
An Educational Interventional Study on Stem Cell Awareness among Eligible Beneficiaries in Ambikapur (C.G)

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ABSTRACT

Stem cells are pluripotent cells capable of continuous division, self-renewal, and differentiation into various tissues and organs. They hold significant promise in regenerative medicine. Globally, there are over 80 blood stem cell donor registries, encompassing more than 30 million registered donors. However, India, with its vast population, has a comparatively limited number of registered donors. As of early 2024, approximately 183,000 individuals in India have registered as blood stem cell donors, highlighting a substantial gap in donor availability.

The Indian Council of Medical Research (ICMR) indicates that establishing a registry with 1 million donors could meet at least 40% of the national demand. Yet, even with access to 2 million donors globally, the unique genetic diversity of India's population poses challenges in finding compatible matches.

To address this, it's imperative to raise awareness about stem cell donation across various sectors, including non-governmental organizations (NGOs), government bodies, and the healthcare sector. Collective efforts are essential to enhance the donor registry and improve patient outcomes.

KEY WORDS: *Stem Cells, Awareness, Umbilical Cord Blood(UCB).*

METHODS

A cross-sectional educational interventional study was conducted over two months in the Raipur (CG) region. The study targeted 100 eligible beneficiaries, comprising antenatal care (ANC) mothers and eligible couples. Participants completed structured questionnaires before and after an awareness session on stem cells. The collected data were systematically analyzed to assess changes in knowledge and attitudes.

RESULTS

Post-intervention analysis revealed that 86% of participants believed regenerated tissues from stem cells could effectively replace damaged tissues. Furthermore, 91% expressed a willingness to donate stem cells following the awareness session, indicating a significant shift in perception and intent.

CONCLUSIONS

Healthcare professionals, including doctors and health workers, play a pivotal role in disseminating information about stem cell donation. Their trusted positions and effective communication strategies can significantly influence public awareness and participation in donor programs. Enhancing education and outreach through these channels is vital for expanding India's stem cell donor registry and meeting the country's healthcare needs.

BACKGROUND

Stem cells are unique, pluripotent cells capable of continuous division, self-renewal, and differentiation into various specialized cell types, making them invaluable in regenerative medicine. They are broadly categorized into two types: embryonic and adult stem cells.

Embryonic Stem Cells: Derived from the inner cell mass of the blastocyst during early embryonic development, these cells possess totipotency—the ability to differentiate into all cell types, including extra embryonic tissues. Their unrestricted potential makes them a promising source for regenerative therapies.

Adult Stem Cells: Found in various postnatal tissues such as bone marrow, skin, and dental pulp, adult stem cells are multi-potent. They primarily function in tissue maintenance and repair by differentiating into specific cell types pertinent to their tissue of origin.

Historically, the term "stem cell" was introduced by Russian histologist Alexander Maksimov in 1908. Significant advancements occurred in the 1960s with Canadian scientists' research. A notable milestone was the first successful umbilical cord blood (UCB) transplant in 1988 for a patient with Fanconianemia.

UCB, once considered medical waste, is now recognized as a rich source of hematopoietic stem cells. These cells are advantageous due to their naïve immune status, leading to a reduced incidence of graft-versus-host disease in allogeneic transplants. Moreover, UCB stem cells can be transplanted without a perfect human leukocyte antigen (HLA) match, and their collection poses no risk to the mother or infant.

However, UCB stem cells have limitations. A single UCB unit may not contain sufficient stem cells for adult transplants, and if the donor has a genetic disorder, the UCB may carry the same defect. UCB banking is conducted through:

- **Private Banks:** Store UCB for personal or familial use at a cost.
- **Public Banks:** Collect UCB donations available for any matching recipient, typically free of charge.

Stem Cell Research in India:

India is emerging as a significant player in stem cell research, driven by increasing awareness and investment. In 2010, the Indian stem cell research sector received investments totalling approximately \$540 million. Over 30 institutions are now engaged in stem cell research, supported by government funding of around \$8 million over two years.

The ultimate goal of stem cell research is to develop therapies that can replace damaged tissues or organs, offering potential cures for various diseases. Despite global advancements,

India faces challenges due to its vast genetic diversity and limited donor registries. As of early 2024, India has approximately 183,000 registered blood stem cell donors, a fraction compared to countries like Germany, which has around 7 million donors.

To bridge this gap, increased awareness and participation in stem cell donation are crucial. Organizations like DATRI and DKMS-BMST are actively working to expand India's donor registry, aiming to improve access to life-saving treatments for patients with blood disorders.

Disadvantages of Stem Cell

One of the major disadvantages of getting stem cells and umbilical cord preserved is that the banked cord blood may not be useful for all kinds of treatments. For example, if your child gets sick, then there is no assurance that the banked blood or cells would be of use for that particular sickness.

