COMPUTED TOMOGRAPHY ANGIOGRAPHY FINDINGS IN ADULT STROKE PATIENTS PRESENTING AT RADIOLOGY DEPARTMENT, MUHIMBILI NATIONAL HOSPITAL

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Department of Radiology



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By

Azza Awadh Naif, MD.

A Dissertation Submitted in (partial) Fulfillment of the Requirement for the Degree of Master of Medicine (Radiology) of

Muhimbili University of Health and Allied Sciences

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CERTIFICATION

The undersigned certifies that she has read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation titled: *"**Computed Tomography Angiography Findings in adult stroke patients presenting at Radiology Department, Muhimbili National Hospital",*** in partial fulfillment of the requirements for the degree of Masters of Medicine (Radiology) of the Muhimbili University of Health and Allied Sciences.

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Dr. Hilda Makungu, MD, MMed Radiology

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Date

DECLARATION AND COPYRIGHT

I, **Azza Awadh Naif,** declare to the best of my knowledge that this **dissertation** is my own original work, it has not been presented and will not be presented to any other university for a similar or any other degree award.

Signature_____ Date_____

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Secondly, my special gratitude goes to my supervisor, Dr. Hilda for giving up her time in helping me complete this work.

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My sincere gratitude also goes to Dr. Fredrick Lyimo at MNH for tirelessly helping me and giving me guidance.

Last but not least, I am very grateful to my parents and my siblings for their courage and support during the whole period of my dissertation.

DEDICATION

This dissertation is dedicated to my parents Mr. and Mrs. Naif Abeid for laying an excellent foundation from childhood to where I am today.

ABSTRACT

BACKGROUND

Stroke continues to be one of the most debilitating disease that either leads to disability or morbidity among different ethnicities in the world. In 2008 WHO had estimated deaths by stroke to be 5.7million worldwide which has now risen to 6.24million deaths and projected to be at 7.8million deaths by 2030. The current advancement of technology makes it possible to recognize stroke at an early stage and hence treatment can be planned accordingly. One of such tools is the use of CTA which can be used to outline the cause of stroke and can further be used to pinpoint the location of the problem and hence making it easier for the clinicians to carry out the required interventional procedures. Therefore, it is imperative to apply the use of CTA in sorting outpatients with stroke especially since CT scanners are readily available even in most of the developing countries.

BROAD OBJECTIVE

To determine Computed Tomography angiography findings in adult patients with stroke presenting at the Radiology department, Muhimbili National hospital from September 2018 to February 2019.

METHODOLOGY

The study was conducted at the Radiology department at MNH by using a cross-sectional analysis method and a convenience sampling technique. This study included 86 patients who were diagnosed with stroke and were referred for CTA at the department. Images were interpreted by the primary Investigator and proof-read by the Radiologist. When a difference arose on the interpretation, a senior Radiologist was consulted and results recorded when the consensus was reached. A well-structured questionnaire was used to collect data which were later on analyzed using SPSS version 20. Data was presented in simple frequency tables and charts. Statistical Association of descriptive data was done using chi-square. A p value of <0.05 was considered significant. All images were obtained using the ALARA technique.

RESULTS

This study included 86 stroke patients, among which males were 45 and 41 were females. The age range was between 18-95. Ischemic stroke was found to have a higher prevalence (60.5%) compared to hemorrhagic stroke (39.5%). Of the angiographic patterns examined, stenosis was found to be the commonest abnormal pattern represented by 36%, of which most occurred intracranially (72.2%) as compared to extracranial (27.8%). MCA was the commonest affected vascular territory (29.4%). Among the four modifiable risk factors, hypertension and diabetes mellitus were the only two that had a strong association with stenosis.

CONCLUSION

Stenosis was the commonest abnormal angiographic pattern seen in patients with stroke with a higher prevalence in intracranial segments (72.2%). Among the vascular territories analyzed, MCA had a high prevalence of all. Anterior circulation showed high preponderance as compared to posterior circulation. Hypertension and diabetes mellitus were the two risk factors that showed a significant association with the stenosis (p-value <0.05).

