Red Blood Cell-derived Extracellular Vesicles for Therapeutic Applications in Sickle Cell Disease

O'Neill, Rhyland (School: Charles R. Drew Charter School)

The purpose of this experiment was to investigate whether loading specific microRNAs (miRNAs) into Red Blood Cell-derived Extracellular Vesicles (RBCEVs) could reduce endothelial cell activation and improve vascular health in Sickle Cell Disease (SCD). SCD is a genetic disorder characterized by crescent-shaped red blood cells that obstruct blood flow and oxygen delivery, leading to significant health complications. Current treatments are limited, posing high risks and failing to address genetic causes effectively. To explore this potential therapy, RBCEVs were isolated from whole blood samples using ultracentrifugation, characterized via nanoparticle tracking analysis (NTA) and uBCA protein assays to assess size, concentration, and particle count. Samples were derived from individuals with normal blood concentrations, and protein purity levels between these phenotypes. The hypothesis posed that miRNA-loaded RBCEVs would reduce endothelial activation. Preliminary results supported the feasibility of using RBCEVs as a therapeutic delivery system. However, further experimentation is needed to confirm the functional effects on endothelial cells and optimize miRNA loading and delivery efficiency. This research underscores the potential of RBCEVs as a novel therapeutic tool for addressing SCD-related complications, paving the way for future studies on targeted delivery systems and broader therapeutic applications.

Awards Won: