

Stem Cell Therapy for Diabetes

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Description

Stem cell therapy shows promise for the treatment of patients with diabetes mellitus. Diabetes refers to a family of diseases in which the body cannot effectively make or use insulin, the hormone needed to convert food into energy.

There are three main types of diabetes:

- Type 1 is an autoimmune disease
- Type 2 is related to hereditary and lifestyle risk factors
- Gestational diabetes occurs during pregnancy

Diabetes is caused by loss of "beta" cells in the pancreas that makes insulin, the hormone that lowers blood sugar. Diabetics must take insulin for life. Cell therapy that can induce the diabetic pancreas to produce insulin was the dream of stem cell researchers around the world.

Diabetes mellitus (DM) is one of the most common metabolic diseases. To replace the function of destroyed beta cells in the pancreas in diabetes, islet transplantation is the most widely used treatment. However, it has several limitations.

As an alternative approach, human pluripotent stem cells (hPSC) can provide an unlimited source of pancreatic cells that can secrete insulin in response to high blood sugar levels. However, the determination of the appropriate candidate pancreatic lineage for cell therapy for the treatment of diabetes is still under discussion. Although hPSC-derived beta cells are considered as the final candidate, their efficacy must be further improved to obtain a sufficient number of glucose-sensitive beta cells for transplantation therapy. On the other hand, hPSC-derived pancreatic progenitor cells can be efficiently generated *in vitro* and can further mature into glucose-sensitive beta cells after transplantation *in vivo*.

Research on the differentiation ability of human embryonic stem cells to islet cells has also defined the developmental

stages and transcription factors involved in this process. However, the clinical applications of human embryonic stem cells are limited by ethical concerns and the potential for teratoma formation. As a result, alternative forms of stem cell therapy, such as induced pluripotent stem cells, umbilical cord stem cells, and bone marrow-derived mesenchymal stem cells, have become an area of intense research.

Stem cell-based therapy is considered a promising potential therapeutic method for the treatment of diabetes, particularly in type 1 diabetes mellitus (T1DM). Major advances in research to derive IPCs from hPSCs have improved our chances of restoring glucose-sensitive insulin secretion in patients with T1DM. However, the results of clinical trials on stem cell therapies for T1DM are still unsatisfactory and many questions and technical hurdles remain to be resolved.

The main problems include the following five aspects:

- (1) How to generate more mature functional β -like cells *in vitro* from hPSCs
- (2) How to improve the differentiation efficiency of IPCs from hPSCs
- (3) How to protect implanted IPCs from autoimmune attack
- (4) How to generate a sufficient number of desired cell types for clinical transplantation
- (5) How to establish complete insulin independence.

Despite these obstacles, the use of stem cell-based therapy in DM1 represents the most advanced approach to cure type 1 diabetes.

Recent advances in stem cell therapy may make it a realistic treatment for diabetes in the near future.