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STEM CELL PRESERVATION FROM UMBILICAL CORD – A LIFESAVER FOR LIFE

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ABSTRACT

The objective of the study was to evaluate the importance of umbilical stem cells in present scenario. Stem cells are the very foundation of the human body. Every part of our body including blood, bones, skin and muscles are formed from master cells known as stem cells. Stem cells have three important qualities. They have the capacity to turn into any type of cell in the body such as muscle cell, bone cell, blood cell, tissues and brain cell, can replicate or copy them limitlessly and are responsible for repair and regeneration functions in the body. Owing to these qualities, stem cells are taking center stage in medicine today. Research has proven that stem cells can be used in the treatment of many medical conditions. In the past 50 years, over a million people have benefited from the power of stem cells and are now living a renewed life. The human body has different sources of stem cells such as the bone marrow, tooth, peripheral blood and the umbilical cord. Umbilical cord is a rich source of stem cells that have the potential to treat medical conditions. The umbilical cord that forms the bond between the mother and the baby inside the womb is the richest source of lifesaving stem cells. There is every reason to preserve the umbilical cord blood and the tissue at the time of birth.

Keywords: Stem cell, regeneration, repair, replicate, umbilical cord, preserve

INTRODUCTION

Umbilical cord has a lifetime role to play. Umbilical cord blood was once discarded as waste material but is now known to be a useful source of blood stem cells. It is the richest source of stem cells in the human body. [1] The stem cells from the umbilical cord are easy to collect as they can be collected through a simple, non-invasive process at the time of birth, without any harm to the mother or the baby and have long life when preserved under cryogenic conditions have no expiration date, thereby providing lifetime benefit. The preserved stem cells can be easily retrieved at any time, thereby reducing treatment time. [2]

UMBILICAL CORD BLOOD

Cord blood is the residual blood left in the umbilical cord after the birth of the baby. It contains Haematopoietic (blood) stem cells: rare cells normally found in the bone marrow. Haematopoietic stem cells (HSCs) can make every type of cell in the blood – red cells, white cells and platelets. [3] They are responsible for maintaining blood production throughout our lives. They have been used for many years in bone marrow transplants to treat blood diseases. This blood is rich in a type of stem cells that can treat over 80 blood related medical conditions including Thalassemia, Leukemia, Lymphoma, Myeloma and so on. Cord blood stem cells have been used for over 25 years in over 30,000 transplants across the world. [4, 5]

Unique Benefits Of Umbilical Cord Blood Stem Cells: Low chances of rejection: During transplants, cord blood stem cells pose lower risk of rejection as they produce fewer natural killer cells. Family matching: Cord blood stem cells are immunologically immature and thereby offer higher matching ability than stem cells from other sources. While a 6/6 match

is required for stem cells from other sources, a 4/6 match is sufficient for use of cord blood stem. This way cord blood stem cells can prove to be a potential match for the child's siblings also. [6]
Easy to reprogram: Compared to adult stem cells, it is easier to reprogram umbilical cord blood stem cells to act like embryonic stem cells, thereby increasing their regenerative capabilities. [7]

UMBILICAL CORD TISSUE

Cord tissue is the portion of the umbilical cord itself that is rich in regenerative stem cells. These stem cells have the potential to treat conditions relating to cartilage, muscle and nerve cells. [8]

Unique Benefits of Umbilical Cord Tissue Stem Cells: Youthful: Cord tissue stem cells are youthful and therefore have greater regenerative capabilities compared to adult stem cells. [9]
Ease of use: The application of these stem cells in regenerative medicine in most of the cases is done through simple treatment procedures and delivered through non-invasive means. [10]
Combo Power: The combination of umbilical cord tissue stem cells with umbilical cord blood stem cells have led to better treatment outcomes in substantially lesser times. Hence saving both types of stem cells means more treatment options and better healing potential. [11, 12, 13]

PROCEDURE FOR BANKING OF UMBILICAL STEM CELLS

Umbilical cord stem cell banking is a simple process and an once-in-a-lifetime opportunity to preserve the baby's umbilical cord blood and tissue, which are otherwise discarded as medical waste. The collection of umbilical cord stem cells can be done only at the time of birth and causes no harm to the baby or mother. [14]

Here are the steps involved in the process: [15]
Enrollment: Sign up for umbilical cord banking well before the delivery due date to receive a collection kit. The kit is to be carried to the hospital at the time of delivery. A certified collection kit is temperature validated to ensure thermal insulation, rigid in structure to ensure safety of samples during transportation to the processing site. The kit is packed with necessary tools and instruments in sterile condition for the collection of umbilical cord blood, cord tissue and maternal blood samples.
Collection & Transport: Umbilical cord blood and tissue samples are collected by care giver through a simple 10-minute procedure done just after childbirth, posing no risk to the mother or baby. A minimum volume of 40 ml of cord blood, 20 cms of umbilical cord tissue and 6ml of maternal blood sample are collected. The collected sample is transported to laboratory within 48 hours.

Testing & Processing: Once the sample reaches the lab, it is bar-coded and registered on the Laboratory Information Management System. The samples are immediately moved for testing and processing.

- Testing: The sample is subject to various tests to check for the presence of infectious diseases. Tests are also conducted to assess the cell counts, viability and sterility. Representative samples are preserved to conduct future tests required at the time of transplant.
- Cord Blood Processing: The cord blood sample is processed to remove the red blood cells and retrieve the stem cells. At personalized proprietary processing technology is used to achieve maximum stem cell recovery. [16]
- Cord Tissue Processing: The umbilical cord tissue portions are reduced to smaller size. An Explant cell culture process is used to isolate the stem cells from the tissue.

