REVIEW ARTICLE

Carotid Artery Stenosis and Intervention: A Review

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Introduction :

There is no epidemiological data on the incidence or prevalence of cerebrovascular disease (CVD) in Bangladesh. Clinical experience indicates that this is likely to be similar to that of the Western countries. Even a few years back it was believed that stroke could not be treated. But recent advances in neuroscience and interventional neurology have changed the picture. Interventional neurology is a branch of neuroscience which has rapidly grown with the advances in interventional techniques in neurological diseases in the last decade. Stroke ranks third leading cause of death, after heart diseases and cancers. It is an important cause of disability in the elderly people[1,2]. Each year, more than 6,00,000 Americans suffer from acute ischaemic stroke resulting in death in more than 90,000 women and 60,000 men[3]. The average annual incidence of stroke in Japan is 3.94 for males and 2.52 for females per 1000 population with cases of cerebral infarction outnumbering cerebral haemorrhage[4]. Stenosis due to atherosclerosis commonly occurs to the carotid bifurcation but can also occur in the carotid siphon[5]. Atherosclerotic disease at the bifurcation of thee common carotid artery (CCA) is associated with 20 to 30% of ischaemic strokes[6]. Wepfer was the first in 1658, to recognize the significance of carotid artery obstruction and its relationship to underlying "fibrous masses" and thrombus[7]. Later, Hunt in the early twentieth century emphasized the importance of carotid artery atherosclerosis in cerebrovascular disease[8,9]. Fisher in 1951 recognized that the basic mechanisms causing focal cerebral ischaemia from carotid artery disease were embolization, decreased flow thought the carotid artery or both[10]. Atherosclerosis cannot be cured as yet, but its genesis can be modified by dietary changes, regular exercise and control of diabetes and hypertension. The effects of atherosclerosis can be changed by either endarterectomy or balloon angioplasty and stenting.

Evolution of carotid artery angiography and stenting:

Carotid revascularization has previously been done by carotid endarterectomy and was performed by neurosurgeons[11-13]. Other areas of the vascular territory even then had well established endovascular procedures[14,15]. The risk of stroke caused by embolization during the procedure prevented the application of this technology in the territory of the brain[16,17,18]. The distal vascular bed of coronary, aorto-iliac or subclavian are not as sensitive as that of central nervous system[19,20]. The benefit of carotid endarerectomy for the prevention of stroke in patients with extracranial carotid stenosis has been well established[21-24]. Endarterectomy is the accepted standard treatment of carotid stenosis[25,26]. This procedure was first started in 1950 by Eascott, De Bakey and Cooley[27]. After the landmark study of the North American Symptomatic Carotid Endarterectomy Trial (NASCET) and Asymptomatic Carotid Atherosclorotic. Study (ACAS), carotid endarterectomy has proved beneficial in reducing the stroke[21,23,28-29]. The patient inclusion criteria for the NASCET were very strict[2l]. Patients with one or more of the following conditions were excluded: (a) age more than 79 years, (b) restenosis following carotid endarterectoy, (c) tandem lesion, (d) high grade carotid stenosis with contralateral carotid occlusion, (e) radiation induced carotid stenosis, (f) no angiographic visualization of both carotids and their intracranial branches and (g) heart, lung, liver or renal failure. There were certain groups of patients which were temporarily excluded: (a) uncontrolled diabetes, (b) uncontrolled hypertension, (c) unstable

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angina, (d) myocardial infarction within previous six months, (e) contralateral carotid endarterectomy within four months, (f) signs of progressive neurological dysfunction and (g) major surgical procedure within previous 30 days. These patients could be included if the conditions resolved within 120 days.

Therefore many patients who suffered from symptomatic carotid artery stenotic disease could not be included in NASCET. By that time many neuroscientists have already acquired enough experience in cerebral artery manipulation by balloon angioplasty as a treatment of cerebral aneurysm. With this experience, many centres started angioplasty of carotid arteries only in NASCET excluded patients[30]. But follow-up angioplasty revealed a high percentage of restenosis within two years[29]. From 1995, different centers started angioplasty followed by stenting in NASCET excluded patients. Wholey et al in 2000 showed that by that time a total number of endovascular carotid procedures that have been performed worldwide included 5,210 procedures involving 4,757 patients [31]. There was a technical success rate of 98.4%. The peri-operative (from procedure to 30 days of procedure) stroke and death rate was 2.35% (stroke 1.49% and death 0.86%). But in NASCET trial, the peri-operative death and stroke rate was 5.8%. In addition, anaesthetic hazards and risks of a major operation are there. From the above result, the endovascular treatment of carotid stenosis is safe. But it is difficult to compare carotid artery stenting with endarterectomy without a randomized trial. A randomized trial has been designed and is going on. The superiority of the two procedures may be decided after the result of the study. But the people and neuroscientists are gradually incling towards endovascular treatment. "The Carotid Revascularization Endarterectomy versus Stent Trial" and " The Carotid and Vertebral Artery Transluminal Angioplasty Study" have explained the efficacy of percutaneous angioplasty and stenting and its role in stroke preventing[32'33]. A number of retrospective studies of percutaneous angioplasty and stenting, however, have reported superior results to those of carotid endarterectomy terms of stroke and mortality rates[34-37]. These favourable results seem to support at least a limited role for percutaneous angioplasty and stenting in the management of carotid stenosis.

