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Review Article

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## Cord blood banking: a review

Pentakota Prasanna<sup>1</sup>, Alajingi Susmita<sup>1</sup>, Karukola Anusha<sup>1</sup>, Anwesh Deep Padhy<sup>1</sup>, M.Kelvin Paul<sup>1</sup>, Karrothu Syamala<sup>1</sup>

\*<sup>1</sup> Student, Doctor of Pharmacy, Avanthi Institute of pharmaceutical Sciences, Cherukupally, Vizianagram

Article History	Abstract
Received on: 24-06-2022 Revised on: 04-07-2022 Accepted on: 30-07-2022	Umbilical cord banking is the process of collecting and storing blood for future use. Cord blood contains hematopoietic stem cells which have ability to renew and regrow into any cell in the body. Cord blood is used to treat immune system genetic disorders, cancers and blood disorders. Cord blood contains less amount of stem cells but adults need higher amount of stem cells for transplantation. Public should be educated regarding the usage of cord blood. Health professionals should bring awareness regarding the cord blood donation for parents. People who undergone cord blood transplantation shows relapse of primary diseases and onset of rare genetic disorders. Public cord blood banks accept donations and to be used for anyone in need. Private cord blood banks store cord blood solely for potential use by the donor or donor's family. Public banks charge fee for retrieving stem cells. Private cord blood banks charges fee for collection, processing and annual fee to maintain the specimen. Public banks are widely accepted by the medical community as they follow FDA regulations when compared to private cord blood banks.
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### \*Corresponding Author

Pentakota Prasanna

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### Introduction

- 1) Umbilical cord connects the fetus to the placenta and mediates the supply of oxygen and nutrients to developing fetus. It is approximately 50-70 cm long and 2 cm in diameter, and is known to mediate the fetoplacental circulation and has its origin from the same zygote which gives rise to the fetus [1]. It is composed of three blood vessels which are embedded in a gelatinous substance called as Wharton's jelly which is surrounded by amnion fluid [2]. Two umbilical arteries carry the

deoxygenated blood from the fetus to the placenta whereas an umbilical vein carries the oxygen rich blood from the placenta to the fetus helping in its growth and development [3]. Soon after a baby is born the umbilical cord is clamped while previously it used to be discarded. But, the discovery of cord blood transplantation and its potential use in therapy there is growing concern about the storage of the cord blood and hence what had been a biological waste so far is now playing the vital role of human life. For over 28 years cord blood has been used as an alternative to bone marrow for therapeutic use in conditions of the blood, immune system and metabolic disorders. Parents need to be aware of the options that exist for their infant's cord blood and have

access to the relevant information to inform their choice.

- 2) Umbilical cord banking is the process of collecting and storing blood of the umbilical cord which is rich in hematopoietic stem cells and been used as a source for regenerative cell therapy and immune modulation.

#### Principal Elements in Cord Banking

- 1) Collection – Promotion , Mother Recruitment , Donor Selection / Consent , Donor Follow Up , Transport To Processing Centre.
- 2) Processing – Volume Reduction , Cryopreservation , Storage , Archiving , Testing .
- 3) Registration – Searches , Testing , Issue, Transport To Transplant Centre , Unit Transplantation Follow Up .

#### Cord blood stem cells advantages

- Ease of collection
- Minimal risk to mother and child
- Less expensive than other techniques ( bone marrow collection )
- Less risk for transmission.
- The fluid is easy to collect and has 10 times more stem cells than those collected from bone marrow.
- Cord blood stem cells may support the immune system during cancer treatments. Bone marrow stem cells do not have this capability [4].
- Used to treat immune system related genetic diseases, cancer and blood disorders.
- The collection of cord blood is less complicated and risky for donor than bone marrow.
- Cord blood donation is painless [5].
- Cord blood contains stem cells which have ability to renew and regrow into specialized cells [8].
- Immense potential to treat life threatening diseases.
- Cord blood bank can freeze and store cord blood, which means that it is ready for use when needed. Bone marrow must be used soon after it is collected [8].
- For allogenic transplants; HLA (Human Leukocyte Antigen) mismatch is better tolerated.
- Less chance of transplant rejection [9].

#### Disadvantages of Umbilical Cord Blood Stem Cells-

- Slow engraftment
- Limited cell dose
  - Small volume of unit
  - – Additional cell doses unavailable
- Autologous donation may have limited benebenefitsng to hereditary disorders
- Storage issues
  - – Unknown length of long-term storage
  - – Cost related to long-term storage
  - – Quality control
- Only 8 -12% of umbilical cord blood units have sufficient cell volume for transplant to a person weighing 80kg (176lb).
- The quantity of collected cord blood is very less and it contains less amount of stem cells but adults need higher amount of stem cells for transplantation. Therefore cord blood from multiple sources has been collected [6].
- Once transplanted no more cells can be harvested from same source [7].
- With public cord blood banks,you no longer own your cord blood once you donate it [6].
- Patients who undergone cord blood transplantation are exposed to the risk of rare genetic disorders [4].
- Only 50-200 millimeters of blood is collected from each umbilical cord [7].
- Compared to bone marrow stem cells, cord blood stem cells require more time to graft.
- People have to pay fee for storing cord blood in private bank, which could prove costly [6].

#### USES -

- It is used to treat different types of leukemia:
  - Acute Lymphoblastic Leukemia.
  - Acute Myelogenous Leukemia.
  - Acute Biphenotypic Leukemia.
  - Acute Undifferentiated Leukemia.
  - Chronic Lymphocytic Leukemia.
  - Chronic myelogenous Leukemia.
  - Juvenile Myelomonocytic Leukemia.
- It is used to Myelodysplastic Syndrome.
- It is used to treat different types of Anemia:
  - Aplastic Anemia.
  - Fanconi Anemia.
  - Congenital Dyserythropoietic Anemia.

