**Improving Drug Delivery using Red Blood Cell Hitchhiking**

loading of certain nanocarriers to red blood cells boosts drug delivery in organs of interest

**Inventors**

Jacob S. Brenner, MD PhD, Daniel C Pan, Jacob W Myerson, Vladimir R. Muzykantov, MD PhD

**Problem**

A major challenge in drug delivery is ensuring that the drug reaches the target organ at a concentration sufficient to treat the disease. This is particularly problematic for acute illnesses of the vasculature, such as acute respiratory distress syndrome (ARDS), ischemic stroke, and myocardial infarction. In these diseases, patients are often too sick to tolerate off-target drug side effects, and systemically delivered drugs rarely accumulate to a significant extent in the organs affected by pathology.

**Solution**

Researchers from Vladimir Muzykantov’s lab (Jacob Brenner et al), have developed a drug delivery system that can address these challenges. The drug delivery system, “Red Blood Cell (RBC)-Hitchhiking Nanoparticles” (RHNs), utilizes soft nanoparticles, such as liposomes and nanogels, loaded with drugs and the natural properties of RBCs to target the lung endothelium. The nanoparticles are adsorbed onto the surface of the RBC and delivered intravascularly. Once the nanoparticle-RBCs encounter their first capillary bed, the RBCs are physically squeezed, causing the release of the drug-loaded nanoparticles into the capillary endothelium. Since delivery is dependent on the squeezing of RBCs, the nanoparticles do not release their drug cargo until they enter the pulmonary capillaries. This approach minimizes delivery of the drug to sites other than the target organ and ensures that sufficient drug concentration reaches the target site.

The target organ for delivery of the drugs is determined by which blood vessel the RHNs are injected into: If the RHNs are injected intravenously, the first capillary bed they encounter is the lungs, and the RHNs thereby provide unprecedented delivery to the lung, for diseases such as ARDS. If the RHNs are injected via an intra-arterial catheter, they will deliver massive amounts of drugs to the organ fed by that artery. For example, standard of care in severe ischemic stroke and myocardial infarction is to place an intra-arterial catheter for removal of occlusions. After that occlusion is removed, the same intra-arterial catheter can be used to deliver RHNs and therefore provide unprecedented delivery of drugs to the affected brain or heart, such as drugs that ameliorate ischemia-reperfusion injury.

**Advantages**

- Minimize off-target drug effects
- Maximize delivery of drug to target organ
- Can be delivered intravenously to target the lungs or via intra-arterial catheters to deliver to any target organ, including the brain and heart.