Assessment of Cerebral Collaterals in Acute Ischemic Stroke by CT Cerebral Angiography and Its Relation to the Functional Outcome

Thesis

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا

إلا ما علمتنا إنك أنت

العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

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List of Abbreviations

Abb.	Full term
ACLs	*Anticardiolipin Antibodies*
AF	*Atrial Fibrillation*
APLs	*Antiphospholipid Antibodies*
ASITN	*American Society of Interventional and Therapeutic Neuroradiology*
ASL	*Arterial Spin Labeling*
ATA	*Arterial Transit Artifact*
BBB	*Blood–Brain Barrier*
Ca2+	*Calcium Ions*
CBF	*Cerebral Blood Flow*
CBS	*Clot Burden Score*
CBV	*Cerebral Blood Volume*
CMV	*Cytomegalovirus*
CS	*Collateral Score*
CT	*Computed Tomography*
CTA	*Computed Tomography Angiografhy*
DNA	*Deoxyribonucleic Acid*
DSA	*Digital Subtraction Angiography*
DWI	*Diffusion-Weighted Imaging*
ESR	*Erythrocyte Sedimentation Rate*
H2O2	*Hydrogen Peroxide*
HSPs	*Heat Shock Proteins*
IEGs	*Immediate Early Genes*
LACI	*Lacunar Cerebral Infarction*
LDL	*Low Density Lipoprotein*
MCA	*Middle Cerebral Artery*

List of Abbreviations (Cont...)

Abb.	Full term
MCA	*Middle Cerebral Artery*
MR	*Magnetic Resonance*
MRA	*MR Angiography*
MRI	*Magnetic Resonance Imaging*
MRS	*Modified Rankin Scale*
Na+	*Sodiumions*
NCCT	*Non-Contrast Compute Tomography*
NCEP	*National Cholesterol Education Program*
NIHSS	*National Institute of Health Stroke Scale*
NINDS	*National Institute of Neurological Disorders and Stroke*
PACI	*Partial Anterior Circulation Infarction*
PET	*Positron Emission Tomography*
POCI	*Posterior Circulation Infarction*
RNS	*Reactive Nitrogen Species*
ROS	*Reactive Oxygen Species*
SIR	*Society of Interventional Radiology*
SPECT	*Single-Emission Computed Tomography*
SUD	*Stroke of Undetermined Aetiologies*
TACI	*Total Anterior Circulation Infarction*
TCD	*Trans-cranial Doppler*
TIA	*Transient Ischemic Attack*
TIA	*Transient Ischemic Attacks*

ABSTRACT

Background: Until recently, there was little interest in measuring cerebral perfusion because therapies that might improve perfusion were not available. Now we have a variety of recanalization and flow augmentation procedures. In addition, older perfusion measurement techniques suffered from a lack of speed, resolution, ability to accurately quantify perfusion, and reproducibility of blood flow values. With the development of helical and spiral computed tomography (CT) and echo-planar magnetic resonance (MR) imaging, we now have very rapid imaging techniques that make it possible to rapidly follow a bolus of contrast material or image a large area of the brain, thereby increasing the accuracy and applicability of these techniques.

Purpose: To evaluate the relationship between state of cerebral collateral blood vessels and functional outcome of patients with acute ischemic stroke with or without thrombolytic therapy.

Subjects and Methods: This A prospective study. The inpatients in the institute of neurology of Ain Shams University Hospitals. Ain Shams University is located in Eastern Cairo and serves a catchment area of about the third of Greater Cairo. It serves both urban and rural areas, including areas around Greater Cairo as well.

Results: The results of the present study revealed that more than have of patients included in the study were diabetic, hypertensive, smokers, positively for dyslipidemia, and negatively for cardiac disease, alcohol consumption or past history of transient ischemic attack/ stroke.

