

Stem Cells Preservation

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Review Article

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ABSTRACT

Embryonic stem cells are pluripotent stem cells which can give rise to all of the cell types that make up the body; embryonic stem cells derived from the inner cell mass of a blastocyst, an early-stage preimplantation embryo. Adult stem cells have demonstrated tremendous human therapeutic potential. Currently, human embryonic stem cells are used principally for understanding growth and disease development but also hold enormous medicinal potential. The capability to preserve stem cells is difficult for their use in medical applications. Preservation of cells allows the movement of cells between sites, as well as completion of safety and quality testing. Preservation allows the development of a 'manufacturing paradigm' for cell therapies, thereby maximizing the number of products that can be produced at a given facility.

Different modes of preservation and the current status of preservation of hematopoietic, mesenchymal and human embryonic stem cells can be studied in this article. Present and upcoming issues in the area of stem cell preservation will be discussed here.

INTRODUCTION

Stem cells are used to treat a large number of diseases and disorders. Hematopoietic stem cells is an example, which have traditionally been used to treat leukaemia are now being used to treat cardiac diseases, hereditary blood disorders and autoimmune diseases [1-7]. Preservation of stem cells is critical for stem cell research and medical application of stem-cell based therapies. Preservation allows development of cell banks with different major histocompatibility complex genetics and [genetically modified clones](#). Collection of stem cells from different sources such as umbilical cord blood can be difficult to predict or control, the ability to preserve cells permits the storage of stem cells until later use in the research lab or medicinal application. The ability to preserve cells permits completion of quality and safety testing before use as well as movement of the cells inbetween the sites of collection, processing and medical administration [8-15]. Finally, the ability to preserve cells used therapeutically facilitates the development of a manufacturing paradigm for stem cell based therapies. The capacity to preserve the cells after production of the therapy facilitates coordination of therapy with a patient care regime and reduces staffing requirements of clinical cell production facilities [16-23].

Cryopreservation is one of the technique for cell preservation which involves the following steps: a) pre-freeze processing; b) introduction of a cryopreservation solution; c) freezing protocol; d) storage conditions; e) thawing conditions and f) post thaw assessment.

Hematopoietic Stem Cells preservation focused mainly on modification of the freezing medium and freezing and storage protocols. Dimethyl sulfoxide is used to cryopreserve HSCs, with a DMSO concentration of 10% being the most commonly used [24-31].

[Human Embryonic Stem Cells](#) are preserved in the following manner: Colonies of hESCs (100–400 cells) are placed in a vitrification solution composed of DMSO + EG + 0.5 mol/l sucrose. The colonies are loaded into straws and plunged into liquid nitrogen [32-38].

Many scientific [open access journals](#) on stem cell started the awareness in the public by its unrestricted access of articles to the society. The articles published in these [peer reviewed stem cells journals](#) will promote the steps to be

taken for the prevention of cancer. [Dr. Marek Malecki](#) from University of Wisconsin, USA is an Editor-in-Chief for the [Journal of Stem Cell Research & Therapy](#) and as an editor in chief his service for the journal's growth is extraordinary. The other journal like [Cell Biology: Research & Therapy](#) with an eminent [Editorial board](#) is striving for the betterment of cell biology research.

List of Major societies in USA for Stem Cell Research

Many [societies](#) in the USA committed to preserve and save the stem cells. The International Society for Stem Cell Research (ISSCR), an independent profitless organization and the voice of the stem cell research community, which was founded for the exchange of information on stem cell research. Few societies like [International Placenta Stem Cell Society](#), [Stem Cell research Italy](#), [European Biotechnology Thematic Network Association](#), National Institute of Health – Stem Cell Lines, [Egyptian Society of Stem Cell Therapy](#) etc. provides guidelines for human embryonic stem cell research as well as a compilation of frequently asked questions, National Academy of Sciences which helps in providing guidelines for Human Embryonic Stem Cell Research, Norwegian Center for Stem Cell Research, etc are involved in providing support to the stem cell preservation [39-45]. Some foundations and funding agencies like Christopher Reeve Foundation, Diamond Blackfan Anemia Foundation, Juvenile Diabetes Research Foundation, Multiple Sclerosis Foundation, Muscular Dystrophy Association, etc. helps in the stem cell research [46-53].

Every year many conferences on stem cell research and preservation are attracting lot of researchers in the field to expose their research and to know new researches and innovations in the field of stem cell preservation. [7th Annual Conference on Stem Cell and Regenerative Medicine](#) based on the theme “Advanced Approaches in Stem Cell and Regenerative Medicine” which included many research topics like Stem Cell Therapy, Stem cell & Regenerative Market, Tumour Cell Science, where highly affiliated Speakers like [Nilanjana Maulik](#), [Barritault Denis](#), Y James Kang, [Hazem Barmada](#), etc. shared their valuable experiences in the field. With the success of 2016 conference, [8th Annual Conference on Stem Cell and Regenerative Medicine](#) which is going to be held during Sep 25-26, 2017 at Berlin, Germany for all the researchers worldwide.

