NanoClear: Removal of Microplastics From Human Blood

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Microplastics have been detected in human blood and are associated with oxidative stress, inflammation, mitochondrial dysfunction, neurotoxicity, and increased risk of DNA instability at concentrations greater than 10 µg/mL. Despite this, no clinically approved method currently exists to remove them from blood because of their small size and chemical stability. NanoClear addresses this problem through a magnetic blood-purification approach using surface-modified superparamagnetic iron oxide nanoparticles (SPIONs) designed to selectively bind microplastics and enable external magnetic extraction. The nanoparticles were synthesized by co-precipitation, coated to improve biocompatibility and stability, and tested in synthetic blood as well as in human blood. A calculated CAD prototype of the magnetic removal system was also designed and tested to maintain a controlled constant flow rate at approximately 100 mL/min during extraction. Results showed strong SPION–microplastic binding confirmed by microscopy and particle characterization techniques along with significant reductions in the microplastic turbidity index after magnetic extraction. Safety testing on treated human blood samples was conducted to evaluate the integrity of blood components after the removal and it confirmed that the system did not cause significant hematological disruption. These findings indicate that NanoClear as a feasible, biocompatible, and potentially scalable strategy for microplastic removal from blood.

Awards Won:

Zydus Pharmaceuticals USA Inc.: First Place Biomedical Engineering