Electrocardiographic changes in patients with acute cerebrovascular stroke and their prognostic importance

Thesis

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Ahmed Ezzet

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LIST OF ABBREVIATIONS

Abb.		Full Term
AIS	:	Acute ischemic stroke
TOAST	:	Trial of ORG 10172 in Acute Stroke Treatment
CVA	:	Cerebrovascular accident
CVS	:	Cerebrovascular stroke
NCCT	:	Noncontrast computed tomography
MRI	:	magnetic resonance imaging
ACA	:	Anterior cerebral artery
MCA	:	Middle cerebral artery
PCA	:	Posterior cerebral artery
PICA	:	posterior inferior cerebellar artery
AICA	:	anterior inferior cerebellar artery
TIAs	:	transient ischemic attacks
ATP	:	adenosine triphosphate
NMDA	:	N -methyl-D-aspartate
MI	:	myocardial infarction
AVM	:	Arteriovenous malformation
VT	:	ventricular tachycardia
VF	:	ventricular fibrillation
ECG	:	Electrocardiography
SAH	:	Subarachnoid hemorrhage
SCD	:	Sudden cardiac death
LQTS	:	long QT syndrome
MI	:	Myocardial infarction
Tdp	:	Torsades de pointes
PE	:	pulmonary embolism
QTc	:	Corrected QT interval
QTD	:	QT dispersion
TCA	:	Tricyclic antidepressants
CO	:	carbon monoxide

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ABSTRACT

Cerebrovascular stroke is a major public health concern and a leading cause of death worldwide. Complications after CVS can worsen neurologic and patient outcomes. Patients with CVS may have a variety of electrocardiographic changes which may be disturbance of rate , rhythm , P wave , QRS complex , PR interval , T wave, ST segment, QT interval or ischemic like changes. Early ECG may serve as an inexpensive test to screen for cardiac dysfunction prior to ordering more expensive and potentially more invasive testing. So, ECG should be a mandatory investigation for all patients with CVS.

We were aiming in our study To determine if there are ECG changes with CVS and if these changes are related prognosis.

In our study we found that ECG changes on admission are statistically significant but certain types of ECG changes were not correlated with outcome.

Further studies are required to more clarify the connection between these ECG abnormalities and CVS.

INTRODUCTION

Cerebrovascular accidents, the second most frequent cause of death world-wide, accounts for 6.2 million deaths. Between 1990 and 2010 the number of stroke patients has decreased by approximately 10% in the developed countries and increased by 10% in the developing countries **(Feigin et al., 2014).**

Stroke is the term used to describe episodes of focal brain dysfunction due to focal ischemia or hemorrhage. The incidence of first stroke is around 1.5/1000/year, and of transient ischemic attack 0.6/1000/year. About 22% of all strokes are recurrent events **(Hamel , 2006).**

Cardiovascular abnormalities are common after a stroke. Studies have evaluated electrocardiogram changes and rhythm disturbances in ischemic stroke patients without primary heart disease to distinguish abnormalities specifically associated with acute stroke **(Aro et al., 2014)**.

Disorders of the central nervous system cause a wide array of cardiovascular system dysfunction ranging from electrocardiogram changes and transient myocardial dysfunction to sudden cardiac death. Electrocardiogram changes are present in 60-90% of patients with intra-parenchymal or subarachnoid bleeding and in about 5-20% of patients with acute ischemic stroke **(Toghaet al., 2013)**.

The underlying basis is disordered repolarization process. The possible mechanism is through disturbances in autonomic regulation and massive stimulation of the sympathetic nervous system. Moreover studies have shown that the frontal lobe, insular cortex and amygdale play an important role in regulating the heart rate via autonomic nerves **(Xavier et al., 2012).**

Aim of the Work

The aim of this study is to determine the incidence of electrocardiographic changes associated with isolated acute cerebrovascular stroke, and to study if these changes are related to prognosis.

