Enhancing Platelets with Gene Therapy for More Effective Transfusions

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Platelets are small circulating blood cells that act as natural delivery vehicles for numerous biomolecules, and regulate many important processes such as blood clotting, immune function, and even cancer metastasis. Platelets are regularly transfused to help stop severe bleeding, but can be ineffective in the most severe cases of hemorrhage. In addition to hemostasis, platelets are a potential cell therapy in other applications, but development has been hindered by inadequate methods to control which proteins are expressed by platelets. In this proposal, we therefore aim to develop novel approaches to directly engineer transfusable platelets by using lipid nanoparticles (LNPs) to deliver messenger RNA (mRNA) and alter the protein composition of platelets. Once successful, this strategy will create a platform technology to produce transfusable platelets with new and modified functions that current transfused platelets do not possess, and in the long-term yield more effective platelet products, increase the efficacy of transfusions, and decrease the number of transfusion-related adverse effects. The technology will also enable transfused platelets to locally deliver therapeutics to injured tissues, such as sites of trauma, or potentially to diseased vasculature associated with atherosclerosis and Alzheimer’s disease in the future. By controlling the expression of proteins in platelets, this technology will be an important tool for the field of platelet research.