

UMBILICAL CORD STEM CELL BANKING

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ABSTRACT:

The process of umbilical cord stem cell banking involves the collection of the umbilical cord and placenta immediately after childbirth, processing the tissue to extract stem cells, testing the stem cells for quality and viability, and cryopreserving and securely storing the stem cells. Families have the option to store the stem cells privately for exclusive access or donate them to a public bank for research and transplantation. Cord blood banking specifically focuses on collecting and storing the baby's umbilical cord blood after delivery, which contains valuable stem cells. The umbilical cord is a known source of endothelial progenitor cells with roles in angiogenesis, vasculogenesis research, and hematopoiesis. This process provides valuable resources for potential future medical treatments and research endeavors.

Key Words: Umbilical cord, stem cell, placenta, stem cell banking.

INTRODUCTION

Umbilical cord stem cell banking refers to the process of collecting, processing, and storing stem cells derived from the umbilical cord and placenta after childbirth. These stem cells, specifically hematopoietic stem cells (HSCs) and mesenchymal stem cells (MSCs), have the potential to differentiate into various cell types, making them valuable for future medical treatments (Gluckman et al., 2011 Broxmeyer, H. E., Auerbach, A. D., Friedman, H. S., Douglas, G. W., Devergie, A., ... & Boyse, E. A. (2011). Hematopoietic reconstitution in a patient with Fanconi's anemia by means of umbilical-cord blood from an HLA-identical sibling.).

The umbilical cord is a rich source of HSCs, which can be used to treat blood-related disorders, such as leukemia and lymphoma (Ballen et al., 2013, Umbilical cord blood transplantation: The first 25 years and beyond. Blood).

The process of umbilical cord stem cell banking involves:

1. Collection: The umbilical cord and placenta are collected immediately after childbirth.
2. Processing: The collected tissue is processed to extract the stem cells.
3. Testing: The stem cells are tested for quality, purity, and viability.
4. Storage: The stem cells are cryopreserved and stored securely.

Families can store their child's umbilical cord stem cells privately or donate them to a public bank. Private banking allows for exclusive access to stem cells for future use, while public banking makes them available for research and transplantation to others (Sugarman et al., 2012).

Cord blood banking is when your baby's umbilical cord blood is collected and stored after delivery. Cord blood is what's left inside your baby's umbilical cord after it's cut. Your baby's umbilical cord is clamped and cut shortly after birth. The umbilical cord connects your baby to the placenta. The placenta grows in your uterus and supplies the developing fetus with food and oxygen.

Umbilical cord blood vessels

The umbilical cord is well known as a source of endothelial progenitor cells. These have been identified for angiogenesis and vasculogenesis research and as model tissues, not least with the standard isolation of human umbilical cord vein endothelial cells (HUVEC) (Crampton SP, Davis J, Hughes CC (2007)).

Their role in hematopoiesis has also been demonstrated as HUVECs produce growth factors and adhesion molecules that can induce maintenance and proliferation of cord blood hematopoietic progenitors (Yamaguchi H, Ishii E, Tashiro K, Miyazaki S (1998)).

The advancement of science, medicine and surgery has helped mankind improve global health, albeit with significant disparities in accessing healthcare worldwide between developed and emerging countries, but many definitions have been proposed for the term 'regenerative medicine' (Haseltine WA (2001); Mironov V, Visconti RP, Markwald RR (2004), Greenwood HL, Thorsteinsdottir H, Perry G, Renihan J, Singer P, Daar A (2006))

Kaiser, a health economist forecasting future medical technologies, first presented this concept in 1992 as an attempt to alleviate chronic diseases and restore damaged and failing organs .

With the development of immunosuppressive regimens, transplantation medicine and surgery in the 20th century and now the 21st, have enabled treatment of patients who would have had no therapeutic alternatives. However, shortage of donor organs increased significantly with clinical demand.

WHAT IS CORD BLOOD BANKING USED FOR?

Cord blood contains many types of stem cells, but the primary type is Hematopoietic Stem Cells (HSCs). HSCs are “blood forming” cells that make up our blood and immune system and can turn into: red blood cells, white blood cells, or platelets. HSCs can also be found in bone marrow. When used in a transplant, Hematopoietic Stem Cells can help ‘rebuild’ a new healthy blood and immune system in the patient in need.

As of today, the use of cord blood has proven to be effective in helping treat nearly 80 conditions including: cancers, blood disorders, bone marrow failure syndromes, metabolic disorders, and immune disorders.

WHAT ARE THE TYPES OF UMBILICAL CORD BLOOD BANKING?