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LIST OF ABBREVIATIONS:

ACA	Anterior Cerebral Artery
ACOM	Anterior Communicating Artery
ALARA	As Low As Reasonably Achievable
CT	Computed Tomography
CTA	Computed Tomography Angiography
DALY	Disability Adjusted Life-years
DWI	Diffusion Weighted Imaging
EICA	External Internal Carotid Artery
GBD	Global Burden Disease
ICA	Internal Carotid Artery
IV	Intravenous
MCA	Middle Cerebral Artery
MNH	Muhimbili National Hospital
MRA	Magnetic Resonance Angiography
MRI	Magnetic Resonance Imaging
MUHAS	Muhimbili University of Health and Allied Sciences
NCCT	Non-Contrast Computed Tomography
PCA	Posterior Cerebral Artery
PCOM	Posterior Communicating Artery
SPSS	Statistical Package for Social Sciences
TIA	Transient Ischemic Attack
TOAST	Trial of Org 101712 in Acute Stroke Treatment
tPA	Tissue Plasminogen Activator
WHO	World Health Organization

DEFINITION OF TERMS:

Stroke patient refers to a person that has suffered a focal brain injury due to either compromise in the blood flow secondary to occlusion or narrowing of the vessel or can be due to bursting of the vessels and often develops symptoms depending on the part of the brain affected (1,2).

Brain aneurysm is a balloon-like bulge that occurs at the weakest point of an artery and is prone to rupture (3).

Cerebral arterial stenosis refers to a narrowing of a vessel which can be as a result of a plaque or disease, causing reduced blood flow to the brain cells (4,5).

CHAPTER ONE

INTRODUCTION

BACKGROUND:

Stroke is a medical condition that results from poor blood flow to brain cells which may lead to cell death if the cause is not alleviated and as a result might cause neurological deficits. It is one of the commonest causes of disability and morbidity in the world(6).

In 2002 WHO had estimated deaths by stroke to be 5.5million worldwide(7) which has now risen to 6.24million deaths (8), ranked the third most common cause of death in America (9) and although data is limited in Africa, it is stated to be on the rise(10). Stroke burden is estimated to rise by the year 2030 where the number of deaths due to stroke will be at 7.8million (11).

Worldwide stroke accounts for about 9.7% of all deaths (11). It has been suggested that income bears a risk factor to the development of stroke as such more than 86% of stroke burden occurs in low- to- middle-income countries (12), this has highly been attributed by the fact that in most of these countries acute treatment of stroke is not readily available and there is a poor identification and prevention of the risk factors in this countries (13). It has been estimated that about 8% of the first-ever stroke occur in Africa (14), and according to GBD 2004, prevalence rates for stroke survivors increased by 10-30% compared to previous studies (15).

Stroke appears to affect more men than women(16)(17)and although it can happen at any age, it has been shown to affect more adults from age 45 (11).

Although NCCT is a quick way to determine whether a patient has a hemorrhagic or ischemic stroke(18), it may not be able to exactly pinpoint the location of infarcts with a small volume(19). However, with CTA one is able to look at the cerebral vessels and in addition, visualization of the arch of aorta and carotid vessels helps outline the cause of the stroke event (18,20,21).

While the accepted standard for diagnosing vascular disease has been the conventional arteriography, its high cost and invasiveness have made it less desirable (22,23). MRA is another best tool that is non-invasive that can be used to examine cerebral vascular diseases but requires highly cooperative patients (24), it is time-consuming and is contraindicated in patients with an aneurysmal clips and pacemakers.

CTA is a method that uses CT scanner and IV non-ionic water-soluble contrast material to visualize vessels within the body. It is non-invasive, fast, low cost (25) and readily available than MRI (26) in most places around the world.

CTA plays a big role in helping clinicians make decisions concerning patients with acute stroke. It has also proven to have a high sensitivity and specificity in detecting large vessel occlusion (sensitivity 98.4% and specificity 98.1% (27). It can also help determine the risk of recurrent stroke in patients with TIA, as one study has shown that the risk of patients developing stroke after TIA within 90 days is about 10-20% (26).

