

Interventional Radiology at Virginia Mason

Working Together for Better Outcomes

Cerebral Angiography for Possible Endovascular Revascularization

(Angioplasty/Stenting)

Background:

Stroke is the third leading cause of death in the United States, surpassed only by heart disease and cancer. Stroke accounts for 10%-12% of all deaths in industrialized countries. In a population of one million, sixteen hundred people will have a stroke each year. Only 55% of these will survive six months, and a third of the survivors will have significant problems caring for themselves. As our population ages, the total number of people afflicted with stroke will continue to rise unless stroke rates decline in the future.

The cause of stroke is multifactorial. The sudden cessation of blood flow to certain areas of the brain accounts for 80% of all first ever strokes, whereas sudden bleeding into the brain (intracerebral hemorrhage) and sudden bleeding into the spinal fluid space (subarachnoid hemorrhage) are responsible for 10% and 5%, respectively.

Of those strokes that are due to the sudden cessation of blood flow, the majority of these are linked to complications of cholesterol plaque in the arteries supplying blood to the brain. The most frequent site of such a cholesterol plaque is at the branch point of the carotid artery known as the carotid bifurcation (See figure 1).

A surgical technique was introduced in 1954 as a logical procedure for the prevention of stroke due to cholesterol plaque in the carotid artery known as carotid endarterectomy. Carotid endarterectomy is a technique where the vascular surgeon opens up the carotid artery and

removes the cholesterol plaque from the lining of the artery. This ultimately removes the source of material, which can potentially travel from the artery up to the brain causing a stroke. Recent landmark studies have further explained the benefits of relieving these severe obstructions in the carotid artery. The first study called the North American Symptomatic Carotid Endarterectomy Trial (NASCET) demonstrated the superiority of carotid endarterectomy over medical management for patients with symptoms of carotid artery disease with carotid artery blockage greater than 70%. Medical management in this study consisted of a blood thinner in the form of aspirin, anti-hypertensive medication, cholesterol lowering medications and drugs to control diabetes.

More recently, another study called the Asymptomatic Carotid Atherosclerosis Study (ACAS) showed a reduction in stroke occurrence after carotid surgery in patients with no symptoms with a carotid artery blockage of greater than 60%.

Despite these very promising surgical studies, a surgical approach does have several limitations. In the first study, the NASCET, the risk of stroke or death was 5.8%, but in high risk patients, such as patients with significant coronary artery disease, morbidity (injury) and mortality (death) rates in that series was high as 18%. In addition, carotid artery surgery is generally confined to the portion of the carotid artery found in the neck. Transient cranial nerve palsies (weakness or paralysis of nerves of the head and neck) occur in 7.6% to 27% of patients in some series following carotid surgery. Finally, the process of restenosis, which is the recurrence of the blockage in the carotid artery caused by the body's healing response, has been inadequately studied after carotid surgery but does appear to occur in up to 5% to 19% of patients. It should be noted, that despite these above limitations, carotid artery surgery does remain the "tried-and-true" technique for stroke prevention due to cholesterol plaque in the carotid artery. Carotid artery surgery is the "gold standard" that all other therapies and techniques should be compared to.

The application of percutaneous techniques, have the potential for being safer, less traumatic, more cost effective, and feasible in patients at high surgical risk and are not limited to the cervical carotid artery. Percutaneous techniques are those procedures performed by individuals skilled in using various catheters that have balloons to open up blockages and/or stents, which are metal tubes that provide a scaffold to keep blockages from recoiling. These techniques are called percutaneous because they do not require surgery in the form of an

incision, but require entry into a peripheral artery i.e. the femoral artery in the groin via a small tube which subsequent catheters and wires are passed through up to the neck where the carotid artery is located. Percutaneous carotid balloon angioplasty was first performed in 1980, with significant improvement in devices and techniques used since that time.

It has become increasingly clear that stroke and transient ischemic attacks (TIAs) or mini strokes, most frequently occur as a result of particulate matter that breaks loose from the cholesterol plaque in the carotid artery which travels to the brain. The reason that the cholesterol plaque ruptures is currently unknown, but it appears that this plaque rupture occurs more frequently in areas of blockage that have thin caps covering the plaque with a predominant amount of cholesterol content. Interestingly, it is known that not only severe but moderate degrees of plaque may cause neurologic symptoms. Percutaneous balloon angioplasty fractures the cholesterol plaque and stretches the artery, which promotes so-called remodeling or redistribution of the cholesterol plaque in the arterial wall. The arterial wall response to angioplasty is associated with a healing process which ultimately may cause re-narrowing of the artery which is known as restenosis.

Scaffolding of the balloon expanded artery, with a metal stent limits immediate recoil of the arterial wall and results in a larger arterial lumen or opening than angioplasty alone. In addition, stenting limits the chronic arterial remodeling process and/or restenosis and has been shown to reduce restenosis in coronary arteries when re-evaluated with coronary angiography. Therefore, investigators speculate that angioplasty immediately followed by stenting of significant carotid artery blockages will reduce the occurrence of subsequent stroke and transient ischemic attacks, and this new method of treating carotid artery blockages may potentially be a very useful therapy in the future for patients with severe carotid artery disease.