Endovascular Management of Medically Refractory Intracranial Arterial Stenosis

Thesis

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Romany Adly Yousef

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List of Abbreviations

Abb.	Full term
ACA	Anterior cerebral artery
ACE-I	Angiotensin converting enzyme inhibitors
ACT	Activated clotting time
AE	Adverse events
AHA	American Heart Association
ARBs	Angiotensin receptor blockers
ARIC	Atherosclerosis risk in communities
ATP	Adenine triphosphate
BES	Balloon-expandable stent
BP	Blood pressure
CCA	Cervical carotid artery
CIN	Contrast-induced nephropathy
D. Normal	Diameter of normal
D. Stenosis	Diameter of stenosis
DBP	Diastolic blood pressure
DSA	Digital subtraction angiography
ECA	External carotid artery
ECST	European Carotid Surgery Trial
FLAIR	Fluid-Attenuated Inversion Recovery
GP	Glycoprotein
ICAS	Intracranial arterial stenosis
ICA	Internal carotid artery
ICAD	Intracranial arterial disease
ICH	Intracerebral hemorrhage
IPH	Intra parenchymal hematoma
IQR	Interquartile range
IV	Intravenous
LA	Left atrium
LAA	Left atrial appendage

Abb.	Full term
MCA	Middle cerebral artery
MFV	Mean Flow velocity
MRA	Magnetic resonance angiography
mRS	Modified Rankin Scale
NASCET	North American Symptomatic Carotid Endarterectomy Trial
NIH	National Institutes of Health
NIHSS	National Institute of Health Stroke Scale
NPO	Nothing per OS
PCA	Posterior cerebral artery
PCCA	Posterior communicating cerebral artery
Pcom A	Posterior communicating artery
PFO	Patent foramen ovale
PT	Prothrombin time
PTA	Percutaneous transluminal angioplasty
PTAS	Percutaneous transluminal angioplasty and stent
PTT	Partial thromboplastin time
RRR	Relative risk reduction
SAMMPRIS	Stenting and Aggressive Medical Management for Preventing Recurrent stroke in Intracranial Stenosis
SES	Self-expandable stent
SIAS	Symptomatic intracranial arterial stenosis
TCD	Transcranial Doppler
TIA	Transient ischemic attack
TOF	Time-of-flight
VZV	Varicella zoster virus
WASID	Warfarin-aspirin symptomatic intracranial disease

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Abstract

Background: Atherosclerotic intracranial arterial stenosis (ICAS) is one of the most common causes of stroke worldwide and is associated with a high risk of recurrent stroke. Patients with a recent transient ischemic attack (TIA) or stroke and severe stenosis (70 to 99% of the diameter of a major intracranial artery) are at particularly high risk for recurrent stroke in the territory of the stenotic artery (approximately 23% at 1 year) despite treatment with aspirin and standard management of vascular risk factors. Therefore, alternative therapies are urgently needed for these patients.

Objective: Our study aimed to determine the efficacy and safety of angioplasty with stenting in medically refractory intracranial arterial stenosis.

Methodology: The current study is a randomized prospective single center study carried out during the period from June 2016 to June 2018 at the Neuroendovascular Unit of El Mataria Teaching Hospital after obtaining an informed consent. Fifty patients were enrolled, randomized 1:1 and underwent twenty five stenting procedures and twenty five take medical treatment. The patients had been recruited from inpatient El Mataria Teaching Hospital admission and outpatient clinics.

Results: Success rate in our study was 96 % where only one patient failed to deployment of stent due to tortuosity of Vessels. Restenosis occurred in one patient after stenting and complete occlusion occurred in one patient also so the percent of restenosis was 8%.

Conclusion: Our study concluded that intracranial arterial stenting and best medical treatment superior in efficacy and safety than best medical treatment without stenting.

Keywords: Endovascular, Intracranial Arterial Stenosis

Introduction

Stroke is a leading cause of death globally. Patients surviving a stroke or transient ischemic attack (TIA) are at an increased risk for subsequent strokes. Without secondary prevention measures, patients after stroke or TIA face an annual risk of 4-16% of developing serious vascular events **(Zhang et al., 2015).**

Atherosclerotic intracranial arterial stenosis is one of the most common causes of stroke worldwide and is associated with a high risk of recurrent stroke. Patients with a recent transient ischemic attack (TIA) or stroke and severe stenosis (70 to 99% of the diameter of a major intracranial artery) are at high risk for recurrent stroke in the territory of the stenotic artery (approximately 23% at 1 year) despite treatment with aspirin and standard management of vascular risk factors. Therefore, alternative therapies are urgently needed for these patients **(Marc et al., 2011).**

