

Imagine having the ability to repair your damaged or dead cells with new ones derived from stem cells. Think about it.

New replacement cells in your body could greatly enhance the quality of your life - and possibly add a year or two. CyGenics' **MARK KIRKLAND** says this technology may well be around the corner.

# Stem Cells:

## Body, Heal Thyself

**A**dult stem cells are rare cells that can be found in different parts of the human body. When an injury occurs, these cells are activated, dividing to become new cells to replace damaged cells. They are also responsible for replacing normal cells throughout one's life, such as skin and blood. The more scientists understand these cells and what they can do, the more we are discovering that these cells can be the basis for a wide range of medical therapies.

It is important to distinguish "Adult stem cells", which can be found in the fully formed body at any stage after birth, from "Embryonic stem cells", obtained from the early embryo. Unlike embryonic stem cells, adult stem cells are not controversial, and have been used in clinical practice for over 30 years. The "traditional" sources of adult stem cells are from the bone marrow and peripheral or circulating blood. These stem cells are called haematopoietic or blood stem cells (HSCs) and are responsible for making

up to 250 billion new blood cells every day – the white blood cells (fight infection), the red blood cells (carry oxygen), and the platelets (blood clotting). A considerable amount of effort around the world is concentrated on the research and development of therapies using such adult blood stem cells.

Blood stem cells are used in transplant medicine to regenerate a patient's bone marrow and hence the ability to generate new red blood cells, platelets and white blood cells. A blood stem cell transplant – formerly known as a bone marrow transplant – may be necessary when a patient's bone marrow has been damaged by disease or by high dose chemotherapy treatment.

Today, about 80 diseases can be treated using these stem cells, such as leukemia, anemia, myeloma, and thalassemia.

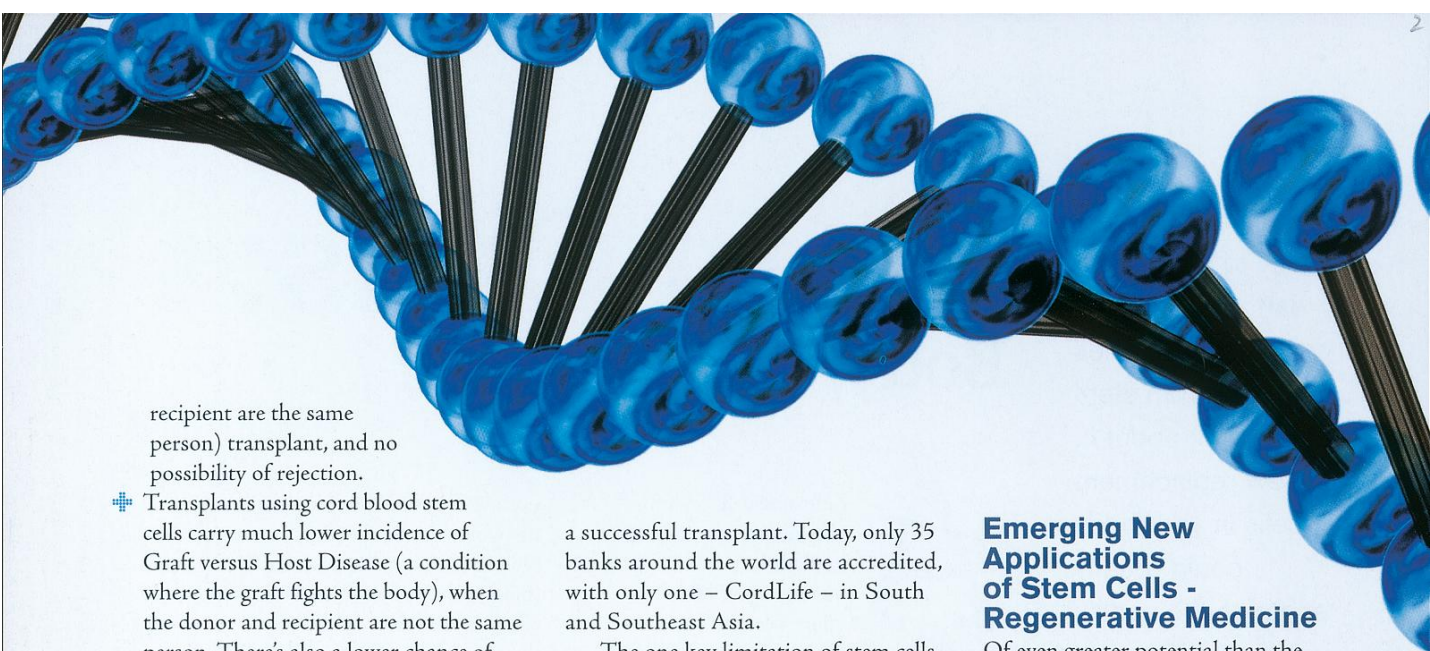
### Benefits Of Umbilical Cord Blood

In recent years, the collection and use of stem cells derived from umbilical cord blood (UCB) for transplants, instead of bone marrow, has been gaining popularity. The advantages are as follows:

