Developing cell co-culture and flow systems to mimic the effects of cell living conditions in the heart

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Laura Antola describes in her master’s thesis in “Co-culture system development of cardiomyocytes and endothelial cells” how two cell types of the heart, the contractible cells called cardiomyocytes and the blood vessel lining cells called endothelial cells were grown and studied in different conditions in Kivelä lab in the University of Helsinki. The work is in the field of biomedical engineering.

All the cells used in this study originated from induced pluripotent stem (iPS) cells that were derived from skin fibroblasts of healthy human subjects. iPS cells are in similar state than embryonal stem cells, which have the capability of differentiating into any cell type of the human body. In this study, iPS cells were differentiated into cardiomyocytes and endothelial cells. Differentiated cells were placed into experimental cultures; either into flow system or co-culture. The differences between different kinds of cell cultures were observed by staining and imaging with fluorescence microscopy and by measuring gene expression profiles of cultured cells using technique called single cell RNA sequencing.

Flow conditioning mimics the natural environment of endothelial cells, because blood flows past them in the inner surface of blood vessels. In flow, some genes typical for mature endothelial cells became more active in comparison to cells cultured in static conditions. These genes promote, for example, new blood vessel formation from the pre-existing vasculature and regulate the degree of constriction in the vessel wall. Gene activation also increases formation of important endothelial markers within the cell. Thus, it was observed that flow enhanced endothelial cell function.

The heart consists of different cell types, which signal constantly with each other. Culturing cardiomyocytes and endothelial cells together in a co-culture made arterial and venous genes more highly expressed in comparison to cells that were cultured alone.

In future, the cell culturing methods used in this work could be applied for cell lines derived from patients to study cardiovascular diseases at cellular level.

More information:

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Two-sentence summary:

In her master’s thesis, Laura Antola developed different systems to culture two heart cell types, cardiomyocytes and endothelial cells in similar conditions that they are exposed in the heart. The results showed that flow and co-culture with cardiomyocytes induced better endothelial cell function.