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Mechanical stretching on cardiac adipose progenitors upregulates sarcomere-related genes

Authors:
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Background: The cardiac tissue is an unfriendly environment for the implantation of therapeutic cells due to its unavoidable contractility. Cardiac cells respond to mechanical stimuli and adjust their performance accordingly. It is also known that mechanical stimulation of tissue-engineered constructs improves their organization and contraction force.

Purpose: We hypothesize that mechanical conditioning of therapeutic cells could improve their retention and cardiovascular potential, to help in cardiac tissue restoration.

Methods: Cardiac adipose tissue-derived progenitor cells (ATDPCs) were mechanically stretched for 7 days at 1 Hz in 3 different surfaces (vertical, horizontal and smooth) (Figure 1). Gene and protein analysis were carried out for each cell type and condition. Secretome analysis after conditioning was also performed.

Results: A device was designed and validated to effectively apply a ~10% stretch. Mechanically stimulated cardiac ATDPCs increased the expression of cardiac transcription factors (GATA-4 and Tbx5) and structural genes (cTnI and α-actinin) after 7 days of mechanical stimulation. This gene modulation was different depending on the patterned surface, however the secretome analysis revealed that the vertical pattern was the most convenient for cardiac ATDPCs conditioning. Indeed, the secretome of cardiac ATDPCs stretched on vertical patterned surfaces was significantly associated to myocardial infarction, left ventricular extracellular matrix remodelling and the regulation of myoblast differentiation.

Conclusions: Mechanical conditioning of cardiac ATDPCs enhances the expression of early and late cardiac genes related with the cardiac sarcomere, and it is strongly dependent on the culture surface pattern.
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