The pathophysiology of ischemic stroke secondary to intracranial arterial stenosis involves multiple mechanisms. Intracranial arterial stenosis may incite downstream ischemia in a specific arterial territory due to hypoperfusion, in situ thrombosis, artery-to-artery emboli,

perforator vessel occlusion by the atherosclerotic plaque, or combined mechanisms. There is an interrelated and complementary occurrence of hypoperfusion and embolism. Reduced blood perfusion distal to high-grade stenosis limits the ability of emboli from the stenosis to be washed out of the cerebral circulation and therefore may accumulate in the lowest perfusion pressure regions. Investigations using MRI and transcranial Doppler studies have corroborated this hypothesis and have suggested additional mechanisms in which stenosis and embolism act synergistically to produce ischemia **(Nestor, 2013).**

Despite aggressive medical therapy, the risk of recurrent stroke in patients with symptomatic intracranial arterial disease (ICAD) is as high as 15% per year. In patients with severe stenosis (>70%) and in certain high-risk groups, the risk of recurrent stroke has been reported to be as high as 25% per year **(Gonzalez et al., 2013).**

Successful management of patients with ICAD requires an intervention that is safe, effective, and has minimal complications. Medical treatment can reduce the risk of ischemic stroke due to thromboembolic events, but it does not reduce the risk of ICAD progression and the associated pathophysiologic components of hypoperfusion and poor collateral circulation **(Taylor et al., 2014).**

Current primary prevention strategies include a combination of life style modification (smoking cessation, dietary intervention, weight loss and exercise), antihypertensive medications, antithrombotic therapy and statins. Recommended secondary prevention includes a combination of medical therapy and revascularization. Tremendous advances were made in cerebral revascularization techniques in recent years, which include percutaneous transluminal angioplasty (PTA) alone and PTA with stenting (PTAS) using balloon-mounted coronary stents **(Muthanna & Raghavan, 2012).**

Angioplasty has traditionally been used for the treatment of intracranial stenosis, primarily for intracranial stenosis refractory to medical therapy. However, since no stent is specifically designed for intracranial arteries, treatment is usually completed with balloon angioplasty alone **(Takashi et al., 2014).**

Balloon angioplasty has several advantages over bypass surgery in treating the stenotic lesion of the middle cerebral artery (MCA). First, the ability to access to the stenotic lesion and start angioplasty more promptly after neurological deterioration of the patient compared to bypass surgery. Second, endovascular treatment could be performed without induction of general anesthesia and

considered to be less invasive than open surgery. Third microembolism is thought to be one of the mechanisms of cerebral ischemia in intracranial stenosis, so we consider angioplasty of the lesion may be more essential than bypass surgery in treating the stenotic lesion **(Hideo et al., 2015).**

Despite the low one year stroke rates following intracranial angioplasty, restenosis remains a possible weakness of primary angioplasty. Symptomatic and angiographic restenosis occur at 6 months in approximately 5–30% of patients treated with angioplasty alone. The re-angioplasty rate was in excess of 20% in the most recent study in which sub-maximal technique was rigorously employed **(Dumont et al., 2012).**

Stenting was developed in response to the need for better outcomes after angioplasty and was proven to be effective by reducing the occurrence of plaque dislodgement, intimal dissection, elastic recoil of the vessel wall, and early and late restenosis **(Farooq et al., 2014).**

Stenting has been a popular treatment for intracranial stenosis, particularly with the advent of the Wingspan® Stent System is an endovascular tool. As with the placement of any bare metal stent, intracranial stents require dual antiplatelet therapy during the stent

endothelialization period. So, treating the areas of intracranial stenosis with angioplasty and stenting. Through improving vessel caliber in the stenotic segment, is more beneficial than medical therapy alone. Theoretically, angioplasty and stenting should increase blood flow and decrease the incidence of watershed infarcts secondary to chronic cerebral ischemia due to hypoperfusion. Early reports of stenting for ICAD showed promise to this end. Bare metal stents, balloon mounted (balloon-expandable) stents, and drugeluting stents have been evaluated for this purpose **(Lee et al., 2013).**

A joint position statement by major radiology and neuroradiology societies in October 2005, in alignment with the FDA indication, concluded that balloon angioplasty with or without stenting should be considered in patients who had failed medical therapy **(Aakriti et al., 2013).**