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Opinion Article

Vector Based Differentially Regulated Totipotent Stem Cell Therapy

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DESCRIPTION

In biology, the term "totipotent" describes a cell that has the ability to divide and generate all differentiated somatic cells, both embryonic and extraembryonic. In animals, zygotes and spores are totipotent. In plants, plant cuttings or plant calli that grow into fully mature plants are also examples of totipotent cells. Stem cells are characterized by degrees of potency, which refer to varying capacities to differentiate into different cell types. Totipotent cells are the most potent of all stem cells and their definition is important for the research and regenerative medicine fields. Totipotent stem cells are different from pluripotent cells that can differentiate into cells from all three germ layers, or less potent pluripotent cells. Totipotent stem cells have the ability to produce all adult cell types, can enter the germ line (i.e., contribute to the next generation of genetic material) and have a demonstrated ability to self-renew (i.e., produce daughter cells that are identical to the parent cell). Totipotent cells can form all cell types in the body, plus extraembryonic or placental cells.

Totipotent stem cells are cells that have the capacity to self-renew by division and develop into extra-embryonic tissues such as the three major germ cell layers of the early embryo and the placenta. A fertilized egg cell is a totipotent stem cell that can develop into any specialized cell found in an organism. Totipotent stem cells are in vivo transient cells that can form all embryonic cell types, including the placenta, and are actively pursuing *in vitro* counterparts. Totipotent cells with different robustness and biological relevance are then established. Totipotent stem cells can divide into all cell types of an organism. Totipotent cells can divide until they form a complete organism. Totipotent cells are abundant early in embryonic development and are therefore also known as embryonic stem cells. Embryonic stem cells are totipotent. On the other hand, adult stem cells such as bone marrow cells are a type of pluripotent stem cell.

The only human cells so far with totipotent characteristics are blastomeres from the early stages of embryonic division. Totipotent cells formed during sexual and asexual reproduction include spores and zygotes. The separated cells are transferred to the uterus (after being inserted into an empty zona pellucida or after developing to the blastocyst stage in culture) to become fertile adults. Human totipotent cells outside the human body are related to their mode of derivation (e.g., fertilized eggs implanted from a woman's fallopian tubes or totipotent cells generated *in vitro* by the somatic cell nuclear transfer technique). No single isolated blastomeres have been shown to have the ability to generate a complete organism in most mammalian species. Thus, human totipotent cells outside the human body cannot qualify as the human body in the early stages of their formation and development and should not be excluded from patentability. Cells of the Inner Cell Mass (ICM) of the blastocyst are pluripotent. The transition from totipotent to pluripotent cells occurs between the 4-cell and morula stage.

Totipotency is lost because cells are committed or too small. Cell attachment or fate refers to the irreversible developmental restriction (i.e., differentiation) of cells. However, the blastomere becomes smaller at the beginning of the division. The best example of a totipotent cell is the fertilized egg or zygote (single-cell embryo).

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