

S-2-2

Isolation and characterization of mesenchymal stem/progenitor cells from chorionic villi of human placenta

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For more than 20 years, bone marrow has been the main source of replacement stem cells for hematopoietic reconstitution in the treatment of malignant and genetic diseases of the blood. Recently, transplant physicians have embraced umbilical cord blood as an efficacious alternative to bone marrow as a source of hematopoietic stem and progenitor cells. Typically after harvesting the cord blood, the placenta is discarded as medical waste. We have studied the discarded placenta as a possible allogeneic source of cells for regenerative medicine by searching for mesenchymal cells within the tissue.

Placenta derived mesenchymal cells (PDMCs) were isolated from chorionic villi by explant culture method. The cells showed fibroblast-like morphology, which did not express CD31, CD34, CD45 or HLA-DR, but did express CD13, CD44, CD73, CD90, CD105, similar to previous characterizations of mesenchymal stem cells (MSCs). These cells also expressed the lineage-specific genes, type I collagen, osteocalcin, and nestin. To examine the differentiation potential of PDMCs, the cells were cultured under specific induction conditions. RT-PCR or histochemical staining was used to demonstrate the lineage-specific marker and morphological evidence of differentiation after 3 weeks induction. In adipogenic differentiation conditions, the expressions of peroxisome proliferator

activated receptor gamma (PPAR γ) gene and Oil Red staining were detected. Osteogenic differentiation was demonstrated by using alkaline phosphatase detection and von Kossa staining. In chondrogenic differentiation, the expression of the SOX 9, type II collagen and aggrecan genes were detected, and toluidine blue and type II collagen staining revealed the deposition of extracellular matrix in the pellet culture. In neural induction medium, the cells showed typical neural like morphologies and a variety of neural markers including nestin, NSE, GFAP, MBP were detected. In summary, our study found that PDMCs represent a population of cells capable of differentiation into osteoblasts, chondrocytes, adipocytes and neural cells and thus provide evidence that mesenchymal stem/progenitor cells exist within the stromal compartment of chorionic villi of human placenta at 38-40 weeks of gestation. Now, we are investigating whether PDMCs will form bone and cartilage in vivo.

Bone marrow has been the main source of MSCs for both experimental and clinical studies. However, the problems of pains and morbidity of the donor and the significant drop in cell number and declining proliferative/differentiation capacity of these cells with the increasing age of the donor makes the search for alternative MSC sources necessary. Our results suggest that the PDMCs may be a useful cell source for tissue engineering.