Future Prospects for the Treatment of Diabetes

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Editorial

Diabetes mellitus is a condition in which the amount of glucose in the blood (blood sugar) is too high. The process of moving glucose from the blood into the body's cells relies on a hormone called insulin. Insulin is made by the pancreas, a gland lying behind the stomach. Insulin helps glucose to enter cells, for example, in muscles, liver and fat tissue. When insulin levels are too low or are ineffective, blood glucose levels can raise, which may result in diabetes. There are two main types of diabetes, type 1 and type 2.

Type 1 diabetes (T1DM) typically appears in children and happens because of a lack of insulin. It's caused when the insulin-producing cells in the pancreas are destroyed by an autoimmune response. The reason for this is still not well understood, but those with a genetic susceptibility are most at risk. There have also been suggestions that viral infections may trigger the process. This type of diabetes is treated with regular insulin injections and is also known as insulin dependent diabetes.

Type 2 diabetes (T2DM) is known as non-insulin dependent diabetes. Insulin is produced, but the muscles that would normally respond by taking up glucose to use as energy storage become insulin resistant, causing glucose levels in the blood to increase. Historically, type 2 diabetes was seen in middle-aged and elderly people and only rarely occurred in young people. Recently, however, it has escalated in all age groups and is now being diagnosed in younger and younger patients including obese adolescents and children [1].

Whole pancreas transplantation is an option for treatment for diabetes, but it is associated with several limitations, such as major surgery, shortage of donors and organ rejection after transplantation. Islet cell transplantation is an alternative noninvasive procedure in which the insulin secreting cells have physiological responses to the blood glucose levels. The Edmonton group in 2000 established the "Edmonton Protocol" and demonstrated sustained long-term insulin-independence [2]. The islet cells are isolated from cadaveric donors and injected into the recipient's portal vein. Instant blood-mediated inflammatory reactions, alloimmune reaction to transplanted cells and diabetogenic effect of immunosuppressive drugs reduced the initial beta cell mass and many patients require repeated episodes of cell transplantation [3]. Due to these limitations, the implantation of stem cells from embryonic or adult sources may be another potential treatment for diabetes [4].

The multipotent (and even pluripotent) differentiation capacity of certain human stem and progenitor cell populations has placed the mass the potential key to the successful regeneration of many tissue types. Over the coming decade, research into this field may take center stage as the new frontier in the treatment of many disabling diseases and injuries. However, one of the greatest challenges within stem cell medicine is the source of stem cells and stem cell lines for use in research or potential therapies – most stem cell sources consist of heterogeneous cell populations with varying differentiation and regeneration potentials. Therefore, the definition of cell populations and sources with specific differentiation capacities will be crucial for the targeted regeneration of tissues. In turn, this will facilitate a controlled and optimized growth and differentiation of stem cells to their targeted tissue types, especially during *ex vivo* tissue development.

Embryonic Stem Cells (ESCs) and induced Plu-

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ripotent Stem (iPS) cells have the capacity to self-renew and to differentiate into all cell types of the body. They promise an essentially unlimited supply of specific cell types for basic research, drug testing, and possibly for future transplantation therapies.

On the other hand, Mesenchymal Stem Cells (MSCs), obtainable from a variety of tissue sources including bone marrow aspirate, umbilical cord blood, and even lipoaspirate, have shown the potential to differentiate into a variety of nonhematopoietic tissue types, including bone or cartilage.

In clinical trial database (http://www.clinicaltrials.gov) by April 2014, 28 human trials using MSC for diabetic patients were documented. In 8 projects, the trial was conducted on type 2 diabetic patients and in 20 studies, MSCs was transplanted to T1DM patients. The efficacy of these cells was also evaluated on chronic diabetic complications, such as diabetic foot. The MSCs were derived from the umbilical cord, autologous bone marrow and Prochymal Commercial drug [8,9].

Recently, Guan et al. presented the results of a clinical trial-based study transplanted allogeneic Umbilical cord matrix stem cells (UCMSCs) in patients with T2DM. After two UCMSC infusions, all the studied patients exhibited a significant improvement in the diabetic status, as indicated by changes in the C-peptide and HbA1c levels. In addition, a reduction in the insulin requirement or insulin independence was achieved during the follow-up period. Cell-infusion related immediate and long-term side effects were not observed during the treatment. Therefore, this study provided a novel cell therapeutic protocol for the treatment of T2D with allogeneic UCMSC transplantation, without the application of immunosuppressive drugs [10].

Finally, Han et al. colleagues suggest that mesenchymal stem cells can promote diabetic wound healing by inducing autophagy. It will be a great breakthrough to improve autophagy activity to promote wound healing in diabetes mellitus patients. This provides a new strategy for diabetic wound healing [11].

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