Comparison Of Carotid Stenting versus Carotid Endarterectomy in Treating Patients with Symptomatic and Asymptomatic Carotid Artery Stenosis

Thesis submitted in partial fulfillment of MD in Cardiology

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مقارنة بين التدخل الجراحى و بين التدخل بالقسطرة و تركيب الدعامات فى مرضى ضيق الشريان السباتى الظاهرة وغير الظاهرة عليهم أعراض

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LIST OF ABBREVIATION

- 3D Three dimension
- ACA Anterior cerebral artery
- ACAS The Asymptomatic Carotid Artery Stenosis Trial
- ACC American College of Cardiology
- ACT Activated Clotting Time
- AHA American Heart Association
- CARESS The Carotid REvascularization with Stenting Systems
- CAS Carotid Artery Stenting
- CAVATAS The Carotid and Vertebral Artery Transluminal Angioplasty Study
- CBF cerebral blood flow
- CC Common Carotid
- CCA Common carotid artery
- CDUS Carotid Duplex Ultrasound
- CEA Carotid EndArterectomy
- CEMRA Contrast enhanced magnetic resonance angiography
- CREST Carotid Revascularization Endarterectomy vs. Stent
- CTA Computed tomography angiography (CTA)
- DM Diabetes Mellitus
- DSA Digital Subtraction Angiography
- ECA External carotid artery
- ECST The European Carotid Surgery Trial
- ECST European Carotid Surgery Trial
- EDV End-diastolic velocity (EDV)
- EEG Electro encephalogram
- EPD Embolic protection device technology
- EVA-3S Endarterectomy Versus Angioplasty in Patients with Symptomatic Severe Carotid Stenosis
- FDG-PET fluorodeoxyglucose positron emission tomography
- HRQOL health-related quality of life
- ICA Internal carotid artery
- ICSS The International Carotid Stenting Study
- MCA Middle Cerebral artery
- MI myocardial infarction
- MRA Magnetic Resonance Angiography
- MRI Magnetic Resonance Imaging
- NASCET The North American Symptomatic Carotid Endarterectomy
- PSV Peak systolic velocity
- PTFE Polytetrafluoroethylene
- SAPPHIRE The Stenting and Angioplasty with Protection in Patients at High Risk
- for Endarterectomy
- SPACE Stent-Protected Angioplasty versus Carotid Endarterectomy in symptomaticpatients
- TCD Transcranial duplex
- TIA Transient ischemic attack.
- TOF Time-Of-Flight

Introduction

Carotid endarterectomy (CEA) has been the Gold standard procedure to minimize further stroke risk in both symptomatic and asymptomatic patients with carotid artery atherosclerosis. However, percutaneous catheterization techniques have led to the development of approaches to carotid angioplasty and carotid stenting (CAS).

Proponents of percutaneous techniques emphasize their less invasive nature (since they can be performed with local anesthesia and sedation) and their lesser likelihood of morbidity from coexisting coronary disease. Unlike CEA, which is limited to the cervical carotid artery, carotid angioplasty, with or without stent placement, can be performed in patients with more cephalad or even intracranial lesions. Another group that may benefit from a percutaneous procedure are those with a "hostile" neck who are at higher risk for complications following standard CEA; included in this group are patients who have undergone radiation therapy, previous neck exploration, or tracheostomy.(1,2)

Despite their advantages, percutaneous procedures are not without risk. Critics have argued that the potential for dislodging plaque during angioplasty or stent placement results in an unacceptably high incidence of neurologic events. (3)

With time the use of protective devices in carotid artery stenting (CAS),from the early description by Vitek et al(4) of innominate artery angioplasty with occlusive balloon protection of the common carotid artery (CCA), through pioneering work by Theron et al(5) and Henry et al, distal and proximal(6) anti-embolic protection technology has developed rapidly. The availability of multiple embolic protection systems has been shown in many single and multicenter registries to confer a remarkably low risk of embolic complications after carotid stenting (7) and has minimized the incidence of neurological events.The lack of data of instant restenosis and its causes and pitfall gives the CEA the upper hand in all studies concerning late restenosis. (8)

In Egypt, the abundance of both techniques and the presence of studies for the feasibility of CAS, its efficacy versus medical treatment (9) and the effects of different carotid stent cell designs on the outcome of carotid artery stenting procedures (10) reflected the status of local practice in Egypt with all its limitations and

differences and led to encouraging results concerning the safety and efficacy of CAS.

