Patient Safety & Quality Improvement Journal
http://psj.mums.ac.ir
PSQI

Review of Post-Carotid Endarterectomy Complications

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ARTICLEINFO

Article type:
Review Article

Article history:
Received: 17- Feb-2014
Accepted: 20- Mar-2014

Keywords:
Carotid endarterectomy
Complications
Post operative
Surgery

ABSTRACT

Atherosclerotic carotid artery stenosis is one of the most common causes of stroke worldwide. Carotid revascularization using Carotid Endarterectomy (CEA) may play an important role in reducing the stroke prevalence in selected patients. Post-CEA complications of significant concern include cerebral hyperperfusion syndrome, ischemic stroke and cranial nerve injury, perioperative myocardial infarction, unstable angina, respiratory problems, renal failure, wound complications, and postoperative hyper- or hypotension. With regards to CEA complications, the individual risk assessment plays an inevitable role in reducing the negative outcomes and increasing the procedure efficacy. In this review, we studied CEA complications by reviewing the previously published literature. In addition to its benefits, CEA has its own complications, but at a lower severity. Reducing the incidence of post-CEA complications is crucial, especially in the patients with a less remarkable margin of benefit in stroke prevention.

Despite its complications, CEA remains the gold standard for treating carotid stenosis in selected symptomatic and asymptomatic patients. Accurate perioperative diagnosis and evaluation may help us develop a practical approach to more a beneficial and accurate surgical strategy.

► ***Please cite this paper as*:**
Modaghegh MH, Ravanbakhsh M, Ghorbanian E. Review of Post-Carotid Endarterectomy Complications. Patient Saf Qual Improv. 2014; 2(3): 135-138.

Introduction

Atherosclerotic carotid artery stenosis is one of the most common causes of stroke worldwide. In this condition, an appropriate intervention can play an important role in the primary and probably the secondary stroke prevention. Atherosclerotic plaques throw distal embolism to branches of the retinal or cerebral arteries; thus, hemodynamically compromising luminal stenosis may lead to a critical reduction in cerebral perfusion.

Two strategies have been proposed for the treatment of high-risk patients: medical therapy (intensive treatment of modifiable risk factors in carotid stenosis in combination with antiplatelet therapy) and endovascular techniques such as Carotid Endarterectomy (CEA), carotid artery stenting and carotid angioplasty. Over the past decades, carotid endarterectomy has shown considerable promise as an alternative treatment in patients who are not eligible or have contraindications for thrombolytics. Despite the fact that in some patients, total occlusion of the carotid results in a deleterious stroke, many patients with adequate collateral flow to the intracranial arteries have had no previous Transient Ischemic Attacks (TIA) (1).

Therefore, carotid stenosis is an important determinant of stroke risk that should be substantially considered to prevent the future devastating disabilities, economic burden, and physical and psychological problems.

Carotid revascularization using Carotid Endarterectomy (CEA) has been established as an effective measure in patients with moderate-to-severe symptomatic carotid stenosis for reducing the incidence of stroke (2).

In 1954, carotid endarterectomy was primarily introduced as a plausible procedure for the prevention of ischemic stroke due to carotid artery stenosis (3).

Over the past decades, the effectiveness of the CEA in the treatment of carotid artery stenosis has been established by prospective randomized clinical trials (4-6). Considering the risk of possible perioperative complications in each and every individual is of significant importance. Combined post-CEA stroke and

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death rates is reported 3% in patients with asymptomatic stenosis and 6% in patients with symptomatic stenosis that would influence the stroke reduction benefit gained through the operation (1).

The general post-CEA complications can be divided into neurological and non-neurological complications.

Neurological complications include Cerebral Hyperperfusion Syndrome (CHS), ischemic stroke, and cranial nerve injury. Non-neurological complications include perioperative myocardial infarction, other cardiac-related complications such as unstable angina, respiratory problems, renal failure, wound complications (e.g. patch material, hematoma, postoperative infection), and postoperative hyper- or hypotension. Finally, carotid restenosis is considered a late complication of CEA.

Carotid endarterectomy is indicated in patients with a history of TIA and the patients with a high-grade (70 to 99%) or, in limited cases, moderate (50 to 69%) carotid stenosis. In a multicenteric study performed in patients with recent TIA or disabling stroke and ipsilateral high-grade internal carotid stenosis, CEA proved highly beneficial (3). In the North American Symptomatic Carotid Endarterectomy Trial (NASCET), CEA in patients with symptomatic moderate carotid stenosis of 50 to 69 percent, was associated with an absolute reduction of 17 percentage points in stroke risk, while patients with severe stenosis (>70% luminal stenosis) CEA had an apparent benefit that persisted up to eight years of follow-up (7).