1. If a child develops any kind of a genetic disease, then his/her frozen blood may not be able to help him get cured. The cord blood too will have some genetic flaws which would have resulted in the disease in the first place and hence it won't prove to be a good treatment.
2. In many cases of illnesses and diseases, the introduction of a new set of immune cells from a donor may be more effective than using your blood and may be able to fight certain types of cancers. This too is a disadvantage of stem cell and cord banking.
3. Cord blood can mostly be used in the treatment of children only since the blood or cells taken from the cord is just about 3 to 5 ounces which is not enough to treat an adult and hence is a drawback.
4. Most blood banks claim that the stem cells taken will help siblings in case of any diseases but the possibility of this is just about 25% which is not enough in most cases. This is another drawback of stem cell banking.
5. There is a high possibility that the stored stem cells and blood may not come to any use at all. In this case, the large amount spent to preserve these may just go to waste. While it is true that banking of stem cells and cord blood is a matter of precaution but there is no definite guarantee that it may prove to be of use even once.
6. Another major disadvantage related to this method or practice is that it is very expensive and not affordable for most parents. Parenting is already an expensive affair, and most families may not be able to invest in something which is still new and comes with little guarantee of curing all kinds of diseases and illnesses. It won't be wrong to state that stem cell banking is currently limited.⁸

Rationale

Globally there are almost 20 lakh stem cell centres, where as in India we don't have such a good network of stem cell registries. There are hardly 2-3 big networks of stem cells. When we are doing an allergenic transplant, and if you don't have a sibling then you need to have an unrelated donor transplant and that is where we are having a problem as our present registry is not able to meet this demand. The current need is awareness of a stem cell registry. The Indian Council of Medical Research (ICMR) study says that if we have 10 lakh stem registry with us, we will be able to serve atleast 40 % of the demand, but when we have 20 lakh of the global registry then we are not able to meet the demand because of genetic

variation. We need to spread awareness from various levels like NGO's, government, health sectors and everybody should take the initiative of doing this. People asking for stem cell banking will put pressure on authorities to put a stem cell registry system into action.

OBJECTIVES

- To assess knowledge and awareness of stem cells among eligible beneficiaries (ANC mothers and eligible couples).
- To provide knowledge to beneficiaries on the applications and availability so it leads to increase in acceptability by people.

An interventional study was done in the Raipur (CG) region for 2 months. A total of 100 eligible beneficiaries (ANC mothers and eligible couples) were registered for the study based on purposive sampling. All the willing beneficiaries were included in the study after informed consent; those who could not be followed up after 15 days of educational intervention were excluded from the study. Ethical permission was asked from the institute. A pretested structured questionnaire was used to assess the pre-intervention knowledge level of the study participants. An education intervention was planned, and all the beneficiaries were made aware of all aspects of stem cells. After 15 days of the education intervention, a post-intervention assessment was done with the same questionnaire as pre-intervention.

Statistical Analysis

Descriptive analysis was done in terms of percentages. To see the association between categorical variables, chi-square test was applied. A P-value less than 0.05 was considered statistically significant.

RESULTS

28 % (28/100) of total subjects in our study had heard about stem cells and among them, 85.7 % (24/28) had heard about stem cell banking. Among the 85.7 % (24/28) of the subjects, those who knew the source of information related to stem cell banking were maximum from media. Among 28 % (28/100) of the subjects, 75 % (21/28) were aware that stem cells were potentially beneficial and 25 % (7/28) were unaware of the stem cells being potentially beneficial. After awareness, 100% of subjects considered that stem cells were beneficial.

78.5 % (22/28) of the subjects knew about the source of stem cell collection among the people knowing about stem cell banking. The umbilical cord as a source was known to all of them. After awareness, there was an increase in knowledge regarding the source of stem cells. Now 96 % knew about cord, 53 % about peripheral blood, 18 % about adipose tissue, 71 % about embryo cells and 63 % about amniotic fluid. Among the subjects who knew about stem cell banking, percentage of people knowing about the type of banks for stem cell storage, 32.14 % (9/24) knew about the private banks, 3.57 % (1/24) knew about the public banks and 32.14 % (9/24) knew about both the banks.

Post awareness among our 100 subjects, 14 % (14/100) knew about private banks, 3 % (3/100) knew about public banks and 83 % (83/100) about both the banks. Among

our 100 subjects, the percentage of people satisfied with the price of stem cell banking was 36 %. Only 6 % of the total subjects knew about other people whose stem cells had been stored. After awareness, no. of people knowing any of the diseases that could be cured through stem cells had increased that is 21 % of the subjects knew less than 2 diseases and 79 % of the subjects knew more than 2 diseases. After awareness, 86

% of the subjects thought that the regenerated tissues from stem cell were good enough to replace the previous tissues.

In our study, subjects suggested that the means of spreading the awareness regarding the stem cells should be maximum through advertisement. After understanding the scenario, 85 % of the subjects were optimistic about stem cell banking in future. 91 % of the subjects were willing to donate stem cells after awareness.

After applying the chi-square test, the following results found out are mentioned under the table.