Two types of banks have emerged for the collection and storage of umbilical cord blood: 1) public banks : Approved public cord blood banks are available for all donors and receives umbilical cord blood following informed parental consent. The cord blood units will then belong to the public bank for later use. The inventory is registered and later searched by the public and healthcare providers to access information for transplantation sources. Prior to inclusion in the registry, samples are screened based on volume, cell number and tissue types, health history and infectious disease status.

2) private banks: private cord blood banks obtain blood samples and store the cord blood for individual use by families and become the property of the child under the guardianship of the parents. The samples are more costly to collect and maintain in private banks. Cord blood samples stored in private banks for either autologous or allogeneic transplants for the infant donor or related family members are not searchable or available to the public. Currently, 134 private cord blood banks worldwide are known to store more than 780,000 units [Salfilippo JS et al 2007].

How does cord blood banking work?

While banking cord blood is a new experience for many parents, it is a simple one. After all, most mothers are worried about how the delivery will go and don’t want to also be worried about the details of collecting, processing and cryo-preserving their babies’ cord blood. Thankfully, the healthcare provider and the cord blood bank do most of the work. Here are the steps found in cord blood banking:

- The cord blood bank sends you a collection kit. Kits like ours just need to be stored at room temperature.
- The cord blood collection kit goes with the expectant parents to the delivery center.
- Upon admission, the mother’s blood is collected to be tested for any infectious diseases as mandated by federal regulations.
- Upon birth but before the placenta is delivered, the healthcare provider will clamp and cut the umbilical cord as normal.
- The collection bag with the baby’s cord blood and the vials with the mother’s blood are placed back inside the collection kit.

HOW IS CORD BLOOD STORED?

Safe and secure storage is crucial for stem cell samples. Cryopreservation is a storage process using controlled-rate freezers to preserve stem cells. Computer-controlled freezers gradually and precisely decrease the temperature to prevent the cells from forming ice crystals. This allows the highest level of viable cells to remain safe during storage and thawing. These devices provide electronic records and hard-cover copies of each freeze run. A controlled-rate freezer cools stem cells at approximately 1 degree Celcius per minute before the cells are stored in liquid nitrogen.

HOW IS CORD BLOOD COLLECTED?

Cord blood is collected by your obstetrician–gynecologist (ob-gyn) or the staff at the hospital where you give birth. After the baby is born, the umbilical cord is cut and clamped. Blood is drawn from the cord with a needle that has a bag attached. The process takes about 10 minutes.

Not all hospitals offer this service. Some charge a separate fee that may or may not be covered by insurance.

BENEFITS OF UMBILICAL CORD STEM CELL BANKING

Umbilical cord blood is a readily available source of hematopoietic stem cells used with increasing frequency as an alternative to bone marrow or peripheral stem cell transplantation to treat malignant and non-malignant conditions in children and adults There is minimal harm to the mother or newborn provided that priority is given to maternal/newborn safety during childbirth management. Recipients of umbilical cord stem cells may experience graft-versus-host disease, transfer of infection or genetic abnormalities, or therapeutic failure. (B. Anthony Armson, David S. Allan, Robert F. Casper, Umbilical Cord Blood: Counselling, Collection, and Banking, 2015)

Financial Negatives of Cord Blood Banking

Private cord blood banking is quite expensive. When you meet with a private cord blood bank, they’ll explain all of the fees to you. There is an initial processing fee and a banking fee. On top of that, there is an annual

storage fee. The initial cost for processing the procedure, for collecting the cord blood, and for storing it ranges from about \$600 to \$1800 for the first year. After that, the yearly storage fee is about \$100. This is a lot of money to pay for something that is an insurance policy. While saving a child's life is, of course, priceless, the research does not, at this time, support the idea that cord blood banking is more helpful in saving a child's life than are other less expensive methods.

Adverse effects in transplantation

Adverse effects are similar to hematopoietic stem cell transplantation, namely graft-versus-host disease if the cord blood is from a genetically different person, and the risk of severe infection while the immune system is reconstituted. This process of neutrophil and platelet production after the transplant, however, takes much longer than that of stem cells. In many cases, the engraftment time depends on the cell dose or the amount of stem cells obtained in the blood sample. (Waller-Wise R (2011)

In Dr. Moise's article about umbilical cord blood, it was found that there is approximately 10% fewer stem cells in cord blood than there is in bone marrow. Therefore, a sufficient amount of cord blood must be obtained to collect an adequate cell dose, however this amount varies from infant to infant and is irreplaceable. Given that this idea is quite new, there is still a lot of research that needs to be completed. It is still unknown how long cord blood can safely be frozen without losing its beneficial effects.^[13] There is a lower incidence with cord blood compared with traditional HSCT, despite less stringent HLA match requirements. (Moise KJ (December 2005).

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