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Novel Placenta-Derived Artificial ECM Platform for Bioengineered Organ Construction

Abstract: Human organ construction holds immense potential for regenerative medicine, offering strategies to replace damaged tissues and treat refractory diseases. The extracellular matrix (ECM) serves as the fundamental for constructing functional organ units, however, developing strategies for artificially regulating the ECM to synthesize tissue-specific microenvironments to construct functional organ units remains a critical challenge.

We conduct research focused on the development of placenta-derived artificial ECM:

- 1) By systematically studying of the core ECM components and structural features across different placental layers and employing multidimensional data analysis and high-throughput screening, we elucidated the regulatory mechanisms of artificial ECM that guiding its structural design and performance adjustment and finally developed an efficient and precise synthesis strategy for placenta-derived artificial ECM.
- 2) By revealing the regulation mechanisms underlying the molecular assembly and adaptation of biological functions, a biomimetic culture system was established through multi-scale molecular assembly. This system enabled the production of function-enhanced stem cells and organoids, notably increasing extracellular vesicle (EV) secretion by 70-fold, and facilitated the culture of autologous endometrial organoids from patients with severe intrauterine adhesions (IUA).
- 3) A biomimetic carrier was engineered to carry diverse organ functional units, matching human tissue architecture to promote integration upon transplantation. And the system enabled precise adaptation of biointerface microstructures and adhesion sites across diverse organ functional units, which facilitated modular assembly and thereby constructed biomimetic organs.

For example, the bioengineered endometrium demonstrates structural and functional restoration after transplantation for effective severe IUA therapy, paralleled by the generation of mimetic ovary exhibiting both gametogenesis and endocrine functionality. This novel artificial ECM-based organ construction technology demonstrates robust translational potential for applications in organ repair and regenerative therapies.

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Keywords: extracellular matrix, biomimetic organ, in vitro organ construction, stem cell, tissue engineering

Biography: Prof. Xiao Yi is a professor in the Translational Medicine Research Center, Zhujiang Hospital, Southern Medical University. She works on stem cells/organoids and tissue engineering. She published 10 papers as the first/corresponding author in Science Advances, Advanced Materials, Biomaterials etc., and obtained approval for Investigational New Drug (IND) and inspection of Class III medical device registrations. Prof. Yi was elected into the Outstanding Youth Program of Guangdong Basic and Applied Basic Research in 2023, acquired supporting by National Key Research and Development Program of China in 2024 and won the gold award in the China Postdoctoral Innovation and Entrepreneurship Competition in 2021.