

Role of Stem Cells in Management of Surgical Diseases

Essay

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By

Ahmed Fathy Yossef Ahmed Elshrif
M.B.B.Ch

Under Suipervison of

**Prof. Dr./ Adel Abd Elkader
Mustafa**

*Professor of general surgery
Faculty of Medicine - Ain Shams University*

Dr./ Mahmoud Saad Farahat

*Lecturer of general surgery
Faculty of Medicine - Ain Shams University*

**Faculty of Medicine
Ain Shams University
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Arabic summary

List of abbreviations

| | |
|--------------|--------------------------------------|
| ALL | : Acute lymphoblastic leukemia |
| AML | : Acute myelogenous leukemia |
| ADSCs | : Adipose tissue derived stem cells |
| AHSCs | : Adult hematopoietic stem cells |
| AMSCs | : Adult mesenchymal stem cells |
| ASCs | : Adult stem cells |
| CSCs | : Cancer stem cells |
| CML | : Chronic myelogenous leukemia |
| CPF | : Complex perianal fistula |
| CLI | : Critical limb ischemia |
| DMEM | : Dulbecco's modified eagle's medium |
| ESCs | : Embryonic stem cells |
| FBS | : Fetal bovine serum |
| FSCs | : Fetal stem cells |
| GVHD | : Graft versus host diseases |
| HSCs | : Hematopoietic stem cells |
| HLA | : Human leucocytic antigen |
| HPSCs | : Human pluripotent stem cells |
| LPA | : Lipoaspirates |
| MSCs | : Mesenchymal stem cells |
| MNC | : Mononuclear cells |
| MDS | : Myelodysplastic syndrome |
| NI | : No implant |
| NA | : Not analyzed |
| PBSCs | : Peripheral blood stem cells |
| PVD | : Peripheral vascular disease |
| PBS | : Phosphate buffered saline |
| SAA | : Sever a plastic anemia |
| SCT | : Stem cell transplantation |
| T-IC | : Tumors initiating cell |

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INTRODUCTION

The present enthusiasm for and controversy around stem cell researches began with two breakthroughs: first of all The successful cloning of "Dolly" by Ian Wilmut, Keith Campbell and Coworkers in 1997 and The establishment of human embryonic stem cell lines by the laboratory of James Thomson in 1998 .Without any doubt, these technologies have opened up novel avenues for tissue engineering and organ transplantation (*Anthony and Wolfgang, 2006*).

The ability to rejuvenate or even replace defective organs and the tissue of the human body has been a century's old dream. Stem cells have demonstrated their potential to develop into practically all types of specialized cells and tissues in the body and therefore became the "*Fountains of youth* "that mankind searched for since long time .Recent discoveries using both adult and embryonic stem cells as the primary

cells for starting population have led to many speculations. So from this "raw material" we might be able to produce all sorts of replacement parts for regenerative medicine. Hopes are high that many age related degenerative disorders such as heart diseases, Parkinson's disease, diabetes and stroke could be cured by stem cell therapy (*Anthony and Wolfgang, 2006*).

In this study we will try to understand what stem cells are, what their sources are, their properties, obstacles against their uses and what their surgical uses are.

AIM OF THE WORK

The aim of the work is to throw lights on stem cell therapy which involves the introduction of healthy new cells to potentially repair and replace damaged or lost cells. This therapy often referred to as regenerative medicine provides much promise for the treatment of what was previously regarded as incurable diseases.

I. STEM CELL BIOLOGY

A stem cell is a cell that has the dual ability to self-renew and to produce progenitors and different types of specialized cells in the organism. For example, in the beginning of human life, one fertilized egg cell (the Zygote) becomes two cells then four cells. In these early stages, each cell may remain as a totipotent cell from which the organism can be derived out. Within 5 to 7 days, 40 cells are formed which buildup the inner cell mass surrounded by an outer cell layer which forming the placenta, at this stage each of these cells in the inner cell mass has the potential to give rise to all tissue types and organs, Including germ cells which are Pluripotent cells . Ultimately the cells forming the inner cell mass will give rise to 10^{13} cells that constitute a human body, organized in 200 different cell types (*Anthony and Wolfgang, 2006*).

Many somatic, tissues -specific or adult stem cells are produced during fetal

development, Such stem cells have more restricted ability than the Pluripotent embryonic stem cells and they are multipotent that can give rise to multiple lineages of cells. These adult stem cells persist in the corresponding organs to varying degrees during a person's whole life (*Anthony and Wolfgang, 2006*).