Review of Literature

Acute Cerebrovascular Stroke, Etiology and Pathophysiology

Acute cerebrovascular stroke

Acute ischemic stroke (AIS) is characterized by the sudden loss of blood circulation to an area of the brain, typically in a vascular territory, resulting in a corresponding loss of neurologic function. Also previously called cerebrovascular accident (CVA) or stroke syndrome, stroke is a nonspecific state of brain injury with neuronal dysfunction that has several pathophysiologic causes. Strokes can be divided into 2 types: hemorrhagic or ischemic. AIS is caused by thrombotic or embolic occlusion of a cerebral artery **(Ovbiagele et al., 2013)**.

Nearly 800,000 people suffer strokes each year in the United States; 82-92% of these strokes are ischemic. Cerebrovascular stroke(CVS) is the fifth leading cause of adult death and disability, resulting in over $72 billion in annual cost. Between 2012 and 2030, total direct medical stroke-related costs are projected to triple, to $184.1 billion, with the majority of the projected increase in costs arising from those 65 to 79 years of age **(Ovbiagele et al., 2013).**

Stroke categories

The system of categorizing stroke developed in the multicenter Trial of ORG 10172 in Acute Stroke Treatment (TOAST) divides ischemic strokes into the following 3 major subtypes: large arteries, small vessels and cardioembolic infarction **(Broderick et al., 2007).**

Hemorrhagic stroke is less common than ischemic stroke epidemiologic studies indicate that only 8-18% of strokes are hemorrhagic. However, hemorrhagic stroke is associated with higher mortality rates than is ischemic stroke **(Feigin et al., 2003).**

Patients with hemorrhagic CVS may present with focal neurologic deficits similar to those of ischemic CVS but tend to be more ill than are patients with ischemic CVS. However, though patients with intracerebral bleeds are more likely to have headache, altered mental status, seizures, nausea and vomiting, and/or marked hypertension. Brain imaging is a crucial step in the evaluation of suspected hemorrhagic stroke and must be obtained on an emergent basis. Brain imaging aids in excluding ischemic CVS, and it may identify complications of hemorrhagic CVS such as intraventricular hemorrhage, brain edema, and hydrocephalus. Either noncontrast computed

tomography (NCCT) scanning or magnetic resonance imaging (MRI) is the modality of choice **(Broderick et al., 2007).**

Blood Supply of the brain:

The brain is the most metabolically active organ in the body. While representing only 2% of the body's mass, it requires 15-20% of the total resting cardiac output to provide the necessary glucose and oxygen for its metabolism. Knowledge of cerebrovascular arterial anatomy and the territories supplied by the cerebral arteries is useful in determining which vessels are involved in acute stroke. Atypical patterns of brain ischemia that do not conform to specific vascular distributions may indicate a diagnosis other than ischemic CVS, such as venous infarction **(Adams et al.,2007).**

In a simplified model, the cerebral hemispheres are supplied by 3 paired major arteries, specifically, the anterior, middle, and posterior cerebral arteries. The anterior and middle cerebral arteries carry the anterior circulation and arise from the supraclinoid internal carotid arteries. The anterior cerebral artery (ACA) supplies the medial portion of the frontal and parietal lobes and anterior portions of basal ganglia and anterior internal capsule **(Mozaffarian ,2015).**

