Indian Institute of Science
Centre for BioSystems Science and Engineering

BSSE Annual Work Presentation

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Surface Engineering Strategies To Study Diseases Of Heart And Skeletal Muscle

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ABSTRACT

There is an increasing need to develop simplified in vitro platforms that mimic the tissue environment to understand cardiovascular and musculoskeletal diseases. Towards this objective, we first explored different surface engineering strategies for culturing cardiomyocytes, which could be used for investigating disease conditions like cardiac hypertrophy. Firstly, we investigated the possibility of using human hair derived keratin as a simple, efficient and costeffective substrate for culturing cardiomyocytes. Cardiomyocytes grown on keratin expressed cardiac specific markers and displayed spontaneous contraction. We further evaluated the development of cardiomyocyte hypertrophy upon treatment with the agonist, phenylephrine. We observed the induction of hypertrophy at the transcriptional as well as signaling level. We also observed a marked increase in protein synthesis in these cells indicating the development of hypertrophy. Next, we employed microscale topography to confine cardiomyocytes along ridges which closely resembles mammalian heart. Cardiomyocytes grown on micro-ridges showed global alignment and elliptical nuclear morphology. Calcium currents traversed the cardiomyocytes in a directional manner and were also responsive to hypertrophic stimuli. Like cardiomyocytes, we also investigated the effect of aligned topography on primary myoblasts using nanofibers. These nanofibers retained the myotubes in culture for longer duration as compared to myotubes formed on flat surfaces. We observe that once the myoblasts grown on flat surfaces become confluent they spontaneously differentiate to form myotubes and lift off from the surface. We also notice that aligned topography does not necessarily enhance the extent of muscle differentiation. We are now investigating if the alignment in muscle gives it a functional advantage when subjected to biochemical stimuli. These results emphasize the importance of topography in assessing cardiac and musculoskeletal function. We propose that studies which take into account the morphology of the cells offer greater potential towards clinical translation.