Since such studies have not to our knowledge been conducted in Egypt we decided to study the efficacy and safety of CAS technique versus CEA in symptomatic and asymptomatic and high risk patients. This will give us real live data about the treatment of carotid artery stenosis in Egypt and the further improvements needed to improve the techniques and indications of CAS.

References

1. Diethrich, E. Which carotid lesions can presently be treated with angioplasty and stents and which should not be. Twenty-fourth Annual Symposium: Current Critical Problems, New Horizons and Techniques in Vascular and Endovascular Surgery, New York, 1997, p. XV 4.1.
2. Naylor, A. Carotid endarterectomy versus carotid angioplasty. Lancet 1997; 349:203
3. Grotta, J. Elective stenting of extracranial carotid arteries. Circulation 1997; 95:303.
4. Vitek JJ, Raymon BC, Oh SJ. Innominate artery angioplasty. AJNR Am J Neuroradiol. 1984;5:113–114.
5. Theron J, Courtheoux P, Alachkar F, Bouvard G, Maiza D. New triplecoaxial catheter system for carotid angioplasty with cerebral protection.AJNR Am J Neuroradiol. 1990;11:869–874.
6. Parodi JC, La Mura R, Ferreira LM, Mendez MV, Cersosimo H, Schonholz C, Garelli G. Initial evaluation of carotid angioplasty and stenting with three different cerebral protection devices. J Vasc Surg.2000;32:1127–1136.
7. Guimaraens L, Sola MT, Matali A, Arbelaez A, Delgado M, Soler L, Balaguer E, Castellanos C, Ibanez J, Miquel L, Theron J. Carotid angioplastywith cerebral protection and stenting: report of 164 patients (194 carotid percutaneous transluminal angioplasties). Cerebrovasc Dis. 2002 13:114 – 119.
8. Hans-Henning Eckstein, Peter Ringleb, Jens-Rainer Allenberg Stent-Protected Angioplasty versus Carotid Endarterectomy (SPACE) study to treat symptomatic stenoses at 2 years, The Lancet Neurology, Volume 7, Issue 10, Pages 893 - 902, October 2008.
9. Mohamed Khaled Elewa, Mahmoud Hemeda, Nahed Salah El-din، Hany M Zakieldine, SamiaAshourHelal Department of Neurology, Ain Shams University; Egypt, Aggressive Medical Treatment versus Carotid Artery Stenting in Management of Carotid Artery Stenosis: An Egyptian Study, [Egypt J NeurolPsychiatNeurosurg.
10. Ahmed Shawky ; SamehShaheen; Hany Aref; HamdySoliman; Ali Elsharkawi CRT-85 Comparative Study For The Impact Of Different Carotid Stent Cell Designs On Patient Outcome, JAmCollCardiolIntv. 2013;6(2_S):S28-S28. doi:10.1016/j.jcin.2012.12.104.

Aim of the work

1. To verify whether carotid artery stenting (CAS) is safe and feasible.
2. To compare carotid artery stenting (CAS) versus carotid endarterectomy (CEA) as regard incidence of stroke, myocardial infarction and death at 30 days and 6 month follow up.
3. To verify whether CAS is as suitable as CEA for all patient categories including high risk patients and asymptomatic patients.

Review of article

Chapter I:

Anatomy of the Aortic arch and carotid system

THE AORTIC ARCH AND ITS BRANCHES

From its midline origin at the aortic aperture of the left ventricle, the aortic arch adopts a posterior leftwards course to reach the left lateral border of the thoracicspine where its junction with the descending thoracic aorta is arbitrarily set.

Because of this oblique course, the aortic arch and its branches are betterappreciated on a left anterior oblique projection.

Classification of the Aortic arch:

The aortic arch can be classified into three types based on the distance of the origin of the great vessels from the top of the arch (Fig.1). The widest diameter of the left common carotid is used as a reference unit. If all the great vessels originate withinone diameter length from the top of the arch, it is classified as a type I arch. In a type II arch, all the great vessels originate within two diameter lengths from the top of the arch, and in a type III arch the great vessels originate beyond two diameter lengths from the top of the arch. Type III arches are harder to access during percutaneous intervention than type I arches.