[2nd International Conference & Exhibition on Tissue preservation and Bio-banking](#) which held on September 12-13, 2016 at Philadelphia, USA with a theme “Global Innovations in Tissue preservation and Biobanking Technologies”. The [Biobanking-2016](#) Conference was carried out through various sessions with discussions on Cryopreservation Methods, Next Generation Biobanking, Germplasm Bank, Stem cell Biobanking, etc. Various sessions were chaired and co-chaired by: [Kelvin GM Brockbank](#) (Tissue Testing Technologies LLC, USA); [Simone Chevalier](#) (McGill Urology Director of Research, Canada), USA; Charles W Wang, (Shanghai Jiao Tong University, China); Yaffa Rubinstein (National Institute of Health, USA).

With the inspiration of the 2nd International Conference & Exhibition on Tissue preservation and Bio-banking, [Conference LLC](#) is inviting all the participants from all over the world to attend “[3rd International Conference & Exhibition on Tissue Preservation and Bio banking](#)” during august 23-24, 2017 in San Francisco, California, USA. Some of the upcoming Conferences on the stem cells preservation are [10th World Congress on Stem Cell and Bio banking](#) which is going to be held during October 23-24, 2017 in Osaka, Japan, [Bio banking Tissue 2017](#)

Procedure of collecting stem cells storage in a stem cell bank

The Stem cell's capacity to repair and [regenerate](#) is the basis for all the researches in the field of [stem cell](#) therapy. This unique characteristic of stem cell is very attractive. The research and findings in this field of stem cell therapy proved to create a revolution in the field of medicine [54-60]. In recent investigation, the knowledge on stem cells and its role in treatment of different diseases developed awareness among people and moved them to adopt stem cell collection and [preservation techniques](#).

The stem cells are taken from the source from where the cells are harvested [61-68]. Based on its source stem cells are classified as [fetal stem cells](#), embryonic stem cells, umbilical cord stem cells and adult stem cells [69-74]. Stem cells are utilized for treating diseases by altering its characteristics of undifferentiated to well differentiated specific cell type under controlled condition as shown in figure 1.

The cells formed from the zygotic division are called the [embryonic stem cells](#) because of its ability to develop into any type of cell [75-81]. The embryonic stem cells are removed from the embryos in vitro by adopting a technique called [in vitro fertilization](#) (IVF). In vitro fertilization is a method used for treatment of sterile couples. In this method the sperm is inserted into the egg under controlled conditions in a laboratory conditions [82-89]. The use of in vitro embryos for harvesting [stem cells](#) is a very accurate procedure which is done only by obtaining permission from the

couple whose egg and sperm are used in developing the embryo. The harvested embryonic stem cells are developed through cell culture technique. In this, the doctor decides the media and the required environmental and physiological parameters for the [cells](#) to grow into well defined, specific [cell type](#) ^[90-96]. The advantages of using embryonic stem cells in a research are that they are fresh and they are not obstructed by any condition and mostly devoid of any [chromosomal abnormality](#). The main drawback of using these cells in the treatment of disease is its unsuppressed cell division which may leads to cancer ^[97-102].

The umbilical cord blood is a rich source of stem cells; it is a connection between the mother and baby through which nutrients are transferred from placenta to the baby in the womb. In order to collect the cord blood for stem cells, the cord between the placenta and the baby is clamped and a trained person collects the blood from the umbilical cord by using a needle ^[103-109]. The collected blood is transferred to the sample vial and sent for storage. Sterile conditions are maintained during the process of collection to avoid contamination of the sample. People with a family history of genetic disorders or diseases can preserve their baby's [cord blood](#) which can be used effectively in future treatment of various diseases ^[110-117]. The collected blood can be stored. The complete family can be benefited by storing umbilical cord stem cells.

Adult stem cells are the existing cells in an adult. The cells of muscle tissue, bone marrow, skin cell and nerve cell are examples for adult stem cells ^[118-123]. The collection of stem cells from bone marrow requires a surgical procedure in which the donor is given anesthesia first and a needle is inserted into the bone marrow at a specific site to collect the stem cells ^[124-126]. [Bone marrow transplantation](#) is a widely used treatment method in treating various disorders. Collection of adult stem cells from blood is done by collecting the blood intravenously from one hand and passing it through a processor which separates the [stem cells](#) from the blood. Once the stem cells are separated, the blood is sent back to the body ^[127]. The drawback for adult stem cells is the present abnormalities or the cell damage due to various parameters. In comparison to the embryonic stem cells, the division of adult stem cells can be controlled and hence the risk of cancer is minimized to an extent ^[27].

Apart from these above mentioned stem cell types, the stem cells are discovered in [amniotic fluid](#) and menstrual blood. Stem cells from menstrual blood and its application in treating arthritis, cardiac disease has been proved in a research.



Figure 1. Stem cell preservation

CONCLUSION

Stem cell contribute to a natural healing and plays an important role for regenerative medicine. Stem cell banking through long-term storage of different stem cells represents a basic source to store original features of stem cells for patient-specific clinical applications ^[64]. Stem cells can heal the body, promote recovery, and offer an enormous amount of therapeutic potential. [Cord blood](#) holds promise for future medical procedures. Many scientists are still studying more ways to treat more diseases with cord blood. For example many researchers are using patients' own cord blood in trials for cerebral palsy and [Hypoxic ischemic encephalopathy](#).

[Stem cell treatable diseases](#) continue to grow at a rapid pace. With the potential to become different cell types, researchers are searching for the possibility of using cord blood stem cells to treat some of the dangerous diseases such as heart diseases and stroke. Thus, saving the baby's cord blood now can ensure child's access to his/her own stem cells for such cellular therapy in the future.

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