Long range correlation of force fluctuation in an endothelial cell layer

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Efficient wound healing requires that mechanical processes such as cell spreading, contraction and crawling are coordinated within a cell population across large distances. Here we monitored the coordination of cell movement and force fluctuation in an intact monolayer of human vascular endothelial cells. Cells from passage one or two were plated onto collagen coated elastic polyacrylamide hydrogels (E=3000Pa) and grown up do confluency. Images (300x500 μm) of ongoing cell shape changes and associated changes in gel deformation were recorded every minute for a total of 30 min. For each image pair taken 1 min apart, gel embedded markers, and associated changes in cell traction forces were computed using the method of Butler et al. Am J Physiol, 2002. Thus we obtained a spatial map of the evolution of traction forces. We then computed correlation in tine of the force fluctuation between any two spatial coordinates. As expected we observed correlated force fluctuations inside single cells and between neighbouring cells. Unexpectedly, however, we also found highly and significantly ($p<0.0001$) correlated force fluctuations over long distances ranging up to 300 um. These findings demonstrate that changes in shape and tractions of cells within a confluent monolayer do not occur at random but are highly coordinated. We speculate that mechanochemical signal transduction processes are responsible for the behaviour and are currently testing for correlated force fluctuations after stimulation with histamine.