Mesenchymal Stem cells derived from human perinatal tissues as a model for drug screening and toxicity testing – A perspective

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Background

Stem cells have a great potential for basic research and hold the future for clinical applications. These cells have characteristic features quite unique from other cells i.e., they are capable of self-renewal and differentiating into any cell type. The two types of stem cells being considerably worked on are the embryonic stem cells (ESCs) and the adult stem cells.

ESCs are pluripotent cells and hence capable of differentiating into all three germ layers viz., endoderm, mesoderm, and ectoderm. Adult stem cells are generally regarded as multipotent having the capability of differentiating into limited cell types. However, some reports show evidence of having pluripotent nature in adult stem cells like mesenchymal stem cells (MSCs), though it is not generally accepted. In general, MSCs are capable of differentiating into adipocytes, chondrocytes, and osteocytes.

MSCs vary significantly in their paracrine secretions based on the tissue of origin. This difference is probably required for the maintenance of the tissue homeostasis in which they are residing. All the MSCs have immune regulatory properties. Area of mesenchymal stem cells (MSCs) has flourished lately. Mesenchymal stem cells can be isolated from perinatal and postnatal tissues. MSCs are present in almost all the postnatal organs viz., liver, skeletal muscle, adipose tissue, heart, lung, brain etc. making their presence ubiquitous. However, it is not possible to recover these MSCs for research purposes as it evokes ethical issues and technical difficulties. Hence, the best choice left to researchers is perinatal tissue available as biological waste. Perinatal MSCs can be harvested from various sources viz., cord blood, umbilical cord, placenta, amnion, and chorion. These MSCs are the promising resources for autologous stem cell transplantation because they are the biological wastes that are easily available with negligible legal issues. The most important features of these MSCs are that they are human origin and represent normal diploid cell population having finite life. Human diploid cells have been employed in viral vaccine preparation such as rabies. It is very difficult to prepare and establish human diploid cell culture such as MRC5 and MRC9 derived from human fetal lung and kidney respectively. Under this scenario, human tissue derived MSCs come to our rescue to form a novel alternative/substitute for drug screening. A study performed by Petlzer et al., highlighted the importance of elaborated predictive in vitro test to screen between-donor variability of perinatal tissues for banking allogeneic standardized MSCs. Perinatal MSCs are useful for ex vivo expansion of hematopoietic progenitor cells as they have the potential to modulate the in vitro immune response. Umbilical cord MSCs and placenta-derived MSCs are considered to be genetically stable under hostile in vivo situations, demonstrating their suitability to be used for therapy.