Stem Cell Research and Regenerative Medicine

Hashemzadeh, Stem Cell Res Regen Med 2017, 1:2

Mini Review

OMICS International

Stem Cells and Regenerative Medicine: The Potential Aspects in Cardiovascular System

Mohammad Reza Hashemzadeh*

Department of Stem Cells and Regenerative Medicine, Royesh Stem Cell Biotechnology Institute, Mashhad, Iran

Abstract

Stem cells have a key role in therapeutic field in today's world. Regenerative medicine is a vast realm in which stem cells are recruited as source of tissue regeneration in most of organs especially in heart and cardiovascular system where cardiovascular diseases are the leading cause of mortality in recent years. The numerous types of stem cells such as embryonic stem cells and adult stem cells have been used in regenerative medicine especially in cardiovascular diseases and there are different routes of delivering cells to heart as a target tissue. Notwithstanding that using stem cells is a decent procedure, in some cases this is inefficient due to lack of targeted localization. This issue can be solved with triggering of CXCR4/SDF1 axis in these cells in order to stimulating of targeted mobilization and directing towards target tissue. Another aspect of regenerative medicine is the upregulation and downregulation of microRNAs during stem cell differentiation and in cardiovascular diseases. On the other hand, the base of the majority of myocardial ischemia is inflammation and it sounds that the evaluation and manipulation of some immunological key genes such as toll like receptors and downstream elements in differentiation of stem cells into cardiomyocytes can be appropriate in therapeutic targets of cardiovascular diseases.

Keywords: Stem cells; Regenerative medicine; Cardiovascular system; Homing; Micro RNA; Toll-like receptors

Introduction

The vast types of stem cells have been identified to regenerate myocardium. Each of these cell lines has some advantages and/or disadvantages. Embryonic stem cells (ESCs) and induced pluripotent stem (IPS) cells are two cell lines which despite the high proliferative capacity, they can lead to teratoma formation. Among adult stem cells, mesenchymal stem cells which derived from adipose tissue and bone marrow are decent option in cell therapy because of immunomodulatory features in allogenic graft. According to recent studies, cardiac stem cells are the best cell line for myocardial regeneration due to express markers of cardiogenesis [1,2].

In addition to the source of cells and the manner of extraction, the delivery method of stem cells is a main parameter in the ideal regeneration process. There are some available routes for delivering of stem cells to heart which include direct epicardial injection, injection in the coronary sinus, intracoronary (IC) and intravenous (IV) injection. All of these methods are ineffectual owing to lack of targeted homing and among these methods; the IV route is the least invasive. After injection in all of methods some cells are lost by extrusion, some of them die within one week of injection and most of them trapped in the lungs. The most yield of homing belongs to IC method which 3% of delivered cells engraft to the heart [3,4]. Some studies show that the triggering and upregulation of CXCR4, the chemokine receptor involved in homing, in delivered stem cells can solve this problem. The ischemic region such as infarcted heart releases the numerous amount of conjugated chemokine of CXCR4 called SDF-1 whereby delivered stem cells with upregulation of CXCR4 are attracted towards injured region. [5-8].

The small non-coding RNAs, microRNAs, link to messenger RNA (mRNA) and subsequently mediate gene expression in two ways: mRNA degradation or translational repression. Manipulating of these RNAs on stem cells and during their differentiation is a decent process in regenerative medicine especially in cardiovascular diseases [9]. Some of micro RNAs such as mir-126, mir-197 and mir-210 are essential in angiogenic differentiation [10,11]. Co-transcription and translation of mir-143/mir-145 are involved in smooth muscle cell differentiation [12] and mir-1-2 has a key role in morphogenesis and electrical function of cardiomyocytes [13]. Also in response to myocardial infarction, downregulation of the members of miR-29 family lead to upregulation of extracellular matrix genes implicate in cardiac infarct healing [14]. According to role of miRNAs in cardiovascular system, miRNA therapeutics can be used via the use of antisense oligonucleotide-mediated knockdown or miRNA-mimic-based overexpression techniques. Since myocardial infarction and all of myocardial ischemia diseases have inflammatory reasons, evaluation of immunological genes can benefit in treatment of cardiovascular diseases. Among immunological genes, toll like receptors (TLRs) are the family of pattern recognition receptors, which play an essential role in innate immunity [15], and induce an innate immune responses by responding endogenous ligands released from damaged tissues or necrotic cells. Evaluation of gene expression and manipulation of TLRs and their downstream signaling components can hold promise to provide basic knowledge of new cellular and molecular therapy in heart diseases [16].

