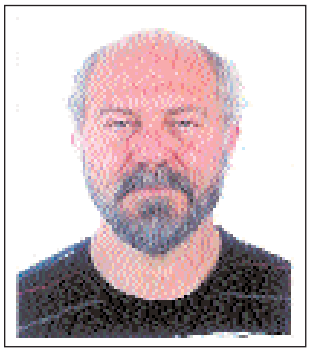
Stem Cells Research



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Preamble:

Research in stem cells captured the imagination because of their unlimited developmental and regenerative potentials. Stem cells have the remarkable potential to develop into many different cell types in the body. Serving as a sort of repair system for the body, they can theoretically divide without limit to replenish other cells as long as the person or animal is still alive. When a stem cell divides, each new cell has the potential to either remain a stem cell or become another type of cell with a more specialized function, such as a muscle cell, a red blood cell, or a brain cell. Fig. 1

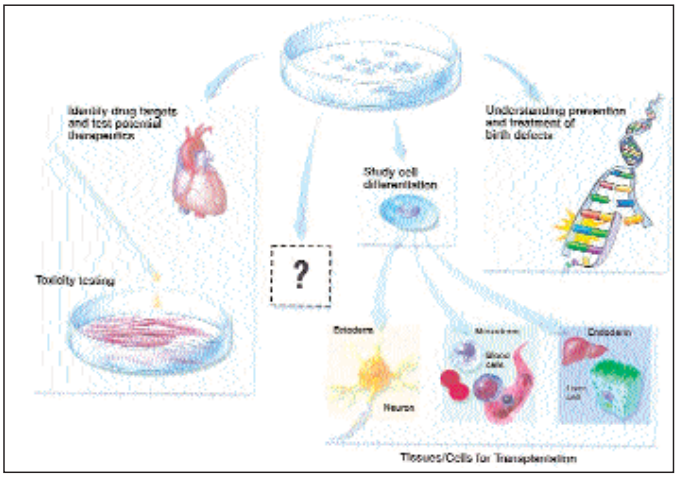

Figure 1- The promise of stem cell research

Multiple sources of stem cells have been identified from various tissues including, embryonic cells, bone marrow, neural tissue, skin, retina and dental pulp:

1. The embryonic stem cells are derived from embryos at a developmental stage before the time that implantation would normally occur in the uterus. Indeed each of the blastomeres has the potential to give rise to any cell of the body (Fig 2).

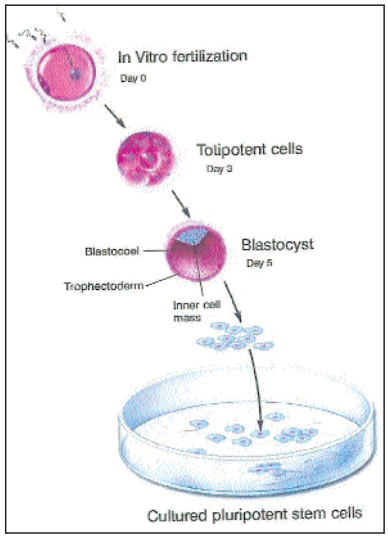

Figure 2- How human embryonic stem cells are derived

2. Umbilical cord stem cells, a new born baby's cord blood, can be used as a resource to treat life threatening diseases. Yes, versatile benefits of blood stem cells in babies' umbilical cords have shown new hopes in the field of medicine. Instead of disposing these umbilical cords, the blood cells are now being extracted and preserved for the future medical treatment, life saving procedures involving gene therapy (Fig 3).

The umbilical cord at term has been discovered to be an interesting and promising source of stem cells. Stem cells can be obtained from both the umbilical cord blood and the mesenchymal cells of the Wharton's jelly. They show an extreme pleomorphism and great proliferative and differentiative potentials; they can generate osteocytes, lymphoblasts, erythroblasts, hepatocytes and neuronal cells.

The culture of these cytotypes and their differentiation into

chondrocytes, osteocytes, adipocytes or myocytes becomes very important in the understanding of staminal potentiality of this embryo-fetal annex.

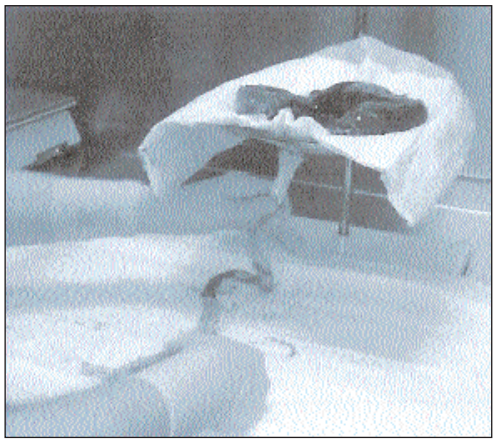

Figure 3- Blood is drained from the umbilical cord vessels either in-utero or ex-utero immediately after delivery

3. Hemopoietic cells, blood and the system that forms it known as hemopoietic system, consists of many cell types with specialized functions. The continued production of these cells depends directly on the presence of Hematopoietic Stem Cells (HSC), the ultimate source of all these cells (Fig 4).

