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EDITORIAL

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Umbilical Cord Blood Banking

Constantly growing attempts are being made to spread awareness of the phenomenon of umbilical blood (stem cell) banking that has, to put it very mildly, created a sensation in the scientific community. There is no doubt that we are on the edge of a major stem cell breakthrough and that these cells which were earlier predicted to provide effective low-cost treatment for diabetes, some form of blindness, heart attack, stroke, spinal cord damage, and many other health problems are finally on their way to achieving their potential. Research being carried out on stem cells for the past few years, has been aimed at their use in the repair of injuries to the heart muscle, restoring of dopaminergic neurons in patients with Parkinson's disease, and reduction or eradication of the clinical symptoms thereby. These cells are being used to try and improve the outcome of cancer patients, to improve learning and memory functions in patients with cognitive disorders and Alzheimer's disease, and for improving visual acuity by repairing damaged retina. There has been a completely new wave of research trials involving umbilical stem cell research that has swept through the nation.

Recently published evidence of the value of umbilical stem cells

Kang et al [1] have recently reported the use of umbilical cord blood stem cells to restore feeling and mobility to a spinal-cord injury patient, a women who had been a paralegic for 19 years due to an accident. Forty-one days after stem cell transplantation, 'testing' also showed regeneration of the spinal cord at the injured site and below it [1]. Stem cells from umbilical cord blood , given intravenously with mannitol reduce stroke size and damage [2]. Researchers first gave mannitol to provide temporary passage through the blood-brain barrier, and then transfused human umbilical cord blood cells into a stroke animal model. When used in the first hour and days following a stroke, stroke size decreased by 40% and resulting disability was significantly reduced [2].

Weiss et al [3] report that umbilical cord contains an inexhaustible, non-controversial sources of stem cells for therapy. Stem cells derived from human umbilical cord Wharton's Jelly are called umbilical cord matrix stem (UCMS) cells. UCMS cells have survival properties that make them of interest as a source of cells for therapeutic use. They can be isolated in large number and are negative for CD 34 and CD 45 .They can grow robustly and can be frozen . UCMS cells can be clonally expanded and can easily be engineered to express exogenous proteins. UCMS cells have genetic surface markers of mesenchymal stem cells and appear to be stable in terms of their surface marker expression. UCMS cells express growth factor and angiogenic factors suggesting that they may be used to treat neurodegenerative disease. To test the therapeutic value of UCMS cells , the study involved transplantation of undifferentiated human UCMS cells into brains of hemiparkinsonian rats that were not immune suppressed and comparing the results with the transplantation of the same cells into normal rats. The study concluded that the umbilical cord matrix appeared to be a rich, non-controversial and inexhaustible source of primitive mesenchymal stem cells [3].

Umbilical cord cells show great promise of being an effective treatment for leukemia. Normally, leukemia patients must rely on receiving bone marrow transplants from donors, and the donor must be a close match or the patient develops serious immunological problems. Closely related donors, such as siblings, have the best chance of being a good match. Laughlin et al [4] conducted a study of 68 patients with leukemia or with other blood disorders. Most of the patients received transplants of umbilical cord cells from unrelated donors. About 90% of the patients grew new, healthy blood cells from the "mismatched" cord blood cells. Only 20% of the patients developed severe immunity problems compared to 55% of the patients who developed such problems after receiving perfectly matched bone marrow. It is thought that because the umbilical cord cells are immature immunologically, they adapt to the patient's body better than mature bone marrow cells and thus don't cause as many immunological problems. Umbilical cord cells are in abundance, are immunolgically flexible, and can be used as a truly ethical form of therapy [4].

Use of cord stem cells is rapidly expanding in bone marrow transplantation, where the immunologically naive cord blood cells carry a much lower risk of graft versus host disease (GVHD) than that occuring with traditional transplants of adult, marrow-derived stem cells. Investigators also speculate

that cord blood stem cells could be used to revitalize a damaged immune system, making them nearly as versatile as embryonic stem cells for treating such immune disorders as type 1 diabetes and rheumatoid arthritis.

The most promising treatment of diabetes involves replacement of the beta cells of the pancreas by stem cells derived from mice, monkeys or humans and cultured to differentiate into insulin positive cells [5]. Banerjee et al's [5] laboratory is in the process of carrying out in vivo studies involving transplantation of generated duct derived islets into experimental diabetic mice to achieve normoglycemia.

Embryonic versus umbilical stem cells

Stem cells are primal undifferentiated cells which retain the ability to differentiate into other cell types that allows their use in repair and replenishment. Human stem cells can be derived from three basic sources which include: (i) embryonic stem cells derived form aborted fetuses or fertilized eggs, (ii) umbilical cord blood cells from the newborn baby, and (iii) adult stem cells which are isolated from an adult's tissues (such as the bone marrow, fat, or blood) and then grown in tissue culture.