Conclusion

The present short commentary points to the stem cells and regenerative medicine especially some potential aspects in cardiovascular system. Considering the regulatory role of micro-RNAs and use of antisense oligonucleotide-mediated knockdown, they can be used as a decent factor in regulation of stem cells for application in cardiovascular diseases. On the other hand, optimization of stem

***Corresponding author:** Mohammad Reza Hashemzadeh, Department of Stem Cells and Regenerative Medicine, Royesh Stem Cell Biotechnology Institute, Mashhad, Iran, Tel: +98 5136036108; E-mail: hashemzadeh@royesh-scb.com

Received June 20, 2017; **Accepted** August 02, 2017; **Published** August 09, 2017

Citation: Hashemzadeh MR (2017) Stem Cells and Regenerative Medicine: The Potential Aspects in Cardiovascular System. Stem Cell Res Regen Med 1: 102.

cell homing can direct stem cells towards correct way to infarcted and ischemic heart. Regulation of TLRs gene expression during stem cell differentiation into cardiomyocyte can be used as a good way to obtain lower immunogenic cardiomyocytes which can be used in stem cell transplantation after myocardial infarction.

References

1. Hotkar AJ, Balinsky W (2012) Stem Cells in the Treatment of Cardiovascular Disease-An Overview. Stem Cell Rev 8: 494-502.
2. Karantalis V, Hare JM (2015) Use of Mesenchymal Stem Cells for Therapy of Cardiac Disease. Circ Res 116: 1413-1430.
3. Kraitchman DL, Tatsumi M, Gilson WD, Ishimori T, Kedziorek D, et al. (2005) Dynamic imaging of allogeneic mesenchymal stem cells trafficking to myocardial infarction. Circ 112: 1451-1461.
4. Hou D, Youssef EA, Brinton TJ, Zhang P, Rogers P, et al. (2005) Radiolabeled cell distribution after intramyocardial, intracoronary, and interstitial retrograde coronary venous delivery: implications for current clinical trials. Circ 112: I150-156.
5. Theiss HD, Zaruba MM, Gröbner M, Vallaster M, Brunner S, et al. (2011) Dual stem cell therapy after myocardial infarction acts specifically by enhanced homing via the SDF-1/CXCR4 axis. Stem Cell Res 7: 244-255.
6. Yellowley C (2013) CXCL12/CXCR4 signaling and other recruitment and homing pathways in fracture repair. BoneKEy Rep 300: 1-9.
7. Hashemzadeh MR, Seyedi Z, Rafiei S, Hassanzadeh-Moghaddam M, Edalatmanesh MA (2017) Chemokine receptor's expression in human adipose derived mesenchymal stem cells primed with valproic acid. Comp Clin Pathol 26: 115-120.
8. Karimi F, Hashemzadeh MR, Irfan-Maqsood M, Edalatmanesh MA, Naderi-Meshkin H (2016) Overexpression of Chemokine Receptors on Neural Stem Cells Pretreated with Valproic acid: Towards Improved Homing. Cell Ther Regen Med J 1: 98-106.
9. Hashemzadeh MR (2017) Role of micro RNAs in stem cells, cardiac differentiation and cardiovascular diseases. Gen Rep 8: 11-16.
10. Wang S, Aurora AB, Johnson BA, Qi X, McAnally J, Hill JA, et al. (2008) The endothelial-specific microRNA miR-126 governs vascular integrity and angiogenesis. Dev Cell 15: 261-271.
11. Kane NM, Meloni M, Spencer HL, Craig MA, Strehl R, et al. (2010) Derivation of endothelial cells from human embryonic stem cells by directed differentiation: analysis of microRNA and angiogenesis in vitro and in vivo. Arterioscler Thromb Vasc Biol 30: 1389 -1397.
12. van Rooij E, Sutherland LB, Thatcher JE, DiMaio JM, Naseem RH, et al. (2008) Dysregulation of microRNAs after myocardial infarction reveals a role of miR-29 in cardiac fibrosis. Proc Natl Acad Sci USA 105: 13027-13032.
13. Huang H, Xie C, Sun X, Ritchie RP, Zhang J, et al.(2010) MiR-10a contributes to retinoid acid-induced smooth muscle cell differentiation. J Biol Chem 285: 9383-9389.
14. Sluijter JPG, van Mil A, van Vliet P, Metz CH, Liu J, et al. (2010) MicroRNA-1 and -499 regulate differentiation and proliferation in human-derived cardiomyocyte progenitor cells. Arterioscler Thromb Vasc Biol 30: 859 -868.
15. Beutler B, Jiang Z, Georgel P, Crozat K, Croker B, et al. (2006) Genetic analysis of host resistance: Toll-like receptor signaling and immunity at large. Annu Rev Immunol 24: 353-389.
16. Hashemzadeh MR, Aghdami N, Aghajanpour S, Mazidi Z, Fonoudi H, Aflatoonian R (2013) Evaluation of Toll Like Receptors Expression in Cardiomyocyte Differentiation from Human Embryonic Stem Cells. Cell j 15 (sup 1): 44.

Citation: Hashemzadeh MR (2017) Stem Cells and Regenerative Medicine: The Potential Aspects in Cardiovascular System. Stem Cell Res Regen Med 1: 102.