Percutaneous transluminal angioplasty and stenting (PTAS) of carotid stenosis:

Presently majority of patients with carotid artery stenosis are treated by endarterectomy. because the result of randomized trials of angioplasty are pending. But the PTAS have dramatically altered traditional approaches to the management of both coronary and peripheral vascular diseases. The major advantage is that it is less invasive than conventional surgical procedures, offering benefits without the risks of general anaesthesia, and with lesser procedural morbidity and mortality, shorter hospital stay and lower cost. Although the traditional standard of care in treating cervical carotid stenosis is carotid endarterectomy, in certain subsets of patients (NASCET excluded), PTAS is the alternative measure. In those patients, carotid artery angioplasty and stenting has been shown to be effective and safe[38-41]. PTAS are commonly performed in Europe and America despite the lack of prospective randomized study comparing this modality with carotid endarterectomy.

The endovascular approach for the treatment of carotid stenosis began with the use of percutaneous balloon angioplasty in 1980[42]. In 1987, Theron et al published the first large series of internal carotid angioplasty in 48 patients with de novo atherosclerotic or post-surgical restenosis[43]. Since then many centres have reported their experiences with PTAS. With time there has been an increase in the knowledge base, catheter, balloon and stent technology, which has resulted in improved results of carotid angioplasty and stenting with low mortality and morbidity even in high-risk patients. The growth rate of the procedure is good. In June 1997, 2,047 PTAS procedures were done by the original 24 centres[44]. The number of PTAS procedures was increased to 2,591 in January 1998, a 27% annual growth rate. The current rate of annual growth in the original 24 centres is 47%.

The ideal patents for the endovascular stent placement are:

- Contralateral ICA occlusion;
- Restenosis following carotid endarterectomy[45,46];
- Radiation-induced carotid stenosis[47,48];
- Isolated high ICA lesion inaccessible for surgery[49];
- Numerous confounding medical comorbid conditions[50];
- Tandem lesion [30];
- Fibromuscular dysplasia[30];
- Unstable angina awaiting for coronary revascularization[51];
- Carotid stenosis associated with neck malignancy[52]; and
- Post traumatic carotid stenosis[52];

Patients who are not suitable for PTAS[51] are:

- Patients with femoral or iliac access problem;
- Patients with contraindications to anticoagulation therapy with heparins; and
- Patients with contraindication for antiplatelet therapy.

Recently, various devices have been used for thromboembolic protection during stenting. Use of these devices further reduces the risk of perioperative embolic stroke[53]. After the publication of Hobson's study result, PTAS for carotid stenosis is evolving from its initial[32] controversial situation to a reasonable alternative for treating carotid occlusive disease.

Atherosclerotic involvement of the intracranial internal carotid artery is the carotid siphon which is not also surgically approachable. It should be treated because 60% of those patients present with stroke[54]. PTAS is also performed in these cases to prevent stroke.

Suggested protocol for PTAS for Bangladesh:

All patients with symptomatic carotid stenosis should be included in this protocol. All patients selected for PTAS should undergo a through neurological examination before the procedure. Baseline investigations like CBC, PT, APTT, blood sugar, BUN, serum creatinine, ECG, X-ray chest should be done. A base line MRI/CT scan should be done to document any preexisting infarction. Oral aspirin 325 mg/day or clopidogrel 75 mg/day should be started at least three days prior to the procedure. After the procedure the patient should be maintained on 75 mg aspirin daily life long and clopidogrel 75 mg daily for three months. The procedure should be performed under local anaesthesia and conscious sedation should be used only if required. Right femoral approach should be ideal but left may be chosen when right femoral could not be used. The guiding catheter should be placed in the common carotid artery proximal to the stenosis. A baseline activated clotting time (ACT) should be performed before the procedure. A bolus dose of heparin (70 to 90 mg/Kg) would be given just before the inflation of balloon to achieve an ACT of two to 2.5 times of baseline. Atropine syringe should be attached to the IV line and to be injected only if patient develops bradycardia during balloon dilatation or stent placement. A 4-vessel cerebral direct subtraction angiogram in a minimum of two planes should be done to analyze the intracranial circulation. The stenosis should be crossed with a guide wire under road map image. Pre-dilatation should be performed if the stenosis is of high grade. Suitable stent should be placed. Heparin should not be given after placement of the stent and the effect of heparin already given should be allowed to dissipate naturally. At the end of the procedure a complete angiogram should be done to evaluate the condition of the stenosed area and identification of any embolic stroke during the procedure. The femoral sheath should be removed when ACT returns to baseline level. The patient should be under close observation for the day and discharged on the following day.

Conclusion:

Symptomatic carotid stenotic patients should be treated by PTAS. It is the need of time to develop a full-fledged interventional neurology unit.

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