Saudi Pharmaceutical Journal (2015) **23**, 333–340

King Saud University

Saudi Pharmaceutical Journal

www.ksu.edu.sa
www.sciencedirect.com

REVIEW

Diabetes treatment: A rapid review of the current and future scope of stem cell research

Sheriff Sheik Abdulazeez *

Department of Clinical Laboratory Sciences, College of Applied Medical Sciences, Shaqra University, Shaqra 11961, Kingdom of Saudi Arabia

Received 5 November 2013; accepted 14 December 2013
Available online 25 December 2013

KEYWORDS

Stem cells;
Diabetes;
β-Cells;
Induced pluripotency

Abstract Diabetes mellitus is a major health concern of the developing and developed nations across the globe. This devastating disease accounts for the 5% deaths around the world annually. The current treatment methods do not address the underlying causes of the disease and have severe limitations. Stem cells are unique cells with the potential to differentiate into any type of specialized cells. This feature of both adult and embryonic stem cells was explored in great detail by the scientists around the world and are successful in producing insulin secreting cells. The different type of stem cells (induced pluripotent stem cells (iPSCs), embryonic stem cells (ESCs) and adult stem cells) proves to be potent in treating diabetes with certain limitations. This article precisely reviews the resources and progress made in the field of stem cell research for diabetic treatment.

Contents

1. Introduction . . . 334
2. Stem cells and their therapeutic potential . . . 334
3. Adult stem cells and diabetes . . . 335
   3.1. Pancreatic stem cells . . . 335
   3.2. Haemopoietic progenitor cells . . . 336
   3.3. Other adult stem cells . . . 336
4. ESCs and diabetes . . . 336
5. Induced pluripotent stem cells and diabetes . . . 337
6. Hurdles in the progress . . . 337

* Tel.: +966 592069545.
E-mail address: biosherif@yahoo.co.in
Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.jsps.2013.12.012

6.1. Safety aspects . . . 337
6.2. Transplantation issues . . . 338
6.3. Scale up issues . . . 338
6.4. Ethical issues . . . 338
7. Conclusions . . . 338
References . . . 338

1. Introduction

Diabetes mellitus (DM) is most devastating, chronic, common non-communicable disease (NCD) and has become a serious problem globally. The number of the diabetic population around the globe is continuously increasing with a current estimation of 371 million cases in 2012 and it is expected to reach 552 million by 2030 (IDF diabetes atlas, 2012). It is also estimated that 5% of all deaths in the world are caused by diabetes and the number is rapidly increasing. Among two general types of diabetes, type 1 diabetes (TIDM) is characterized by immune complex mediated attack on insulin producing β cells of the pancreas (Atkinson and Eisenbarth, 2001). Type 2 diabetes (T2DM) arises due to either insufficient insulin synthesis or the body's inability to respond secreted insulin and leading to glucose build-up in the blood (DeFronzo, 1997). The impairment in glucose control leads to both micro and macro vascular complications that often result in the other clinical conditions associated with diabetes.

The chemical methods of treatment for diabetes do not address the causes of the disease and have side effects. Thus, there is an obvious search for the suitable alternative treatment methods. The current cellular based therapeutic method for the treatment of diabetes is focused on the transplantation of either the pancreas or islet-cells to reconstitute the insulin-secreting functional β cells. However, this technique is hampered by a shortage of donor organs. All these issues paved the way to explore the research possibilities of generating pancreatic β cells from stem cells. The unique regenerative properties of stem cells could be a vital tool which can be exploited in the treatment of diabetes. Developing a renewable source of islets with stem cells would circumvent the current supply/demand issues in islet transplantation and provide patients with a long-term source of insulin-producing β-cells. Thus, stem cell investigation has become the centre of attraction for diabetic treatment (Mccall et al., 2009). This article reviews the progress of stem cell research made in the field of diabetic treatment and practical hurdles associated with it.

2. Stem cells and their therapeutic potential

The stem cells are more gifted and are responsible for the formation of different types of cells during the early embryonic life and the later growth of the organism. Stem cells possess an exceptional quality to replenish itself and to produce any specialized cell types under appropriate microenvironment. A rapidly dividing stem cell produces two new cells, each having two choices depending upon the requirement of the organism. Thus, a newly produced cell either may remain as a stem cell or it may undergo further differentiation to become a more specialized cell with specific function. The stem cells have the potential to become any type of specialized cell such as a myocyte, blood cell, hepatocyte and brain cell (Fig. 1). The

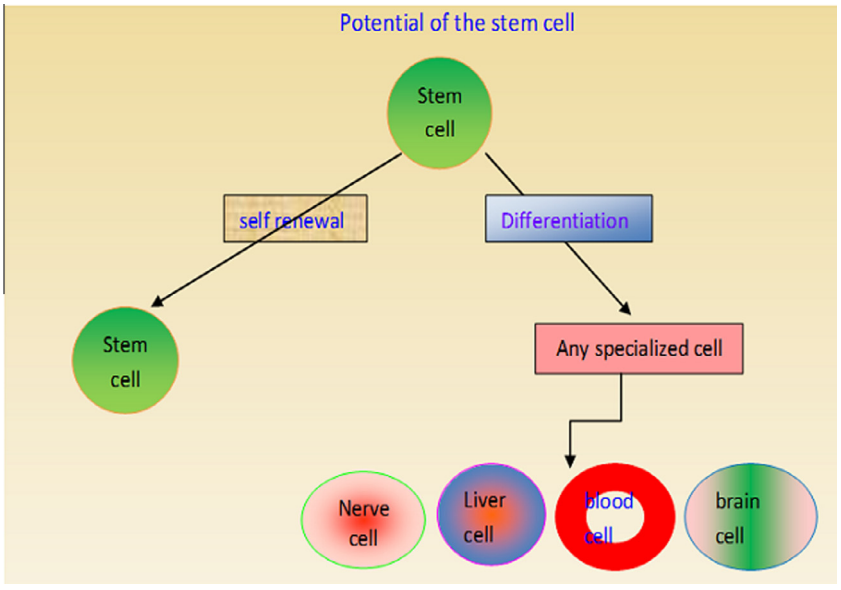

Figure 1 Self renewal and differentiation potential of the stem cells.