Apart from being able to rule out occluded vessels, CTA can show aneurysms or any arterial vessel malformations (18) as the source of a bleed, where it has a sensitivity of 97-100% in detecting intracranial aneurysm(28). Furthermore, it can show hematoma expansion in patients with intracerebral hemorrhage (also called the spot sign) where contrast extravasation is seen as an enhancement within the hematoma (29).

LITERATURE REVIEW

Stroke continues to be among the top causes of mortality worldwide. It has been postulated to continue rising in the years to come (11) with a prevalence of ischemic being higher than hemorrhagic stroke (84% and 16% respectively) (30). Ischemic stroke has been further subclassified into five subtypes using many systems in the past, but one remains the most useful classification system, the TOAST (31), which was based on finding the most likely cause of ischemic stroke. These subtypes included: Large artery atherosclerosis, Small artery occlusion, Cardioembolism, Other demonstrated causes and Undetermined cause (cryptogenic).

Several studies have been done to determine the relationship between stroke with age or sex of patients of which results were different depending on the region or place of research. According to studies done in China and India, stroke was found to favor males than females with rates of 62% and 76% respectively (32,33). Another study was done in South-Eastern Nigeria also showed male preponderance with a male: female ratio of 4.1:1 for ischemic stroke and 3:1 for hemorrhagic stroke (16).

A study by Ahangar et al (30) showed there was a higher female preponderance compared to males (53% and 47% respectively) of which those above 60years showed a higher prevalence (66.5%).

A difference of about 10 folds has been observed between countries with highest rates and lowest age-adjusted and sex-adjusted mortality rates secondary to stroke whereas 24.5 per 100,000 has been observed in Seychelles and 251 per 100,000 seen in Russia (34). Stroke and vascular diseases have been shown to be the leading causes of death and DALY among adults aged 45-69 years and account for approximately 13% of global lost DALY (11).

In Tanzania, a study by Walker et al (35) conducted in Dar-es-Salaam revealed that stroke incidence in males was 2592.6 per 100,000 and 1904.8 per 100,000 in females aged 65-74, and 4166.7 per 100,000 males aged 75-84 compared to 3496.5 per 100,000 in females. The overall age-standardized incidence rate of stroke was 315.9 per 100,000 which is higher than in most developed countries (35).

There are several modifiable risk factors for stroke, among them are Cigarette smoking, Hypertension and Diabetes mellitus (36). A study done in Nepal has shown that among these, the most common risk factors for stroke were cigarette smoking and hypertension, followed by alcohol consumption and diabetes mellitus among many. A study by V.R. Bhatt et al (36) showed 74% of patients with stroke to have had hypertension and 57% had a history of smoking, this was followed by diabetes 34% and alcohol consumption. Whereas in a study done by Maskey, A et al (37) showed somehow similar findings with hypertension accounting for 61.2%, smoking 59.4%, alcohol use 26.9% and diabetes mellitus 9.3% as modifiable causative risk factors for stroke**.** In a study done in India, it was shown that there was a strong association between hypertension and diabetes with stenosis but no association was noted between age and gender with stenosis (38).

A study by Shrier et al(39) showed that more lesions were located in the MCA (39,40) and PCA (39). In Netherlands a study done using CTA showed a high percent of intracranial involvement of which 67% were located at the posterior circulation(41) and this tallied with the findings in Kerman (Iran) (40), but not so much compared to study by Rotzinger which found that occlusive arterial symptomatic disease was more located at the anterior circulation(42).

A study done by Bash et al found that stenosis was the most common pattern on CTA (43). Whereas studies done in Iran (40) and in India (38) showed that stenosis, as observed by CTA, was more common in the intracranial vessels by 47.6% and 53.3% respectively than the extracranial. Another study was done in South Korea (44) and China (6) showed the commonest vessels to be affected by stenosis were the combined intra- and extracranial 39% and 43% respectively followed by the intracranial vessels 26.4% and 29% respectively.

