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Moving induced pluripotent stem cells towards replacing embryonic stem cells

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A wide range of genetic or degenerative diseases including diabetes, heart disease, childhood leukaemia, etc. could be cured with the help of pluripotent stem cells. Pluripotency is the ability of an undifferentiated cell to differentiate into mature cells of different kinds. Embryonic stem cells were the only cells, which were originally thought to have this ability. But in 2006 two Japanese scientists Kazutoshi Takahashi and Shinya Yamanaka proved that adult cells can be reprogrammed into pluripotent cells for which they won a Nobel Prize in 2012. Induced pluripotent stem cells (iPSCs) are a new type of pluripotent stem cells, which are obtained from the reprogramming of adult cells. iPSCs closely resemble embryonic stem cells (ESCs), they have similar morphologies, growth manners and are sensitive to growth factors and signalling molecules. The first iPSCs were produced from murine adult fibroblasts. Initially, twenty-four factors were selected, which were thought to be responsible for the induction of pluripotency in somatic cells and were evaluated using assays and several other methods, such as southern blot, microarray, RT-PCR, etc. Eventually, as a result, four factors that are responsible for pluripotency, namely Oct3/4, Sox2 (core transcription factors), c-Myc and Klf4 (essential factors) were reported. Some of the applications of iPSCs include pathogenesis studies model, source of cell replacement therapy, developmental biology studies, drug screening for toxicity, drug development and drug discovery, gene therapy, cancer therapy and regenerative medicine. The use of iPSCs resolves ethical issues since they are derived from adult cells and not ESCs. They are not rejected by the immune system as they are derived from the same individual. They open a whole new window for personalised medicine and care. Reprogramming of disease-causing mutations in somatic cells can be achieved with the help of iPSCs. Although they have many advantages, they exhibit certain challenges, such as the association of Oct3/4, Sox2, c-Myc and Klf4 with tumour development, low yield, etc. The advantages of iPSCs have made them the best alternative to embryonic stem cells.

Keywords: Induced pluripotent stem cells (iPSCs), Oct3/4, Sox2, c-Myc, Klf4, Embryonic stem cells, Pluripotent, Treatment, Diseases

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