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Development and evaluation of an endothelium-on-a-chip for screening antioxidative efficacy of nanomedicines

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The rapid progress of pharmaceutical nanotechnology goes hand in hand with the need to evaluate the efficacy and safety of nanodelivery systems on models which mimic conditions *in vivo*. This is made possible by organs-on-a-chip, which enable the cultivation of cells in the presence of flow and movement, enhancing the physiological relevance of cell cultures by increasing similarity to conditions *in vivo* [1]. Thus, the aim of our study was the development of an endothelium-on-a-chip and evaluation of the impact of induced oxidative stress on the human endothelial cells EA.hy926 in static as well as flow conditions.

Our experimental setup involved pressure-based microfluidics, with cells seeded in the Be-Flow culture chip (Beonchip, Spain). Since the experiments were performed outside of a CO_2 incubator, the cell medium was adjusted to enable cell growth and proliferation in conditions without atmosphere control. Oxidative stress was induced using hydrogen peroxide and cell viability was evaluated using a resazurin-based assay. The cell-chips were coated with collagen prior cell seeding, which improved cell adhesion and enabled simulation of *in vivo* conditions in the arteries exposed to sheer stress up to 15 dyn/cm^2 [2]. The concentration of hydrogen peroxide in cell medium that caused a 50% decrease in cell viability was significantly lower under flow compared to static conditions. Notably, the cell morphology changed when cells were exposed to 20 mM H_2O_2 under static conditions or 10 mM H_2O_2 under flow conditions. To sum up, we successfully developed an endothelium-on-a-chip model for evaluation of cell response to oxidative stress. This represents a platform, which will enable the investigation of protective activity of nanomedicines with antioxidants in the future.

References

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