Conclusion: The results of the present study shows that risk for cerebrovascular ischemic stroke is increased by age, male sex, presence of diabetes, hypertension, smoking, and dyslipidemia.

Keywords: *Cerebral Collaterals – Acute Ischemic Stroke - Cerebral Angiography*

INTRODUCTION

Stroke continues to impose an overwhelming burden on global health, causing major disability, but few therapeutic advances have been made despite decades of research. It is the second most common cause of death, with most of the 16 million cases occurring in developing countries ***(Lloyd -Jones et al., 2010).***

Ischemia is the main cause of stroke, typically due to occlusion of a cerebral artery as a result of progressive atherosclerosis or an embolus from the heart or neck vessels ***(Truelsen et al., 2006).*** In some patients the blockage or occlusion can develop within small intracranial Vessels, often because of uncontrolled hypertension or diabetes ***(Adams et al., 1993).*** Irrespective of cause or mechanism of ischemia, collateral flow *"i.e, perfusion via alternative or indirect pathways"* might off set potential injury to the brain ***(Liebeskind, 2007).***

The pathophysiology of the evolving stroke has been well studied in animals and people ***(Shuaib & Hussain, 2008).***

Ischemic thresholds have been established in in-vivo models; generally, these thresholds parallel cellular damage in other tissues of the body, but with a few important differences normal cerebral blood flow (CBF) is between 50 and 60 mL/100 g/min and is tightly controlled by cerebral auto regulation. The pace of cellular death in the brain after an arterial occlusion is closely linked to the severity of decrease in blood flow within the local environment. When blood flow is less than 10 mL/100 g/min, damage is rapid and most cells die within minutes of the insult ***(Astrup et al., 1981).***

When CBF is between 10 and 20 mL/100g/min, neurons cease to function but remain structurally intact and are potentially revivable if normal blood flow is restored ***(Sobesky et al., 2004).*** Therefore, neuronal damage is not uniform when an intracranial artery is occluded, especially in the first few hours after the insult. Depending on the extent of collateral perfusion, infarction might not be complete for hours or even days ***(Hammer et al., 2010).***

Modern neuroimaging techniques, particularly multimodal computed tomography (CT) and magnetic resonance imaging (MRI) including non-invasive angio graphy and perfusion imaging, allow identification of cerebral injury in the first few hours after arterial occlusion. Detailed imaging studies have shown that progression to complete infarction, especially after occlusion of the middle cerebral artery (MCA), is highly variable ***(Liebeskind, 2005).***

In patients whose tissue survives for a long period despite proximal arterial occlusion, retrograde filling of pial arteries (a surrogate indicator of leptomeningeal collateral vessels) is often evident in imaging studies and might have an important protective role ***(Miteff et al., 2009).***

Enhancement of blood flow through collateral vessels might be therapeutically useful in the treatment of acute stroke. The notion of CBF augmentation by volume expansion and induced hypertension has been tested in several small trials dating from the 1970s ***(Aichner et al., 1998).***

Until recently, there was little interest in measuring cerebral perfusion because therapies that might improve perfusion were not available. Now we have a variety of recanalization and flow augmentation procedures. In addition, older perfusion measurement techniques suffered from a lack of speed, resolution, ability to accurately quantify perfusion, and reproducibility of blood flow values. With the development of helical and spiral computed tomography (CT) and echo-planar magnetic resonance (MR) imaging, we now have very rapid imaging techniques that make it possible to rapidly follow a bolus of contrast material or image a large area of the brain, thereby increasing the accuracy and applicability of these techniques ***(Latchaw et al., 2003).***

Additionally, in the last decade, several clinical trials have investigated the effects of endovascular treatment in the setting of an intracranial or extra cranial large artery occlusion. Several studies, including MR CLEAN6, ESCAPE3, EXTEND-IA7 and SWIFT-PRIME8, recently proved endovascular treatment to be more effective than standard medical care, with or without intravenous thrombolysis, using stentrievers in the majority of the