- It is used to treat Hodgkin's Lymphoma and Non-Hodgkin's Lymphoma.
- It is used to treat blood disorders like:
  - Sickle Cell disease.
  - Beta Thalassemia.
  - Pure Red Cell Aplasia.
  - Amegakaryocytosis/Thrombocytopenia.
  - Omenn Syndrome.
  - Bare Lymphocyte Syndrome.
  - Leukocyte Adhesion deficiency.
  - Wiskott-Aldrich Syndrome.
  - Myelofibrosis.
- It is used to treat Bone Marrow Cancers like Waldenström's Macroglobulinemia, plasmacytoid Leukemia.
- Transplants for inherited disorders of immune system and other organs
  - Cartilage-Hair Hypoplasia.
  - Erythropoietic porphyria.
  - Pearson's Syndrome.
  - Schwachman-Diamond Syndrome.
  - Systemic Mastocytosis.
- Transplants for inherited metabolic disorders like:
  - Mucopolysaccharidosis storage disease (Hurler Syndrome, Scheie Syndrome, Hunter Syndrome)
  - Osteoporosis.
  - Leukodystrophy disorders (Adrenoleukodystrophy, Krabbe disease, metachromatic dystrophy).
  - Lysosomal storage diseases (Niemann-Pick disease, Sandhoff disease, Wolman disease) [2].

#### Knowledge towards the cord blood banking among the general public –

Cord blood banking is complex and often poorly understood by parents and health care professionals. Contributions should be made to educate and suggest the uses of the process. Efforts should be made to understand the required methods involved in the whole process to avoid irrational choices. Accuracy, appropriateness and evidence based information on cord blood banking must be identified. The utility of private cord blood banking and the knowledge of it among obstetricians and mothers needs to be improved [11]. The majority of education about UCBB is conducted by obstetricians, however, and when nearing delivery obstetrical care takes priority and cord blood banking, whether public or private, is not always thoroughly explored [12]. Therefore the importance of

cord banking should be reviewed among the parents who are interested. Approximately 90% of the pediatric providers are unclear and lacked formal education about cord banking techniques. Awareness among parents of the value and uses of cord blood was found to be less than knowledge levels of cord blood value and use. There was inconsistency in the information provided to parents about cord blood banking and cord blood use. This inconsistency created awareness and knowledge deficits and arguably prevents parents from making informed choices [13]. Health professions were identified as the preferred source of information on cord blood banking for parents [14].

Highlighted that obstetricians in a developing country like India did believe in the potential utility of UCB banking, but they are still not very clear about the donation of UCB to public banks. To realize their primary role in counselling the expectant parents for UCB donation as well as their role in the collection process itself [15].

#### Major Challenges in Umbilical Cord Blood Banking

1. Some obstetrical practices, such as delayed cord clamping, may affect the volume and cell dose collected.
2. Expensive process and regulatory issues
3. Relapse of the primary disease remains the major death cause in post-transplant patients.
4. Shortage of medically trained personnel and poor funding in under-developed and developing countries.
5. Safety and effectiveness issues (childhood cancers and leukemia) as unable to use for blood transplant.

#### Types of Cord Blood Banking

##### Public Bank

- Public cord blood bank collect and stores donated cord blood stem cells for use for those who are in a need of stem cell transplantation and are close enough match to the cord blood donor.
- Public umbilical cord blood banks accept altruistic donations of cord blood and do not charge donation or storage fees.
- public blood banks are widely accepted by the medical community.
- public bank follow strict quality assurance and FDA regulations and will only Bank cord blood if it is sterile and contains enough stem

cells to use in treatment [16].

- Transplantations are anonymous and no information about your baby is provided to the patient receiving the cord blood.
- while retrieving stem cells from a public bank can be pricey(\$30000 [17].
- Over 400,000 units in more than 100 quality controlled public cord blood banks [18].
- Public cord blood banks follow specific criteria and thresholds for banking.
- The quality of analogous units is same as standards of private banking [19].
- Public banks have released 30 times more CBUs for therapy than private banks [20].

#### Private Bank

- Private cord blood store cord blood solely for the potential use for the donor or donor's family.
- Private cord blood bank charges an initial fee (\$2000) for collection and processing, a yearly fee to maintain the specimen (\$200) or for storage.
- Another fee is charged when sample is removed for testing or treatment.
- 1:3 chance of your child using their own stem cells in their lifetime [17].
- More than 780,000 cord blood units are stored in over 130 private cord blood banks [18].
- Most cord blood units (CBUs) were electively stored in private cord blood banks.
- Quality parameters of privately banked CBUs are inferior to those stored in public bank [19].
- Private Banks are not obligated to fulfill the regulatory requirements of the public banks [20].

#### Disease treated by umbilical cord blood transplant by using either sibling or unrelated donors

**Malignant Diseases /non-malignant Diseases** -Acute lymphocytic leukemia, Neuroblastoma, Myelodysplastic syndrome, myelogenous leukemia, Fanconi anemia, Thalassemia, Sickle cell anemia, Amegakaryocytic thrombocytopenia, Kostman syndrome, Black fan-Diamond syndrome, Osteopetrosis, Globoid cell leukodystrophy, Gunther disease [10].

#### Conclusion

The cord blood banking is the future therapy of collecting and storing umbilical cord blood. Many

public and private banks are emerging to collect and to store the umbilical cords. The uses of umbilical cord is exponential and can be used in various health related issues. The disadvantages are also there in the cord banking. Can only hope for betterment of cord banking in the future and availability for every human use.

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