Commentary

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Human Stem Cells and Treatment for Heart Failure

Karin Meshgin*

Department of Surgery, University of California San Diego, California, USA

***Corresponding author:** Karin Meshgin, Department of Surgery, University of California San Diego, California, USA, E-mail: meshgin_k@ucs.edu

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Description

Cardiovascular disease (CVD) is one among the most common diseases. Every year, CVD kills more people compared to cancer, HIV, diabetes, and trauma together.

Many advances are made within the medical and surgical procedures of CAD. Despite significant advancements in pharmacological and interventional treatment options, heart diseases represent an increasingly common disorder that carries a poor long-term prognosis. Cardiac surgery has been central in the treatment of nearly every major cardiac condition. Moreover, the success of medical and surgical therapies in the management of acute and chronic ischemic heart disease has contributed to a growing number of patients reaching their sixth, seventh, and eighth decades of life with Congestive Heart Failure (CHF).

Heart transplantation is considered to be the gold standard for the treatment of advanced end-stage CHF. Unfortunately, this is often an epidemiologically inconsequential therapy, with the low number of obtainable donor hearts too few to satisfy the demand.

Although current approaches improve symptoms and decelerate adverse cardiac remodelling, they fail to deal with the underlying problem of an irreversible loss of cardiac tissue.

Innovative stem cell (SC) therapies have the potential to fundamentally alter the conventional treatment of CVDs by stimulating the regeneration of injured myocardium. Over the last 20 years, many pre-clinical and early clinical trials have demonstrated the security and feasibility of various SC types.

Types of stem cells

- Embryonic Stem Cells
- Adult Stem Cells
- Skeletal Myoblasts
- Bone Marrow Cells
- Endogenous Cardiac Stem Cells
- Adipose-derived stem cells
- Induced pluripotent stem cells

Mechanisms in cardiovascular regeneration of adult stem cells

Investigating the mechanisms by which different SC types govern the regeneration of infarcted heart tissue is of utter importance for the development and improvement of novel SC therapeutics. The capacity of SCs to repair damaged tissue is especially based on indirect/paracrine and direct mechanisms.

- Direct mechanisms (trans-differentiation of Stem Cells)
- Paracrine signalling E.g. Neovascularization, Immunomodulation

Improvement strategies of stem cell-based therapies

The limited outcome of Stem Cell -based clinical trials requires the development and improvement of novel strategies to significantly enhance the efficiency of SCs for cardiac repair. Basically, there are 2 major concepts available to come up with the “next generation” of SC therapeutics:

- Non-genetic modification
- Genetic engineering approaches.

Non-genetic stem cells modifications

Pharmacological pre-conditioning represents a convenient and price effective technique to stimulate the regenerative activity of SCs. As these cells exert their therapeutic effects on damaged tissue mainly by paracrine signalling, drug pre-treatment was applied to push their secretion activity.

Genetic stem cells modifications

Genetic modification represents another powerful technique to boost SC efficiency. Compared to non-genetic based pre-conditioning genetic engineering is typically applied to induce prolonged effects on SC activity. In general, three main strategies of genetic modification are utilized, includes the following:

- Protein overexpression after DNA or mRNA delivery
- Gene editing
- Gene silencing

Personalized stem cells therapy

Personalized Stem Cells therapy is a concept in which personalized medicine is predicated on targeted therapeutic

treatment, focuses on patient specific characteristics so as to supply the higher end quality of therapy, whereas the danger of side effects and costs of ineffective interventions are reduced.