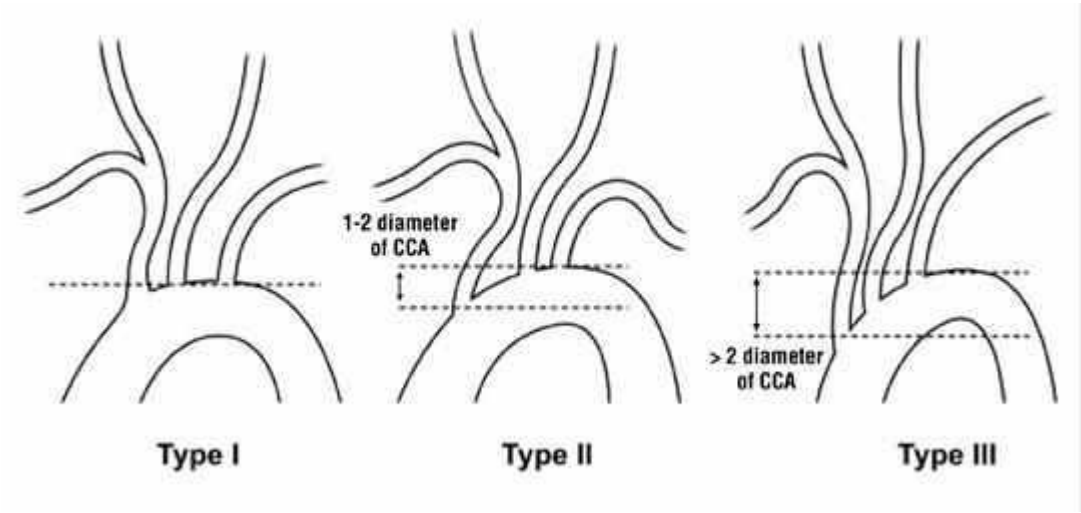

Figure 1: Classification of the aortic arch based on the distance of the origin of the great vessels from the top of the arch. (1)

Aging and the atherosclerotic process elongate and distend the aortic arch andshift the ostia of the brachiocephalic arteries. The aortic knob becomes more superior and posterior.(2)

Patterns of Aortic arch in humans:

The most common aortic arch branching pattern in humans consists of 3 great vessels originating from the arch of the aorta (Fig.2A). The first branch is the innominate artery, which branches into the right subclavian artery and the right common carotid artery. The second branch in the most common pattern is the left common carotid artery, and the last branch is the left subclavian artery.

The second most common variant of aortic arch branching occurs when the left common carotid artery has a common origin with the innominate artery. Rather than arising directly from the aortic arch as a separate branch, the left common carotid artery origin is moved to the right and merges with the origin of the innominate artery. This variant is most often termed a “bovine aortic arch” 3 (Fig.2B).

A similar but less common variant occurs when the left common carotid artery originates directly from the innominate artery rather than as a common trunk (Fig.2C). Both variants of left common carotid artery origin have been called in various textbooks and medical articles a “bovine-type arch,” though this term is most commonly ascribed to the common trunk variety.1,2,4 More than 20 different aortic arch configurations have been described, but those specifically described previously are by far the most commonly encountered.

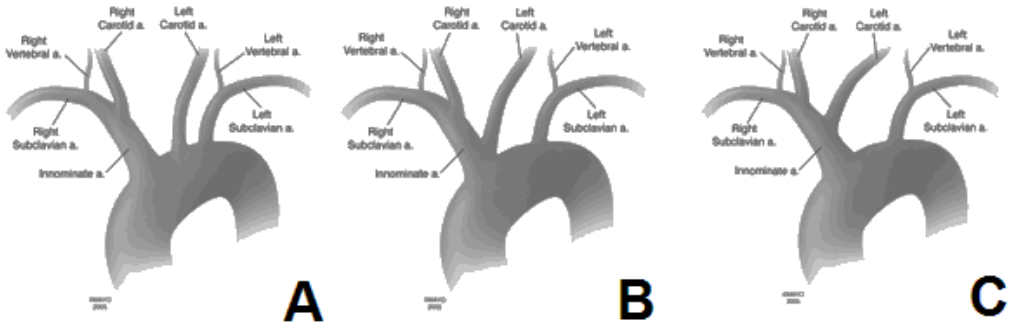

Figure 2: A showing the usual pattern of human Aortic arch, B showing the bovine pattern & C showing another bovine configuration(4)