Since the use of embryo-derived stem cells is controversial and the adult derived cells may not be as effective, many clinicians have started working with stem cells that are obtained from umbilical cord blood. In addition to the moral and ethical issues involved in obtaining cells that cause the destruction of human embryos, embryonic stem cells have other problems, including contamination with blood and tissue cells which have developed ABO and HLA antigens on their surface. These cells may induce graft versus host reaction and cause health problems in the patient receiving them.

Umbilical cord blood has been approved for use by the FDA and other authorities since the late 1980's. The first umbilicial cord blood transfusion cured a blood cancer in 1988. Over 1,000 cord blood transfusions, frequently in children with leukemia, have been successfully performed in the United States with little or no side effects. Recent research has shown that umbilical cord blood stem cells have similar powers and health promoting benefits as do embryonic stem cells. Advances are being made each day in providing greater safety to the patient. New methods of separating the stem cells from all other blood components have resulted in a product that consists of only stem cells. Since these umbilical cord stem cells have not developed ABO and HLA antigens on their surface they do not induce graft versus host reactions nor other problems that may occur with embryonic and adult bone morrow stem cells [6,7].

Umbilical cord blood banking

As stem cell therapy breaks new ground and stem cells derived from the umbilical cord blood are proving to be such a boon to stem cell therapy, it is but natural that the prospect of preservation of umbilical cord blood is gaining momentum. Thus, so called, umbilical cord blood banking is being touted as insurance for life. Storage of the stem cells derived from umbilical cord blood means one can preserve and use genetically matched stem cells on hand, in case the child or someone else in the family suffers from a treatable blood disorder or needs a bone marrow transplant. There is a 25% genetic match between the siblings and parents, which proves to be the most alluring prospect for expectant couples to bank their child's cord blood (thus ultimately their stem cells). The use of these stem cells more or less ensures absence of graft versus host reaction, which is a huge drawback in cases of organ transplantation. In India, there are approximately 72000 births daily, which results in discarding 72000 umbilical cords a day. The storage of stem cell rich blood derived from these umbilical cords can prove to be the best possible insurance against life threatening diseases.

In brief , the procedure of the umbilical cord blood banking, involves the cutting and clamping of the umbilical cord. A specialized blood bag is then bar-coded for collection of cord blood. For the collection step, the needle of the blood bag is inserted into the umbilical vein and the bag is held at a lower level in order to allow the blood to drain into the bag. Stem cells are then harvested from the cord blood and stored in cryo-vials at -196^0 C in liquid nitrogen. Molecular tests are conducted for tissue (HLA) typing.

The first treatment using umbilical cells derived from cord blood was that of Fanconi's anemia by Dr. Elaine Gluckmen in 1998, in Paris . Umbilical cord research was initiated at the Cancer Research Institute, Tata Memorial Center, Mumbai in 1990 with National Center for cell Science, Pune as the co-investigator. The research shows that cord blood derived stem cells were comparable to bone marrow in terms of number and quality. The technology of umbilical cord blood collection, enrichment of stem cells, and their cryopreservation was transferd to Armed Forced Medical Collage, Pune and the Tata Memorial Hospital in Mumbai. However, these institutions did not get any support from government of India to set up a stem cell bank. The first private cord stem cell bank was established in 2002.

The Ministry of Health has approved a Grant of Rs 5 crores to upgrade its stem cell research at the Mumbai based National Institute for Research in Reproductive Health under the Indian Council of Medical Research (ICMR). The Ministry of Health is working on a memorandum of understanding with

California based private Korean research company Histostem that wants to setup four umbilical cord blood banks in India as part of what it believes to be the largest umbilical cord blood banking in the world. Histostem claims to have initiated clinical trials for stem cell therapeutic application in the area of strokes, liver cirrhosis, diabetes, Berger's disease, osteoporosis, spinal cord injuries, hypertension, and avascular necrosis. The company said that they would be obliged to only conduct research while its application would be carried out at the two leading institutes–All India institute of Medical Sciences, Delhi and Post Graduate Institute at Chandigarh. Histostem and Apollo Hospitals have also agreed to setup a Histostem Cell Therapy Center for which the Apollo Hospital will provide the cord blood from the births at the hospital.

New private cord blood banks are being established all over India in an attempt to use their knowledge, research and storage facility to benefit the Indian pollution. What seemed like a dream few years back is now becoming reality. The use of umbilical stem cells for therapeutic purposes can ensure lower treatment costs and longer lives. Some may say the cost of umbilical cord blood storage which is approximately Rs 35,000 for 21 years in a considerable amount, but comparing it with the benefits of the child's and ones own future will help one put things in perspective.

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ADI DASTUR
Associate Editor
103, Razak Haven,
12, Darabsha Lane,
Nepean Sea Road
Mumbai - 400 026.
Tel. 9821023230
Email : adi.dastur@gmail.com
aedastur@vsnl.com