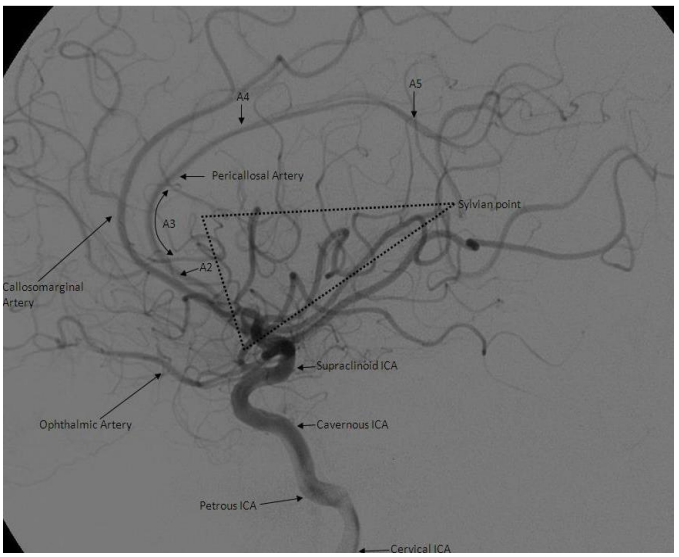

Figure (1): Lateral view of a cerebral angiogram illustrates the branches of the ACA and Sylvian triangle**(Mozaffarian ,2015).**

The middle cerebral artery (MCA) supplies the lateral portions of the frontal and parietal lobes, as well as the anterior and lateral portions of the temporal lobes, and gives rise to perforating branches to the globus pallidus, putamen, and internal capsule. The MCA is the dominant source of vascular supply to the hemispheres **(Mozaffarian ,2015).**

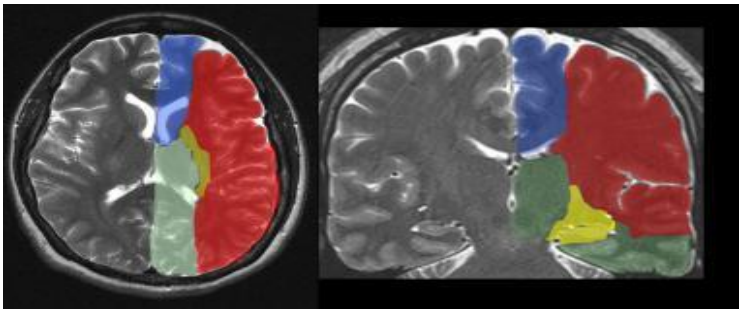

Figure (2): The supratentorial vascular territories of the major cerebral arteries are demonstrated superimposed on axial (left) and coronal (right) T2-weighted images through the level of the basal ganglia and thalami**(Mozaffarian ,2015).**

The posterior cerebral artery(PCA) arises from the basilar artery and carry the posterior circulation. PCA gives rise to perforating branches that supply the thalami and brainstem and the cortical branches to the posterior and medial temporal lobes and occipital lobes **(Mozaffarian ,2015).**

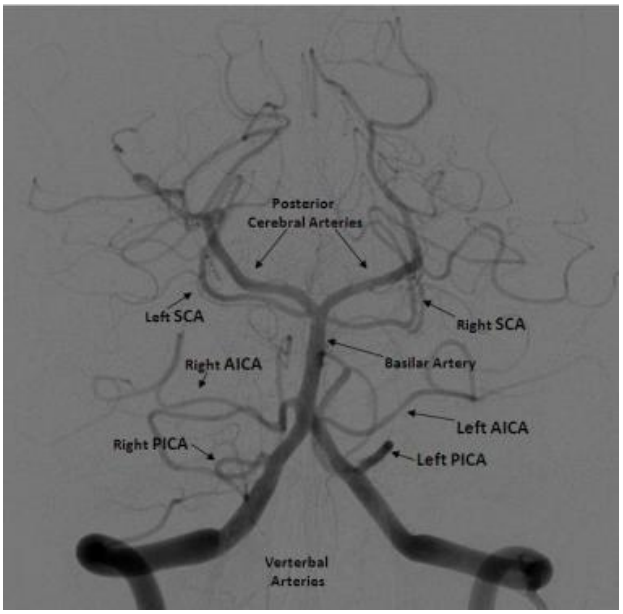

Figure (3): Frontal projection from a right vertebral artery angiogram illustrates the posterior circulation**(Mozaffarian ,2015).**

Cerebellar blood supply:

Inferiorly by the posterior inferior cerebellar artery (PICA), arising from the vertebral artery. Superiorly by the superior cerebellar artery. Anterolaterally by the anterior inferior cerebellar artery (AICA), from the basilar artery **(Dziadkowiak et al.,2016).**