Microplastic Identification and Quantification in Biological Samples

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Background

The convenience and durability of plastics has made it a staple in the manufacturing industry, but without adequate recycling, these plastics are filling landfills at an alarming rate. This plastic waste is broken down into micro- and nano-plastics that have been found in both marine and terrestrial environments. The potential ramifications of accumulating plastic particles in the environment are of urgent attention as humans are exposed to these particles through ingestion, inhalation, and dermal exposure. Due to the lack of consensus of the effect microplastics have on the coagulation cascade, our aim was to form clots under various conditions so that a comparison can be drawn.

Methods

We utilized varying sizes (500-2,000 nm) and concentrations (25-250 µg/ml) of non-functionalized polystyrene (nPS) microplastics to characterize their effect on clot size, strength, and anatomy using ex-vivo shear flow clot formation of human whole blood via a Chandler loop apparatus. Additionally, we studied the effect of fluorescent Nile red dye (NR, ex/em: 545/625 nm) on clotting dynamics and visualization of microplastic particles via fluorescence microscopy.

Results

Ex-vivo clots were made (422 s^{-1} shear at increasing nanoplastic concentrations), sectioned, and utilized for quantification optimization in histological processing to preserve plastic integrity and fluorescent signal. NR-dyed microplastics were shown to produce sufficient fluorescent signal for imaging. Images were taken at various magnifications (4x-40x) and exposure times (100µs-500ms) using brightfield and fluorescent microscopy (Cy3 filter) on a Nikon Eclipse Ni microscope and a Nikon DS-Ri2 Microscope camera.

Potential Impacts

These results highlight the need for further analysis of the effects of microplastics on the coagulation cascade, as well as further optimization of techniques used to identify and quantify microplastics in complex biological samples.