It seems that there is a risk association between non-elective CEA and Cerebral Hyperperfusion Syndrome (CHS). In a study by Mass and colleagues, the risk of CHS was 1.7% (0.6% seizures and 0.5% intracerebral hemorrhage) which occurred in patients with potential risk factors including a history of dyslipidemia, high diastolic blood pressure, coronary artery disease, intraoperative shunt use and non-elective CEA (8).

Tight blood pressure control may reduce the prevalence of post-CEA hyperperfusion and subsequent CHS (9).

The Carotid Revascularization Endarterectomy Versus Stenting Trial (CREST) found a higher risk of Myocardial Infarction (MI) and isolated rise in cardiac biomarker (with neither chest pain nor ECG abnormality) after CEA that were independently associated with increased future mortality (10).

Similarly, another study reinforced the significant risk of non-ST-elevation myocardial infarction (NSTEMI) and its in-hospital outcomes such as stroke, cardiac events, and mortality (11). Cunningham reported a 4 % risk of Cranial Nerve Injury (CNI) after CEA, which resolves over few months (12). In the Vascular Study Group of New England (VSGNE) research, urgency and acute reintervention increased the risk of postoperative CNI, while neither prior ipsilateral CEA nor cervical radiation was accompanied with an increased CNI rate (13).

Sundt devised a predictive instrument for appraising the risk of CEA-related morbidity (14,15).

Concomitant medical risk factors increase the perioperative risk of stroke and death caused by CEA.

Thus, it may be logical to avoid performing the procedure in certain patients due to higher cumulative risk of complications, and especially stroke. To be eligible for the procedure and to minimize the confounding factors, two large, randomized clinical trials provided a helpful guide in the treatment of symptomatic high-risk patients (4,16).

Treatment recommendation for a patient with carotid stenosis of 70 to 80%, with or without neurological manifestation or prior TIA, should be based on an understanding of the most probable adverse side effects and the advantages and risks of the treatment over time.

Discussion

In addition to some benefits, CEA has its own complications but in a smaller scale. Reducing the incidence of post-CEA complications is crucial, especially in patients with a less remarkable margin of benefit in stroke prevention.

The use of carotid artery stenting as an alternative strategy to carotid endarterectomy is even more controversial. Although carotid artery stenting is less invasive and comes with a rapid recovery rate and lower risk of cranial nerve palsies, studies have demonstrated that the perioperative risks (mainly death and recurrent stroke) are significantly higher in carotid artery stenting (17,18).

In a systematic review, the risk of stroke and death in patients operated in acute phase was four times higher than the patients with stable disease. In contrast, the presence/absence of the symptoms is of limited help in predicting operative risk (2).

It seems that minor surgical complications occur commonly and are associated with greater risk of stroke and death (19). Based on the North American Symptomatic Carotid Endarterectomy Trial (NASCET), the post-CEA complications were 8.1%, 69.7% and 26.8% of which were short-term and long-term complications, respectively. The highest portion of these complications belonged to the cardiovascular events, especially in the patients with previous cardiovascular history (20,21).

The risk of two-year ipsilateral stroke in symptomatic patients with high-grade stenosis who had undergone CEA showed an absolute reduction of 17% (4).

According to the comprehensive research in 22 countries worldwide, ninety percent of all strokes are associated with the 10 most important risk factors including previous hypertension, current smoking, diabetes mellitus, lack of a regular physical activity, a high waist-to-hip ratio, a high dietary risk score, excess alcohol intake, stress or depression, cardiovascular disease, and a high ratio of apolipoprotein B to apolipoprotein A1. Therefore, targeted interventions

can noticeably diminish the burden of stroke (22).

Furthermore, the length of hospital stay after CEA procedure can be reduced to one to two days in nearly half of CEA patients by intervening on modifiable risk factors (23). The perioperative outcome of CEA was also evaluated with respect to CEA timing, which showed a significantly decreased rate of perioperative stroke in patients who underwent CEA ≥ four weeks after TIA or stroke (24). In contrast, some demonstrated no differences between the early (within 30 days of symptom onset) and late (after 30 days from symptom onset) CEA (25).

Despite its complications, CEA remains the gold standard for treating carotid stenosis in selected symptomatic and asymptomatic patients. Accurate perioperative diagnosis and evaluation develop a practical approach to more beneficial and accurate surgical strategy.

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