Our brain depends on continuous blood flow to deliver the oxygen and nutrients it needs to function. Disruption to this oxygen supply, as in cerebrovascular diseases, has devastating consequences, most strikingly in acute stroke. Noninvasive imaging of brain blood flow and metabolism is technically challenging, but would provide critical information to diagnose and select therapies for patients.

My mission is to engineer new imaging biomarkers of brain physiology to address this need. In this talk, I describe development of a novel magnetic resonance imaging (MRI) technique to quantify oxygenation in cerebral blood vessels. I also validated MRI methods to measure cerebral blood flow against the reference standard by positron emission tomography (PET), using state-of-the-art simultaneous PET/MRI hardware. I performed these studies in challenging cerebrovascular patient cases, including Moyamoya disease, and used imaging to inform our basic understanding of disease pathophysiology.

In the long term, the imaging tools I develop will establish a vascular “fingerprint” that succinctly captures the metabolic health of an individual, and alerts us to a broad set of neurological diseases in its earliest stages.