell production, addressing reproducibility challenges in stem cell therapies.
The team also emphasized overcoming hurdles like cell homing and safety via AI-driven optimization, paving the way for future clinical trials.

This approach represents a paradigm shift in fertility preservation, said Dr. Yang Yu, one of the co-corresponding authors. By merging AI's predictive power with stem cells' regenerative capacity, we can now target ovarian aging at its roots. Our OvaResCells platform not only aims to restore function but also offers a blueprint for precision medicine in reproductive health.

The technology could advance fertility treatments for aging women, cancer survivors, or those with premature ovarian failure. Clinically, OvaRePred may become a standard tool for fertility assessments, while OvaResCells could supplement or replace ART. Beyond reproduction, the AI-stem cell framework may inspire therapies for other age-related diseases, such as neurodegenerative disorders. However, challenges like regulatory approval, cost, and long-term efficacy require further study.

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