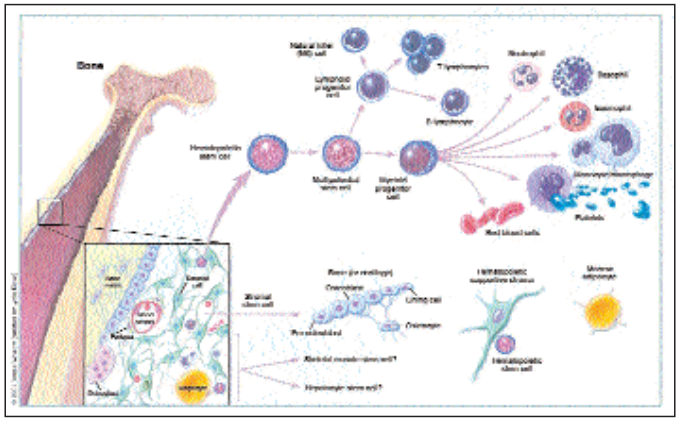

Figure 4- Hematopoietic and stromal cell differentiation

4. Dental pulp stem cells have a self renewal capability, multi-lineage differentiation capacity and clonogenic efficiency. Our understanding of the biology of the pulp has improved significantly in recent years and this has allowed us to present more robust hypotheses regarding the molecular and cellular processes responsible for dental regeneration. However, it is still not possible to state with any certainty which cell populations and which specific molecular signaling pathways predominate during dental regeneration, although the variety of cell populations potentially involved and many of the signaling events are becoming clearer. This is, in part, due to the fact that no one episode of regeneration will be the same. The intensity and duration of the tissue injury, the involvement of inflammatory processes and their possible exacerbation by bacteria will all impact on the tissue environment in which regeneration takes place. This environment will be further influenced by host factors, such as ageing, which will modify the cell populations present and systemic and innate immunity. A number of these factors may also influence the availability and/or the ability of cell-signaling molecules, which may be sequestered within the dentine matrix and released during injury. Therefore, it is not surprising that a diversity of tissue responses can be observed during dental regeneration as the latter represents a pathophysiological response of utmost relevance (Fig 5).

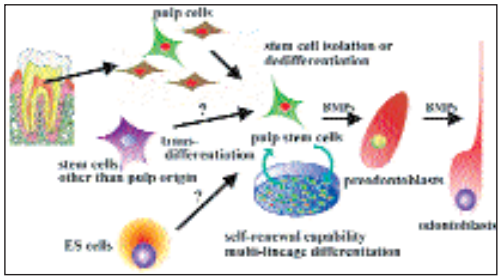

Figure 5- The potential of dental pulp stem cells and signals for dental regeneration

hes to dental regeneration are developed to a clinical stage, tissue banks for sourcing autologous cells will become increasingly important. However, although it is tempting to speculate that such clinical therapeutics will prove successful, we are some way from taking this knowledge from bench to clinic- Objective 8. (Fig 6).

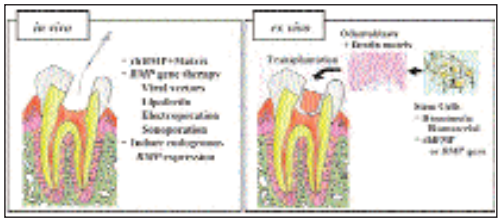

Figure 6- Two main strategies for pulp therapy to regenerate dentin.

The various methodologies used are ultimately based on 3 basic components of biologic tissues: (1) to have well characterized responding cells (multiple sources will be used), (2) to have the proper extracellular matrix scaffold and(3) the appropriate inductive morphogenetic signals (Fig 7).

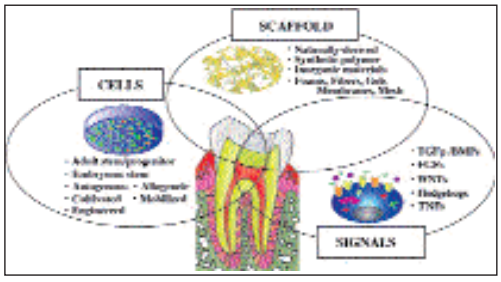

Figure 7- the key elements of stem cell culture

Stem cells have a promising future therapeutic potential, however, the ethical issues have to be given a priority.

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