- ✦ Collecting umbilical cord blood poses no risk to mother or child, whereas a bone marrow donor must undergo anesthesia and is at risk of infection.
- ✦ Collecting bone marrow is a painful and invasive process. Collecting umbilical cord blood is painless to the mother and child, and is usually over in a few minutes.
- ✦ Umbilical cord blood can be stored in a cryogenic freezer, ready for use when needed. Bone marrow is collected only when needed and it may take many weeks or even months to find a suitable and willing donor.
- ✦ There is of course a perfect match in the case of an autologous (donor and







recipient are the same person) transplant, and no possibility of rejection.

- ✦ Transplants using cord blood stem cells carry much lower incidence of Graft versus Host Disease (a condition where the graft fights the body), when the donor and recipient are not the same person. There's also a lower chance of the body rejecting the transplant. This makes it possible to perform transplants with less than a perfect match. Umbilical cord blood may therefore be used more readily.
- ✦ It is believed that the 'biological clock' is stopped for umbilical cord blood in cryogenic storage. That is, it is protected from damage due to environmental factors, age and viral or bacterial attack. Bone marrow would be as 'aged' and 'damaged' as the donor.
- ✦ Umbilical cord blood stem cells seem to be particularly well suited to some of the new therapies under development, as they appear to have greater 'plasticity' than stem cells collected later in life.

### Cord Blood Is A Vital Resource Today

Cord blood, which in the past used to be thrown away as medical waste, is today increasingly realized as a vital resource. In some countries such as Japan, the total number of HSC transplants using cord blood has already exceeded bone marrow transplants. As cord banks are set up to meet this new demand, internationally recognized standards becomes important.

An accreditation such as that granted by the AABB, ensures that the best possible sample has been qualified, collected, tested, processed, and stored properly. Should the cord blood sample be needed, a transplanting physician anywhere in the world will know that the sample has been collected, tested, processed and stored in a way that is consistent with enhancing the chances of

a successful transplant. Today, only 35 banks around the world are accredited, with only one – CordLife – in South and Southeast Asia.

The one key limitation of stem cells derived from cord blood is the quantity. Cord blood can only be collected at the time of birth. The sample collected is usually enough for a single transplant. There are a few companies around the world engaged in expanding the quantity of stem cells. When this becomes commercially and clinically viable, the uses of cord blood stem cells will increase dramatically.


One of the companies involved in such work is CyGenics. It has a patented technology called the Cytomatrix. This has been proven to effectively grow different cells in three dimensions, close to how they would normally grow in the body. Some of the research has also successfully generated new immune cells called T cells, for the first time outside the body. This of course, has huge potential applications for a very wide range of diseases – provided the starting material, those all too precious stem cells, are available.

These advances, coupled with the company's focus on developing the best quality cord blood banking solutions and services across the region, has been recognized by the World Economic Forum. In December 2006, the company was one of 47 companies – and only three in Asia – to be awarded the prestigious Technology Pioneer status. This award recognizes companies "developing life-changing technology innovation and having the potential for long-term impact on business and society."

### Emerging New Applications of Stem Cells - Regenerative Medicine

Of even greater potential than the existing uses of adult stem cells to treat bone marrow diseases, such is leukaemia, is the emerging field of cellular therapies. Recently it has been shown that adult stem cells, particularly those found in UCB, can sometimes contribute to tissue repair in other organs. Stem cells have been used to grow a wide range of cell types in addition to blood cells, including nerve, heart and liver cells – a phenomenon called 'stem cell plasticity'. This is leading to the rapid development of new applications for these cells – an entirely new category called regenerative medicine.

In the past few years, hospitals around the world have successfully treating selected patients with heart failure using adult stem cells. Recent results from the United States and Germany indicate that adult stem cells may be the ideal source of new cells for tissue replacement. Some scientists already believe stem cells can be used to help treat a wide range of other diseases, such as Diabetes, Cystic Fibrosis, Alzheimer's Disease and Parkinson's Disease.

The path ahead is a new one. Instead of relying solely on drugs to treat diseases, stem cell-based therapies hold out the promise of safer treatments for a wide range of ailments. By using the bounty of stem cells contained within the human body, it is possible for the body – with a little help from medical science – to heal thyself. 

*A/P Mark Kirkland is the Chief Scientific Officer at CyGenics*