Carotid Stenosis and Carotid Endarterectomy

Definition
Carotid endarterectomy (CEA) is a surgical procedure done to remove an atherosclerotic plaque from the internal carotid artery to reestablish the cerebral blood flow and prevent or reduce the risk of following stroke.\(^1,2\)

Epidemiology
Asymptomatic carotid stenosis affects 7% of women and >12% of men older than 70 years.\(^3\)

Pathophysiology
Carotid stenosis is related to atherosclerosis of the internal carotid artery. Atherosclerosis is the hardening of the arterial blood vessels.

Atherosclerotic plaque rupture is associated with the inflammatory process. Rupture of the fibrous cap causes bleeding and exposes the thrombogenic materials, such as collagen, to the circulation, which leads to formation of thrombus (blood clot). A thrombus can occlude the blood vessel and cause ischemia. More often, the clots break off from the thrombus and form an emboli. The most common sites for the formation of the atherosclerotic plaques are at the bifurcation of blood vessels.

In the European Carotid Surgery Trial (ECST), carotid stenosis was classified as mild (0-29% occlusion), moderate (30-69% occlusion), and severe (70-99% occlusion).\(^7\)

Manifestations
The ophthalmic artery, the middle cerebral artery and its branches are commonly occluded by the emboli from the stenosis or ulceration of the atherosclerotic plaque in the internal carotid artery. Occlusion of the ophthalmic artery may cause an ocular TIA or amaurosis fugax (transient monocular blindness). Patients with obstruction of the middle cerebral artery or its branches by emboli may have different manifestations depending on the area that is affected.\(^9\)

Diagnostic Tests
The carotid angiogram used to be the golden standard to assess carotid stenosis. However, it is not sensitive in identifying ulcerated plaques. In addition, angiography is an invasive procedure and carries significant post-procedural complications such as blood vessel damage and bleeding, which make it less favorable to use as a first line diagnostic test.

Non-invasive tests are more commonly used to assess the severity of the stenosis and the characteristics of the stenotic plaque. A computed tomography (CT) scan is able to identify the characteristics of the plaque such as soft plaque, calcified plaque or a mixed plaque. Magnetic resonance imaging (MRI) has demonstrated excellent tissue contrast. It can identify carotid atherosclerotic plaque characteristics and is able to identify the risk of a future intraplaque hemorrhage and cap rupture in patients with acute stroke or TIA.\(^5,11\)

An ultrasonogram is noninvasive, can be performed at the bedside and is safe and inexpensive. It is able to assess the carotid stenosis fairly well. Ultrasonography is able to provide information about plaque consistency.\(^5\)

Treatment Options
Indications for treatment for carotid stenosis are based on whether the patient has any symptoms and the severity of the stenosis. Wong et al. (1997)\(^10\) indicated that CEA is appropriate and indicated for patients who are symptomatic and the stenosis is >70%. If patient is asymptomatic and the stenosis is >60%, this group of cases is uncertain because even without surgery, the annual stroke and death rate is approximately 1%. If patients are asymptomatic and the stenosis is <60%, they are not appropriate for surgery.

Results from the North American Symptomatic Carotid Endarterectomy Trial (NASCET) indicated that patients with severe carotid stenosis (70 – 99%) had a 17% reduction in stroke risk two years post-surgery compared with the medical treatment group. Similar results were obtained in the ECST. In this trial, results indicated that for symptomatic patients with severe carotid stenosis (70-99% occlusion), the CEA group has a six fold decreased risk of ipsilateral ischemic stroke than the control group with no surgery in 3 year follow up period.

Conventional CEA is performed by making a longitudinal incision or arteriotomy of the internal carotid artery to remove the plaque. After the plaque is removed, a patch is usually used to close the arteriotomy. The patch is used to close the arteriotomy which has proved to be effective in preventing harmful neurologic effects and decreasing the risk of restenosis.\(^15,16\)

Statins have been used for asymptomatic carotid stenosis patients. Research results indicate that statins are able to reduce incidence of perioperative stroke and cognitive dysfunction.\(^16\)

Complications after surgery
Post CEA complications include hemorrhage (cervical hematoma), cranial nerve damage, cerebral hyperperfusion syndrome, myocardial infarction, dysrhythmias, congestive heart failure, hypotension, hypertension, stroke, and death.\(^17,18\)

Alternative Interventions
Carotid stenting (CAS) has been performed as an alternative treatment for carotid stenosis. Carotid stenting places a stent at the stenosis to "widen" the narrowing of the carotid artery. The Carotid Revascularization Endarterectomy versus Stenting Trial (CREST) was conducted in the United States and Canada to compare the effectiveness between CAS and CEA. Results indicated that patients who received CAS have higher risk of developing post-procedure stroke and restenosis. The International Carotid Stenting Study (ICSS) was conducted in Europe, Australia, New Zealand, and Canada between 2001 and 2008; the results of this study indicated that for
symptomatic patients. CAS has twice the risk of developing stroke within 30 days post-procedure compared with the CEA group. Most strokes occurred on the ipsilateral side to the treated artery.

Nursing Implications

During the postoperative period, strict blood pressure control is essential to prevent a cerebral hematoma and cerebral hyperperfusion syndrome (CH). Maintaining the systolic blood pressure between 90-140mmHg has been suggested. However, Scozzafava et al. (2006) argued that these numbers are only based on physiological rationale and not generated from a randomized controlled trial; more aggressive lowering of BP may be required when patients develop CHS.

A very small percentage of patients who develop CH post CEA require surgical intervention. However, mortality rate in patient who required surgery to remove the CH is as high as 7%. Tissues in the neck are quite loose. It is very difficult to assess if there is any bleeding or a hematoma formation around the neck. Close monitoring for CH is essential. All patients who undergo CEA should have their neck circumference measured immediate post-surgery and then hourly for the first few hours. Any increases in neck circumference and/or signs of respiratory difficulty may indicate CH.

Injury to the branches of the vagus nerve may result in difficulty in speech and swallowing. For any cranial nerve damage, assess the patient’s speech for dysarthria, hoarseness in their voice, ability to clear oral secretion, or change in their swallowing ability.

Patients with hypertension prior to surgery should resume the blood pressure control medication to prevent cerebral hyperperfusion syndrome. If any new neurological signs such as headache, seizure, or any new focal neurological deficits occur, patients must seek medical advice immediately.

Patients with hypotension should have ECG monitoring and test for elevated cardiac enzymes to rule out myocardial infarction.

Reference


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