Type of Response	Pre Awareness (in%)	Post Awareness (in%)
Yes	28	100
No	72	0
Table 1. Knowledge about Stem Cells: Pre and Post Awareness		
Chi square-112.5, d.f.-1, p value-0		

Type of Responses	Pre Awareness (in%)	Post Awareness (in%)
1. Yes (<2 Diseases)	15	21
2. Yes (>2 Diseases)	6	79
No	79	0

Table 2. No. of People Having Knowledge of Any of Disease That Can Be Cured via Stem Cells

Chi square-130.57, d.f.-1, p value-0

Type of Response	Pre Awareness (in%)	Post Awareness (in%)
Yes	24	91
No	51	8
Cannot Say (CS)	25	1

Table 3. No. of People Willing to Donate/Store Stem Cells after Awareness

Chi square-95.528, d.f.-2, p value-0

DISCUSSION

Stem cells are pluripotent cells characterized by their ability to self-renew, differentiate into multiple lineages, and exhibit clonogenic efficiency. Among various sources, umbilical cord blood collected at birth stands out as a rich reservoir of stem cells, offering a valuable opportunity for future therapeutic applications. Banking these cells can be considered a significant gift from parents to their children. Other notable sources include bone marrow, neural tissue, skin, retina, and dental pulp. Specifically, exfoliated deciduous teeth and extracted wisdom teeth have been identified as potential sources of stem cells, known as Stem Cells from Human Exfoliated Deciduous teeth (SHED).

Dental caries and periodontal diseases are primary contributors to tooth loss. Currently, lost teeth are replaced using artificial prostheses, either removable or fixed. However, stem cell research offers the promising prospect of regenerating natural teeth, addressing tooth mortality—a significant public health concern in both urban and rural populations.

In our study focusing on Gwalior city, an urban district headquarters, we aimed to assess the knowledge and awareness of stem cells among its residents. The rural population was excluded based on preliminary observations indicating that over 90–95% were unfamiliar with the term 'stem cells.' Our findings revealed that 28% of participants from Gwalior had heard about stem cells. This is comparable to a study conducted in Delhi by Saran et al., where 25% of subjects were aware of stem cells. The similarity in awareness levels can be attributed to both being large urban centres with higher literacy rates and better media exposure.

Contrastingly, a study in Bareilly reported a lower awareness level of 18.3%, underscoring the variability across different urban settings. In our study, media emerged as the primary source of information for 42.4% of individuals, aligning closely with the 40% reported in the Delhi study. Healthcare professionals, including doctors and health workers, were the next significant sources of information in both studies.

Regarding specific knowledge, 22% of our subjects were aware of stem cell collection sources, with the umbilical cord being the most recognized. Approximately 50% had an idea about the cost of stem cell banking among the 28% who were aware of stem cells, which is comparable to the 55% in the Delhi study. However, only a minority could identify at least one benefit of stem cell banking, with Delhi participants demonstrating slightly higher knowledge levels.

Notably, among those aware of stem cells, only 9 individuals knew exclusively about private stem cell banks, 1 was aware of public banks, and 9 knew about both. This contrasts with the Delhi study, where knowledge about stem cell banking was more prevalent. Importantly, after an awareness session, the willingness to donate stem cells increased significantly in both studies, highlighting the impact of educational interventions.

Our findings underscore a substantial knowledge deficit among individuals who claimed awareness of stem cells. Given the potential of stem cell therapies in regenerative medicine, it is imperative to enhance public education and awareness. Collaborative efforts involving media, healthcare professionals, and educational institutions are essential to disseminate accurate information, thereby benefiting the broader population.

CONCLUSION

The educational intervention significantly enhanced participants' understanding of stem cell sources, particularly highlighting the umbilical cord as a primary source. Additionally, there was a notable increase in awareness regarding the potential of stem cells in treating various diseases.

Despite these gains, concerns about the high costs associated with stem cell banking persist. Many individuals remain hesitant due to financial constraints, underscoring the need for more affordable options to make stem cell banking accessible to a broader population. While public banks offer cost-free donation options, awareness about these alternatives is limited. Government initiatives to promote public banking could alleviate financial barriers and encourage wider participation.

The study also revealed that while media serves as a primary information source, it may not effectively persuade individuals about the benefits of stem cell banking. Healthcare professionals, such as doctors and health workers, emerged as more trusted and convincing sources of information. Their active involvement in educational campaigns could bridge knowledge gaps and foster informed decision-making.

In summary, while educational efforts have improved awareness, addressing cost concerns and enhancing the roles of healthcare providers and media are crucial steps toward broader acceptance and participation in stem cell banking initiatives.

RECOMMENDATIONS

- i. A study with a larger sample is needed.
- ii. Bringing stem cell topics in school would be of great help.
- iii. Local political leader can create much awareness.
- iv. More doctors need to create awareness about stem cell banking.
- v. Governments can bring this into a health insurance policy for people in high-risk groups of certain diseases.
- vi. Media and health workers should readily participate in spreading information taking people's interests into account.

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