In Asia studies done using CTA indicated that stenosis occurred most commonly within the middle cerebral and carotid arteries (6,44,45) similar findings to study done in Switzerland by Rotzinger et al (42). Another study done by Amit et al (38) found that the stenosis affected more MCA by 41.67% followed by the ACA 29.17%.

Another study done in Germany by Knauth et al. (46) revealed that MCA was the most common territory affected (9 out of 21 patients) followed by internal carotid and basilar arteries (4 patients in each territory).

A study conducted in Germany by Sporns et al. (47) showed that hemorrhage on CTA was most commonly found at the basal ganglia (47.8%) followed by cerebral lobes, cerebellum and brainstem.

In addition to detecting the cause of stroke, CTA can help with quantifying clot burden (48) and hence predicting a way forward as to what management should be used. CTA has shown to play a big role in selecting the proper patients for thrombolytic treatment following acute stroke. In a study done in Germany by S.Wildermuth et al, 11 out of 20 who had complete recovery following thrombolysis showed a good extent of the leptomeningeal collateral circulation as estimated by CTA prior to initiation of treatment (49).

STATEMENT OF THE PROBLEM

Stroke continues to be one of the most debilitating diseases that either leads to disability or morbidity among different ethnicities in the world. A WHO updated factsheet in January 2017 showed that stroke resulted in 6.24million deaths globally (50). It is imperative to quickly diagnose stroke and plan management at the earliest stages before disability sets in.

With the current advancement of technology (such as MRA and CTA) and methods of intervention, the cause of stroke can be identified early, thus, helping reduce hospitalization period and disability rates. However, between the two, CT is readily available in most set-ups as compared to MRI and hence will be of benefit to make use of it in stroke patients.

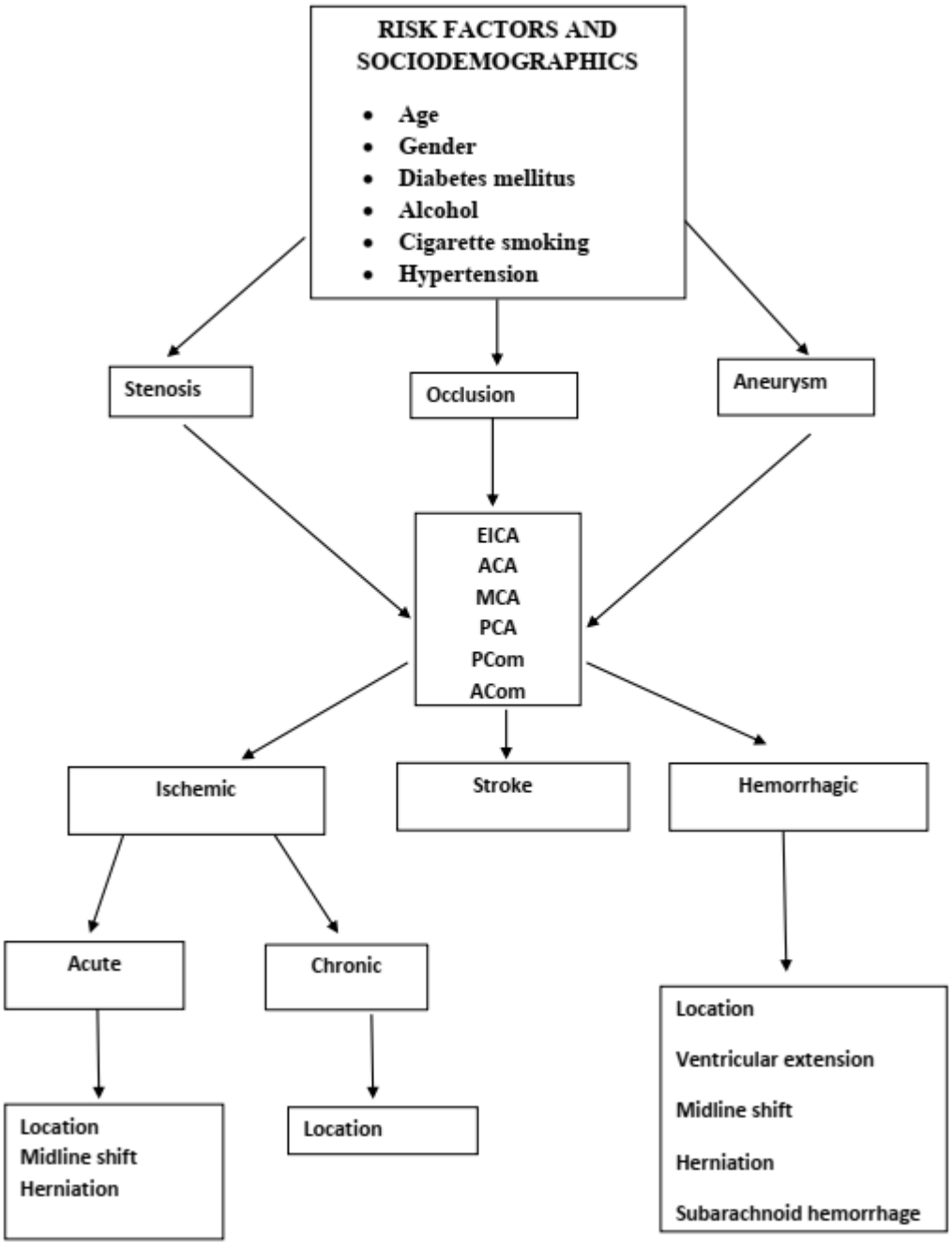
CTA has been one of the most used tools in developed countries to assess patients with stroke especially acute ischemic strokes whose management depends on time. It can be used as a sorting tool for the patients that require immediate intervention procedures such as direct thrombectomy, IV tPA or stenting.

