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Mesenchymal stromal cells from amniotic fluid are less prone to senescence compared to those obtained from bone marrow: An in vitro study.

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Abstract

Mesenchymal stromal cells (MSCs) are considered to be an excellent source in regenerative medicine. They contain several cell subtypes, including multipotent stem cells. MSCs are of particular interest as they are currently being tested using cell and gene therapies for a number of human diseases. They represent a rare population in tissues; for this reason, they require, before being transplanted, an in vitro amplification. This process may induce replicative senescence, thus affecting differentiation and proliferative capacities. Increasing evidence suggests that MSCs from fetal tissues are significantly more plastic and grow faster than MSCs from bone marrow. Here, we compare amniotic fluid mesenchymal stromal cells (AF-MSCs) and bone marrow mesenchymal stromal cells (BM-MSCs) in terms of cell proliferation, surface markers, multidifferentiation potential, senescence, and DNA repair capacity. Our study shows that AF-MSCs are less prone to senescence with respect to BM-MSCs. Moreover, both cell models activate the same repair system after DNA damage, but AF-MSCs are able to return to the basal condition more efficiently with respect to BM-MSCs. Indeed, AF-MSCs are better able to cope with genotoxic stress that may occur either during in vitro cultivation or following transplantation in patients. Our findings suggest that AF-MSCs may represent a valid alternative to BM-MSCs in regenerative medicine, and, of great relevance, the investigation of the mechanisms involved in DNA repair capacity of both AF-MSCs and BM-MSCs may pave the way to their rational use in the medical field.

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An immortalised mesenchymal stem cell line maintains mechano-responsive behaviour and can be used as a reporter of substrate stiffness.

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Abstract

The mechanical environment can influence cell behaviour, including changes to transcriptional and proteomic regulation, morphology and, in the case of stem cells, commitment to lineage. However, current tools for characterizing substrates' mechanical properties, such as atomic force microscopy (AFM), often do not fully recapitulate the length and time scales over which cells 'feel' substrates. Here,

we show that an immortalised, clonal line of human mesenchymal stem cells (MSCs) maintains the responsiveness to substrate mechanics observed in primary cells, and can be used as a reporter of stiffness. MSCs were cultured on soft and stiff polyacrylamide hydrogels. In both primary and immortalised MSCs, stiffer substrates promoted increased cell spreading, expression of lamin-A/C and translocation of mechano-sensitive proteins YAP1 and MKL1 to the nucleus. Stiffness was also found to regulate transcriptional markers of lineage. A GFP-YAP/RFP-H2B reporter construct was designed and virally delivered to the immortalised MSCs for in situ detection of substrate stiffness. MSCs with stable expression of the reporter showed GFP-YAP to be colocalised with nuclear RFP-H2B on stiff substrates, enabling development of a cellular reporter of substrate stiffness. This will facilitate mechanical characterisation of new materials developed for applications in tissue engineering and regenerative medicine.

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Ex vivo evaluation of intravitreal mesenchymal stromal cell viability using bioluminescence imaging.

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Abstract

BACKGROUND:

Bone marrow-derived mesenchymal stromal cell (MSC) therapy is a promising treatment for several degenerative ocular diseases; however, no reproducible method of monitoring these cells into the eye has been established. The aim of this study was to describe successful bioluminescence imaging (BLI) to detect viable luciferase-expressing MSC in the eye.

METHODS:

Human donor MSC in culture were transduced with 50 μl luciferase lentiviral vector (three viral particles/cell) prior to intraocular injection. Twenty-one right eyes of 21 rabbits were evaluated through BLI after receiving 1×10^6 luciferase-expressing MSC intravitreally. Contralateral eyes were injected with vehicle (phosphate-buffered saline (PBS)) and were used as controls. At seven different time points (1 h to 60 days), D-luciferin (40 mg/ml, 300 μl PBS) was injected in subsets of six enucleated eyes for evaluation of radiance decay through BLI analysis. CD90 and CD73 immunofluorescence was studied in selected eyes.

RESULTS:

Eyes injected with MSC showed high BLI radiance immediately after D-luciferin injection and progressive decay until 60 days. Mean BLI radiance measures from eyes with luciferase-expressing MSC were significantly higher than controls from 8 h to 30 days. At the thirtieth day, positive CD90- and CD73-expressing cells were observed only in the vitreous cavity of eyes injected with MSC.

CONCLUSIONS:

Viable MSC were identified in the vitreous cavity 1 month after a single injection. Our results confirmed BLI as a useful and reliable method to detect MSC injected into the eye globe.

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Achieving stem cell imaging and osteogenic differentiation by using nitrogen doped graphene quantum dots.

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Abstract

Nitrogen doped graphene quantum dots (N-GQDs) were synthesized to explore and extend their potential applications in biomedical field. The hemocompatibility and cytotoxity of the obtained N-GQDs were primarily assessed at concentrations ranging from 10 to 100 μg/ml. From the results, it was found that the proliferation of rat Bone Mesenchymal Stem Cells (rBMSCs) was depressed to a certain extent after incubating with the high concentration (100 μg/ml) of N-GQDs. The nanoscale size and superior dispersibility endow N-GQDs with good cell permeability. Meanwhile, owing to their intrinsic photoluminescence characteristic, the N-GQDs can be used to label cells with high uniformity and light stability in absence of chemical dyes. More importantly, the up-regulated expression of alkaline phosphate (ALP), extracellular matrix, osteopontin (OPN) and osteocalcin (OCN) in rBMSCs cultured with N-GQDs, indicating N-GQDs have the abilities to promote rBMSCs osteogenic differentiation. This work would help give a new insight into the advantages of N-GQDs and pave the way for application of N-GQDs in regenerative medicine fields.