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PROCEEDINGS

From Cell to Cell-Free Strategies: New Developments in Cartilage and Cardiac Tissue Repair

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ABSTRACT

1 Introduction

Joint and cardiovascular diseases, such as osteoarthritis (OA) and myocardial infarction (MI), pose significant clinical challenges due to their limited regenerative capacity. The key to mitigating tissue damage and preventing the progression of OA and MI is to repair or even regenerate the infarcted tissue. At present, cell-based therapy is the primary strategy for tissue repair. Delivered cells could either differentiate into functional cells or secrete paracrine signals to promote onsite cell function. Both mechanisms have demonstrated potential in cartilage and cardiac tissue repair, both preclinically and clinically. In addition to cell therapy, cellular secretomes such as growth factors, extracellular vesicles (EVs), and decellularized extracellular matrix (dECM) have also been developed in tissue engineering. Compared to cell therapy, cell-free therapy has advantages such as reduced immune rejection, less ethical complexity, and similar potential to promote tissue repair. Consequently, cell-free therapy is gaining increasing popularity. This talk will highlight developments in cell and cell-free therapies from our group, combined with various biomaterials and 3D biofabrication techniques, for cartilage and cardiac tissue repair.

2 Methods

The therapeutic potential of various cells, including cardiosphere-derived cells (CDCs), bone marrow mesenchymal stromal cells (BM-MSCs), and umbilical cord blood (UCB) MSCs for cartilage and cardiac tissue repair was assessed both in vitro and in vivo. Furthermore, dECM and EVs secreted by cells were evaluated in cellular experiments and small animal models to demonstrate their effect on promoting tissue repair.

3 Results

CDCs reduced cell apoptosis and promoted cell proliferation. In small and large animal models, CDCs demonstrated their capacity to enhance vascular formation and preserve cardiac function. Besides CDCs, BM-MSCs derived EVs delivered via a spray technique also showed potential in cardiac tissue repair, with an enhanced retention rate and reduced immune response. For cartilage repair, the incorporation of silk-based hydrogel improved the chondrogenesis of chondrocytes. Additionally, a bioassembly technique combined with UCB-MSC was able to fabricate an engineered osteochondral tissue construct with a clear zonal structure, which could facilitate cartilage tissue repair. Moreover, cartilage dECM was also introduced in the microfracture technique, demonstrating improved cartilage repair in a rat model.

4 Conclusion

Cell and cell-free therapy could promote cartilage and cardiac tissue repair via the differentiation pathway or

paracrine signalling. Both strategies hold the clinical potential to treat joint and cardiovascular diseases.

KEYWORDS
Cartilage tissue engineering; cardiac tissue engineering; stem cell

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