P70

Polystyrene nanoplastics: Surface- and size-dependent effects on human primary endothelial cells

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Although plastic wastes are considered long-lasting and stable in the environment, they undergo fragmentation to micro- and nanometer-level particles, named micro- and nanoplastics (MNPLs), under the influence of different physical and chemical factors. During this weathering process, plastics suffer from changes in their physicochemical surface properties that can influence their toxicological profile. Nowadays, there is increasing evidence suggesting that environmental MNPLs can reach the human body through different pathways: ingestion, inhalation, and dermal contact. Indeed, MNPLs have been detected in whole blood samples representative of the general population. However, the potential effects of MNPLs on the health of exposed individuals are still unknown and require further research. In the present study, polystyrene nanoplastics (PSNPLs) and human umbilical vein endothelial cells (HUVECs) were used to better understand what are the toxicokinetic and toxicodynamic interactions of MNPLs with the vascular system. Representative PSNPLs of different sizes (PS-COOH 30 nm, 50 nm, and 100 nm) and surface characteristics (pristine PS, carboxyl (-COOH) and amino (-NH2)) were included in the study. Our results suggest that although all PSNPLs are internalized by HUVECs, the internalization dynamic is modulated based on the functionalization and the size of the particle. Interestingly, our flow cytometry data shows that both PS-COOH 50 nm and PS-COOH 100 nm can modify the morphology of the cell and increase its inner complexity/granularity. When analyzing possible toxic effects by treating the cells with a concentration of 100 µg/mL we observe that only PS-NH2 50 nm can reduce cell viability (- 40% vs control; 12 h treatment). Finally, our study of intracellular ROS generation when treating the cells with 100 µg/mL of the different PSNPLs for 24 h shows an increase in ROS production with carboxylated PS at different time points. Overall, our results indicate a surface- and size- dependent effect of PSNPLs on HUVEC cells.

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