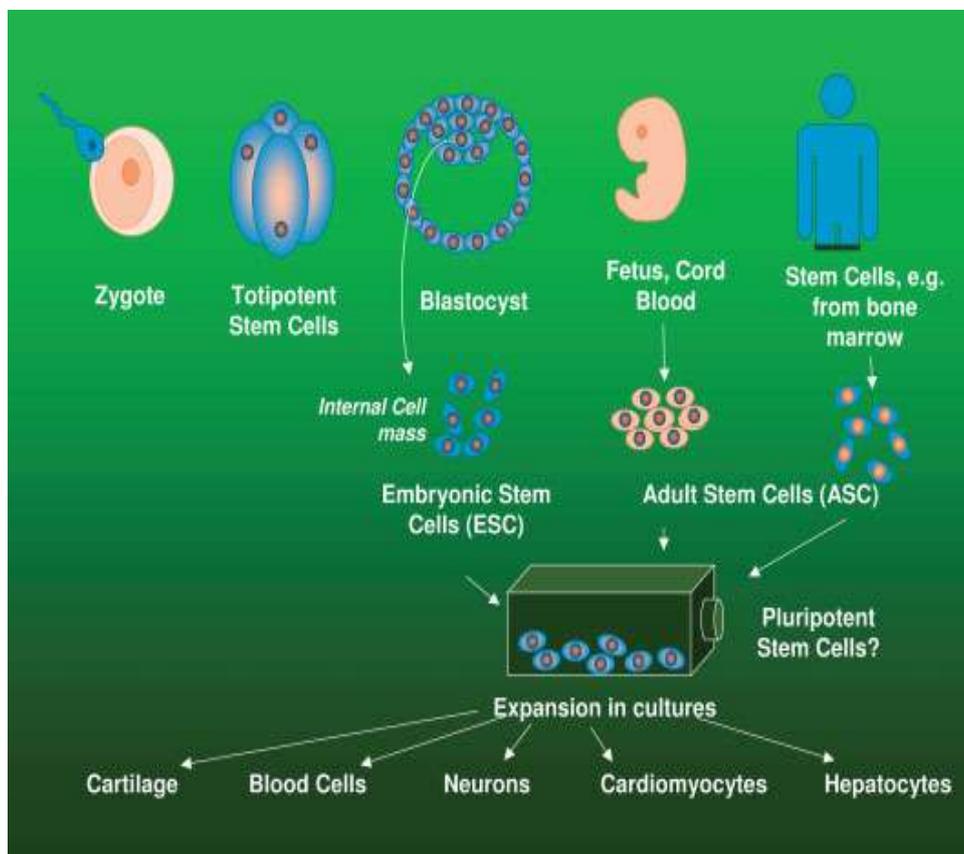


Figure 1: Sources for embryonic and adult stem cells.

II. UNIQUE PROPERTIES OF ALL STEM CELLS

All stem cells regardless of their source have three general properties, First of all they are unspecialized, they are capable of dividing and renewing themselves for long period and they can give rise to specialized cell types (*Bethesda, 2006*).

Scientists are trying to understand two fundamental properties of stem cells that are related to their long term renewal: Why can embryonic stem cells proliferate for a year or more in the laboratory without differentiating, but most adult stem cells cannot and what are the factors in living organisms that normally regulate stem cell proliferation and self-renewal? Discovering the answers to these questions may make it possible to understand how cell proliferation is regulated during normal embryonic development or during abnormal cell division that lead to cancer. Such information

would enable scientists to grow embryonic and adult stem cells more efficiently in the laboratory (*Bethesda, 2006*).

1- Stem Cells Are Unspecialized:

One of the fundamental properties of stem cells that they haven't any tissue specific structure that allows them to perform specialized function, a stem cell can't work with its surroundings to pump blood through the body (like a heart muscle cell); it can't carry molecules of oxygen through the blood stream (Like a red blood cell) and it can't fire electrochemical signals to other cells that allow the body to move or speak (like a nerve cell). However unspecialized stem cells can give rise to specialized cells. Including heart muscle Cells, blood cells and nerve cells (*Bethesda, 2006*).

The specific factors and conditions that allow stem cells to remain unspecialized are of great interest to scientists which had taken them many years of trial and error to learn how to make stem cells grow in the laboratories without spontaneously differentiating into specific cell types. For example it took 20 years to learn how to make human embryonic stem

cells grow in the laboratories, therefore, multiple researches were done to understand the signals that cause stem cell populations to proliferate and remain unspecialized until these cells are needed for repairing of a specific tissue. Such information is important for scientists to be able to cultivate large numbers of unspecialized stem cells in the laboratory for further experimentation (*Bethesda, 2006*).