As a means for stroke prevention, over 100,000 carotid endarterectomy (CEA) and carotid stenting (CAS) procedures are performed in the United States annually. However, the value of CEA and CAS amongst asymptomatic patients with carotid stenosis and symptomatic patients with moderate, <70% stenosis is debated. Clinical trials have shown that the benefit provided by CEA/CAS in these groups of patients is relatively small, and there are many individuals who are subjected to the risk of surgery unnecessarily. However, to deny carotid surgery or stenting to all such patients may subject a subgroup of these individuals to the devastating consequences of stroke – the leading cause of major long term disability and fourth leading cause of death in the U.S. To better select individuals for carotid intervention, improved criteria for identifying the high risk carotid plaque are needed.

Findings from carotid plaques removed at the time of surgery have led to the hypothesis that plaques with a disrupted luminal surface (DLS), and intraplaque hemorrhage (IPH) characterize the high-risk, "vulnerable plaque". Despite widespread consensus on the importance of these lesion features, testing the vulnerable plaque hypothesis has been hindered by the inability to reliably identify these characteristics *in vivo,* until recently.

Carotid magnetic resonance imaging (MRI) has been proven to identify plaque surface morphology and plaque composition accurately and reproducibly. Furthermore, several small studies have shown that individuals who have carotid plaques with IPH and DLS, identified *in vivo* using MRI, have a significantly higher risk for future transient ischemic attack (TIA) or stroke, compared to those with similar stenosis, but without IPH/DLS.

While the results from these studies are promising, confirmation in a larger, multicenter study is needed in order to translate this novel MRI technology into clinical practice. Our long term goal is to 1) establish that MRI-identified IPH and plaque disruption are independent predictors of an increased risk for future stroke in a large prospective study; and 2) test the hypothesis that individuals with IPH and/or plaque disruption on carotid MRI are better served with carotid endarterectomy or stenting compared to contemporary best medical management in a randomized clinical trial.

With funding from the Society for Vascular Surgery, a network of imaging centers is being established, including the University of Washington, University of California San Francisco, Stanford University, University of Utah, and Michigan State University. This network will provide state-of-the-art high-resolution carotid MR imaging in preparation for multicenter randomized clinical trial.

Clinical Relevance: The current paradigm for the management of carotid atherosclerosis is guided by severity of stenosis. With high-resolution carotid MRI, we now have the opportunity to shift the focus from the flow channel to the diseased arterial wall itself. Given the heterogeneity of carotid plaque types, a method that can reliably characterize the carotid atheroma *in vivo* may lead to improved risk stratification for new or recurrent stroke.

Better selection criteria will lead to a reduction in overall health care costs by reserving surgical procedures for individuals at greatest risk for future stroke. Furthermore, a better understanding of the nature of the vulnerable plaque will serve as a foundation for further research into the mechanisms of initiation and progression toward development of high-risk lesions of atherosclerosis, and perhaps lead to development of novel pharmacological therapy.