Current Techniques in Carotid Artery Stenting: A Synopsis

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Introduction
Cardiovascular disease and stroke are the leading causes of death in Canada. Approximately 15,000 Canadians will die of strokes every year and 300,000 people will be living with its effects. In the United States of America, 30% of all stroke related deaths were associated with carotid artery lesions, a statistic likely similar in Canada.

The commonest carotid artery disease is stenosis, where there is narrowing of the carotid artery lumen. Because the carotid arteries are the principal blood supply to the brain, decrease of flow as a result of stenosis can cause transient ischemic attacks or in the case of complete occlusion, cerebrovascular accidents. The majority of carotid artery stenosis cases are a result of atherosclerotic plaque accumulation in the walls of the arteries. Therefore, a secondary risk factor in carotid atherosclerotic stenosis is the dislodging of emboli to the cerebrovasculature. Indeed, the rupture or dislodgement of plaques causing downstream emboli account for the majority of carotid artery strokes.

Patients with carotid stenosis can be asymptomatic or present with a transient ischemic attack or stroke. Diagnosis is made using several techniques. Upon physical examination, carotid auscultation may reveal a carotid bruit. Computed tomography angiography, magnetic resonance angiography or carotid duplex ultrasonography are various imaging modalities used to diagnose suspected carotid stenosis. Furthermore, these images permit the surgeon or interventionalist to calculate the degree of stenosis, an important consideration in terms of deciding between various treatments.

Several treatments have been approved for improving outcomes of patients with carotid artery stenosis. Currently, endarterectomy or surgical removal of the narrowed carotid segment is the accepted and most widely used treatment for carotid stenosis; however, carotid artery stenting has risen as a non-invasive alternative for some patients with the aim of restoring the carotid lumen. This article will explore the procedural aspect of carotid stenting and present the indications and contraindications for this intervention.

Carotid Stenting
Procedure
The non-invasive nature of carotid stenting permits the patient to be awake during the procedure. This allows the physician to monitor the patient’s neurological status; an important consideration due to the possibility of embolism to the cerebral vessels. The procedure is performed in an angiography suite under the guidance of fluoroscopy. Contrast agents are constantly administered to direct catheters and confirm positioning of balloons and stents.

A needle is inserted into the common femoral artery under local anaesthesia. A radio-opaque guidewire is then threaded through the needle and advanced into the abdominal aorta. The needle is subsequently removed and a sheath is placed over the guidewire and advanced into the abdominal aorta. The needle is then inserted and the sheath acts as a catheter by which other catheters and wires can be placed and guided towards the stenosis.

Using catheters, a preliminary carotid angiogram is conducted to demonstrate the degree of stenosis (expressed as a percentage) and assess for artery size downstream of the lesion. This allows the physician to choose the appropriate Embolic Protection Device (EPD) and stent based on degree of stenosis and size of the artery respectively. A cerebral angiogram is...
also performed to rule out any contraindications to carotid stenting. Appropriately, heparin is administered to prevent clotting and its effect is measured using the Activated Clotting Time (ACT). The ACT in this procedure should exceed 250 seconds.

An EPD is a specially designed umbrella shaped device that is used to capture debris and emboli as a result of either Percutaneous Transluminal Angioplasty (PTA) or the release of a stent compressing the atherosclerotic plaque.7 Before the stent is placed, an EPD is deployed upstream with respect to the site of stenosis. The use of an EPD has shown to reduce the risk of ischemic attacks 30 days post procedure to 2.2% from 5.3%.2 This has prompted the routine use of an EPD by many interventionalists. If the degree of constriction is too severe to safely allow an EPD through, PTA with a small balloon may be appropriate to allow for safe passage of the EPD.

At this point, a sheath covered stent is introduced and directed towards the site of the lesion. The sheath is peeled and removed and the stent is positioned in the stenotic portion of the artery.6 The stent is self expandable and will effectively reduce the degree of stenosis. Following stent deployment, an angiogram is obtained to confirm the increase in diameter of the artery.

In severe cases of stenosis, the stent itself may only reduce the occlusion mildly.2 To combat the high degree of post procedure stenosis, a balloon catheter may be placed within the boundaries of the stent and expanded to allow for greater augmentation of the vessel diameter. Similarly, it is essential to confirm with an angiogram the degree of post procedure stenosis. Importantly, the placement of the balloon should not extend further then the margins of the stent. Damage resulting from inflation of exaggerated balloons may cause damage to vessel walls and increase the risk of restenosis. Angiogram confirmation of arterial lumen expansion is followed by catheter dependent removal of the EPD.2,6

Results from a recent study proposed that because pre- and post-stent deployment balloon angioplasty may be the major cause of dislodged emboli in carotid stenting procedures, that removal of these steps in carotid stenting would eliminate the need for EPDs.8 This study demonstrated that the use of self expanding stents alone provided moderate alleviation of stenosis with increasing lumen diameter for up to one year. In conjunction, none of the patients in the study had a stroke as a direct result of the procedure. The implications of this study are twofold. Firstly, PTA may be the major cause of emboli related complications in carotid stenting and secondly, if PTA is not used within the procedure, EPDs may not be necessary. Effectively, these modifications to the carotid stenting technique may provide future interventionalists with a safer, quicker, more cost efficient procedure.

Pre-procedure Considerations
Carotid stenting is only advised over endarterectomy in a subset of patients. Currently, within the context of a randomized control trial, any symptomatic patient (transient ischemic attacks or stroke) with greater than 60% carotid artery stenosis or asymptomatic patients with greater than 80% stenosis are eligible for carotid stenting.2 Additionally, individuals deemed to be at a high risk for surgery or who have had a previous endarterectomy with recurrent stenosis are also eligible for stenting. Some exclusion criteria include individuals with torturous aortic arches, unfavourable anatomy, inaccessible lesions and patients with contraindications to anticoagulation therapy.

If approved for carotid artery stenting, patients should undergo a full neurological examination as well as a neurological angiogram 24 hours pre-procedure. Antiplatelet therapy should be given four days prior to the intervention; however, patients who are over 80 years of age may require longer treatment periods. Acetylsalicylic acid and clopidogrel are administered once daily to the patient.6

Post-Procedural Considerations
Following the intervention, the patient’s blood pressure should be kept under 160mm Hg and antiplatelet therapy continued for 6 weeks. Following these 6 weeks, the patient should be advised to continue acetyl salicylic acid treatment for the duration of their life.
Conclusion
Although endarterectomy has proven highly successful in the treatment of carotid artery stenosis, carotid artery stenting has emerged as an alternative. On the patient level, carotid stenting may prove to be a safer procedure for specific individuals. However, stenting of the carotid artery is a technically challenging intervention with numerous potential complications that make it unfavourable as a standard therapy when compared to endarterectomy. Recent studies have shown the non-inferior nature of carotid artery stenting compared to carotid endarterectomy in a trial using asymptomatic patients with greater than 80% stenosis or symptomatic patients with greater than 50% stenosis. However, increased risk of post procedure complications of stenting have been documented in a trial consisting of only symptomatic patients with greater than 60% stenosis. These studies demonstrate that in specific patient populations stenting may be preferred but support for carotid artery stenting as a routine treatment for carotid stenosis is lacking.

References