

Embryonic stem cell

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Pluripotent: Embryonic stem cells are able to develop into any type of cell, excepting those of the placenta.

Embryonic stem cells (ESC) are pluripotent stem cells derived from the inner cell mass of a blastocyst, an early-stage preimplantation embryo.[1][2] Sheep embryos reach the blastocyst stage 4–5 days post fertilization, at which time they consist of 50–150 cells. ESC measure approximately 14 μm while mouse ES cells are closer to 8 μm . [3]

Pluripotent

Embryonic stem cells are pluripotent, that is, they are able to differentiate into all derivatives of the three primary germ layers: ectoderm, endoderm, and mesoderm. These include each of the more than 220 cell types in the adult body. Pluripotency distinguishes embryonic stem cells from adult stem cells found in adults; while embryonic stem cells can generate all cell types in the body, adult stem cells are multipotent and can produce only a limited number of cell types.

Propagation

Additionally, under defined conditions, embryonic stem cells are capable of propagating themselves indefinitely.[4] This allows embryonic stem cells to be employed as useful tools for both research and regenerative medicine, because they can produce limitless numbers of themselves for continued research or clinical use.

Usefulness

Because of their plasticity and potentially unlimited capacity for self-renewal, Embryonic stem cell therapies have been proposed for regenerative medicine and tissue replacement after injury or disease. Diseases that could potentially be treated by pluripotent stem cells include a number of blood and immune-system related genetic diseases, cancers, and disorders; juvenile diabetes; Parkinson's; blindness and spinal cord injuries. Other potential uses of embryonic stem cells include investigation of early human development, study of genetic disease and as in vitro systems for toxicology testing.

First clinical trial

On January 23, 2009, Phase I clinical trials for transplantation of oligodendrocytes (a cell type of the brain and spinal cord) derived from ESC into spinal cord-injured individuals received approval from the U.S. Food and Drug Administration (FDA), marking it the world's first ESC human trial.[5] The

study leading to this scientific advancement was conducted by Hans Keirstead and colleagues at the University of California, Irvine and supported by Geron Corporation of Menlo Park, CA, founded by Michael D. West, PhD. A previous experiment had shown an improvement in locomotor recovery in spinal cord-injured rats after a 7-day delayed transplantation of ESC that had been pushed into an oligodendrocytic lineage.[6] In the proposed phase I clinical study, about eight paraplegics will be selected. However, the researchers are emphasizing that the injections are not expected to fully cure the patients and restore all mobility. Based on the results of the rodent trials, researchers say restoration of myelin sheathes, and an increase in mobility is probable. This first trial is mainly testing the safety of these procedures and if everything goes well, it could lead to future studies that involve people with more severe disabilities.[7]

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2. "NIH Stem Cell Basics. What are embryonic stem cells?".
3. Thomson, James A.; Zwaka (10 February 2003). "Homologous recombination in embryonic stem cells". *Nature Biotechnology* 21 (3): 319–321.
4. Ying et. al; Nichols, J; Chambers, I; Smith, A (2003). "BMP Induction of Id Proteins Suppresses Differentiation and Sustains Embryonic Stem Cell Self-Renewal in Collaboration with STAT3". *Cell* 115 (3): 281–292. doi:10.1016/S0092-8674(03)00847-X. PMID 14636556.
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6. Keirstead HS, Nistor G, Bernal G, et al. (2005). "Embryonic stem cell-derived oligodendrocyte progenitor cell transplants remyelinate and restore locomotion after spinal cord injury". *J. Neurosci.* 25 (19): 4694–705. doi:10.1523/JNEUROSCI.0311-05.2005. PMID 15888645.
7. Steven Reinberg FDA OKs 1st Embryonic Stem Cell Trial