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Opinion Article

Endometrial Stem Cells: Biology, Potential, and Therapeutic Applications

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DESCRIPTION

Endometrial Stem Cells (EnSCs) are a subset of stem cells located in the endometrium, the inner lining of the uterus. These cells are vital for the regenerative capacity of the endometrium, which undergoes cyclic shedding and regeneration during the menstrual cycle. EnSCs possess unique properties that make them of significant interest in regenerative medicine, tissue engineering, and therapeutic applications.

Endometrial stem cells

The endometrium is a dynamic tissue that experiences repeated cycles of proliferation, differentiation, and shedding. This remarkable regenerative ability is attributed to the presence of stem cells within the endometrial basal layer. Endometrial stem cells are characterized by their capacity for self-renewal and multipotency, meaning they can differentiate into various cell types.

Markers: EnSCs are identified based on the expression of specific surface markers, including CD146, PDGFRβ, and SSEA-1. These markers help distinguish EnSCs from other endometrial cells.

Colony Forming Units (CFUs): EnSCs can form colonies when cultured *in vitro*, a property indicative of their proliferative potential.

Differentiation potential: EnSCs can differentiate into multiple cell types, including adipocytes, osteocytes, chondrocytes, and myocytes. This multipotency is similar to that of Mesenchymal Stem Cells (MSCs) found in other tissues.

Hormonal influence: The activity of EnSCs is regulated by ovarian hormones, particularly estrogen and progesterone. These hormones orchestrate the cyclical changes in the endometrium, influencing the proliferation and differentiation of EnSCs during the menstrual cycle.

Potential therapeutic applications

Endometrial stem cells hold significant promise for various therapeutic applications due to their regenerative properties and ease of accessibility. Their potential uses span from regenerative medicine to disease modeling and personalized medicine.

Regenerative medicine: EnSCs can be used to engineer tissue constructs for repairing damaged tissues. Their ability to differentiate into multiple cell types makes them suitable for creating grafts for bone, cartilage, and muscle repair. The paracrine effects of EnSCs, including the secretion of growth factors and cytokines, can promote wound healing and tissue regeneration. Studies have shown that EnSCs can enhance the healing of skin wounds and ulcers.

Gynecological disorders: EnSCs can potentially be used to treat conditions like Asherman's syndrome (intrauterine adhesions) and endometrial atrophy, where the endometrium fails to regenerate properly. Transplanting EnSCs could help restore normal endometrial function and improve fertility outcomes. While EnSCs play a role in the pathogenesis of endometriosis, where endometrial tissue grows outside the uterus, they also offer a potential therapeutic target. Modulating the behavior of EnSCs could provide new treatment strategies for managing endometriosis.

Cardiovascular and neurological applications: EnSCs have shown potential in cardiac repair due to their ability to differentiate into endothelial and smooth muscle cells. They can contribute to the regeneration of damaged heart tissue following myocardial infarction. EnSCs can differentiate into neural-like cells, offering potential for treating neurological conditions such as stroke, spinal cord injury, and neurodegenerative diseases.

Disease modeling and drug screening: EnSCs can be used to create *in vitro* models of the endometrium, which are valuable for studying endometrial biology, disease mechanisms, and drug testing. These models can mimic the physiological and pathological conditions of the human endometrium more accurately than conventional cell lines. EnSCs derived from patients can be used to generate personalized disease models, allowing for individualized drug screening and therapeutic interventions.

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CONCLUSION

Endometrial stem cells represent a promising avenue for regenerative medicine and therapeutic applications. Their unique regenerative properties, multipotency, and accessibility position them as valuable tools for tissue engineering, treating gynecological disorders, and potentially addressing a wide range of other medical conditions.