Preservation: Cryo-Freezing: The stem cells after harvest are mixed with cryopreservation solution for retaining viability during storage, frozen down slowly using a controlled rate freezing protocol, and then placed inside large stainless steel tanks supplied with liquid nitrogen in order to maintain vapour phase temperatures below -150^0 Celsius. [17]
Preservation Certificate: A preservation certificate indicating the cell count and the viability of stem cells at the time of preservation is sent for your records.

Retrieval: The sample can be retrieved at the time of need through the following steps:

- Doctor Request: The umbilical cord stem cell samples are released only based on a request from a transplant physician indicating the need for a stem cell transplant for an approved therapy. Once the request is submitted, the matching (HLA test) between donor and recipient is initiated. If the stored unit is not a match or an additional unit is required, international registries are accessed.
- Release: Prior to release, the preserved sample is tested for potency, viability through tests. [18]

- Shipment: Cryo-preserved stem cells are shipped in special dry shippers. These dry shippers contain enough liquid nitrogen for temperature maintenance up to 14 days, ensuring safety of sample during transportation to any part of the world.

PROCESSING TECHNOLOGY OF COLLECTED SAMPLE: [19]

One must be wondering what happens to collected samples at the lab. The processing step involves separation of stem cells from the samples.

High Stem Cell Recovery: The volume of stem cells separated from the sample should be higher. The technology should also ensure that it lowers red blood cell contamination, thereby achieving the best quality harvest of stem cells from the cord blood sample. [20]

The efficiency of cord blood processing is dependent on largely two parameters namely

- The recovery of nucleated cells and also
- The reduction of the red blood cells.

Cord blood is being used increasingly on an experimental basis as a source of stem cells, as an alternative to bone marrow. Most cord blood transplants have been performed in patients with blood and immune system diseases. Cord Blood transplants have also been performed for patients with genetic or metabolic diseases. More than 80 different diseases have been treated to date with unrelated cord blood transplants. [3] Scientists are investigating the possibility that stem cells in cord blood may be able to replace cells of other tissues such as nerve or heart cells.

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CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

CONCLUSION

Figure 1: Umbilical cord of new born baby

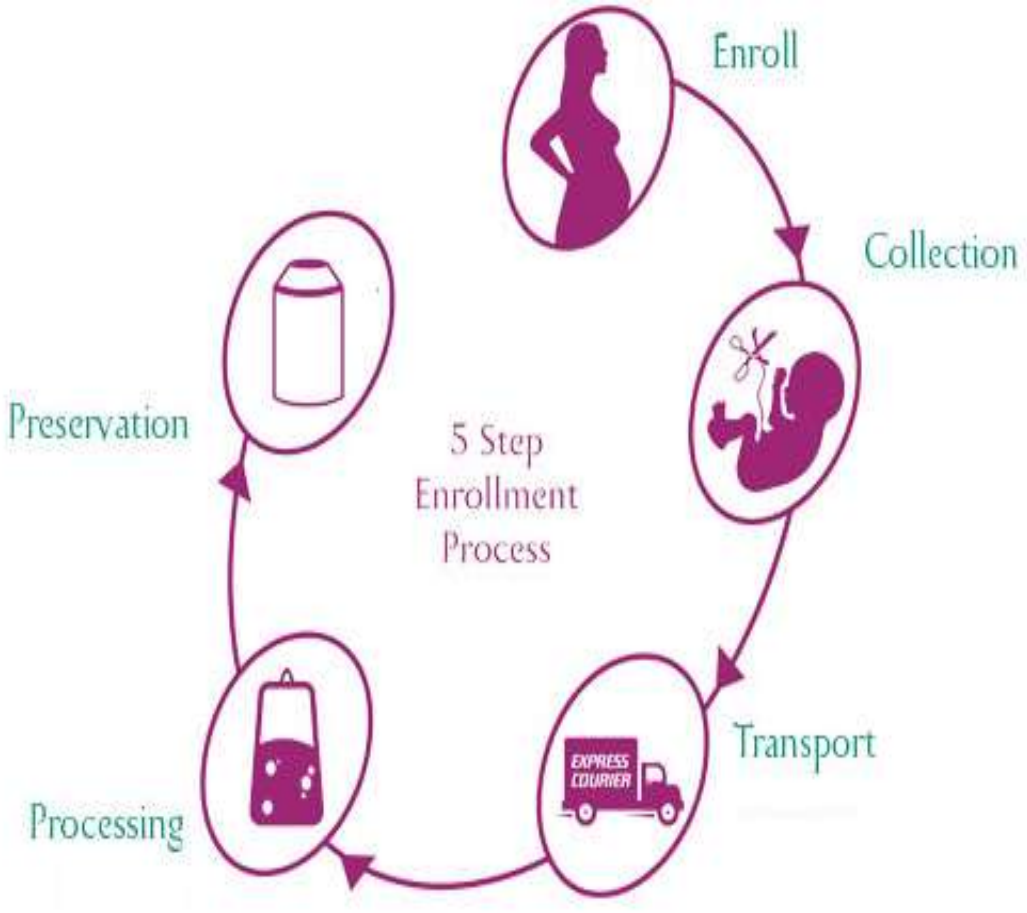

Figure 2: Steps for banking of umbilical stem cells

Figure 3: Enrollment process

Figure 4: Collection of umbilical cord blood

Figure 5: Testing and processing of stem cells

Figure 6: Cryo-preservation of stem cells

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