



Review

Hematopoietic stem cells: An overview



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ABSTRACT

Considerable efforts have been made in recent years in understanding the mechanisms that govern hematopoietic stem cell (HSC) origin, development, differentiation, self-renewal, aging, trafficking, plasticity and transdifferentiation. Hematopoiesis occurs in sequential waves in distinct anatomical locations during development and these shifts in location are accompanied by changes in the functional status of the stem cells and reflect the changing needs of the developing organism. HSCs make a choice of either self-renewal or committing to differentiation. The balance between self-renewal and differentiation is considered to be critical to the maintenance of stem cell numbers. It is still under debate if HSC can rejuvenate infinitely or if they do not possess “true” self-renewal and undergo replicative senescence such as any other somatic cell. Gene therapy applications that target HSCs offer a great potential for the treatment of hematologic and immunologic diseases. However, the clinical success has been limited by many factors. This review is intended to summarize the recent advances made in the human HSC field, and will review the hematopoietic stem cell from definition through development to clinical applications.

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1. Introduction

A stem cell is essentially a type of cell that all other cells in our body arise or “stem” from. There are essentially two major characteristics that make stem cells different from all other cells in the body. The first is that stem cells can divide and thus renew themselves for very long periods of time, both in the body and in vitro. The second unique characteristic is their ability to develop into specialized cells such as muscle cells, nerve cells, skin cells, or pancreatic cells [1].

The generation of sufficient numbers of blood cells to maintain homeostasis requires sustained production of mature cells. This process, called hematopoiesis, yields

approximately 10^{10} blood cells daily, with capability for dramatic increases in response to physiological stress. Its prodigious production capability derives from the sustained presence of a cell type which is generally quiescent, but the descendants of which proliferate vigorously. This cell is the hematopoietic stem cell (HSC) [2].

2. Definition

Hematopoietic stem cells (HSC) or blood forming stem cells are adult stem cells that can develop into any of the three types of blood cells: red cells, white cells or platelets [3]. HSC possess the unique ability to replicate itself (i.e.

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