A study done by Shelagh B. Couts, Jayesh Modi et al. demonstrated that CTA has a higher specificity (68%) and somewhat equal sensitivity (67%) as compared to MRI (DWI sequence) 43% and 75% respectively in predicting stroke among patients with TIA (51).

CTA has high sensitivity and specificity in the detection and exclusion of patients with large vessel occlusion in hyperacute stroke (27).

Tanzania as one of the developing countries has a scarcity of sophisticated machines including CT scanner and MRI. However, between the two, CT scanner is readily available in many facilities as compared to MRI. Currently, most of the clinicians are becoming adapted to using CT as a first modality of choice in suspects of stroke, but there are no studies that have been done on the CTA findings in adult stroke patients.

CONCEPTUAL FRAMEWORK



Narrative summary:

The presence of any of the risk factors can lead to microvascular changes resulting in stenosis, complete occlusion or due to the pliability of vessels cause aneurysms. These changes can occur at any site including external-internal carotid artery, anterior cerebral artery, middle cerebral artery, posterior cerebral artery, posterior communicating artery or anterior communicating artery. The end result of these changes is a stroke, which can either be an ischemic or hemorrhagic stroke.

RATIONALE:

Stroke is the commonest cause of morbidity and mortality all around the world. For most stroke patients, early diagnosis and management can help reduce the hospitalization period and mortality rates. CTA is one of the best tools that can help sort out stroke patients in accordance with the cause and planning of management.

Currently, in Tanzania, CTA is not commonly used especially in diagnosing causes of stroke, and there have been no studies conducted to determine the importance of the findings seen on CTA.

This study will help bring light to the clinicians as to how the CTA findings can be of use in selecting which patients will benefit from early thrombolysis and those that will require immediate intervention procedures.

RESEARCH QUESTIONS:

1. What are CT angiographic patterns in patients with stroke?
2. What are the common territories affected in patients with stroke?
3. What is the relationship between socio-demographic factors, risk factors and angiographic findings?

OBJECTIVES:

BROAD OBJECTIVE:

To determine Computed Tomography angiography findings in patients with stroke presenting at the Radiology department, Muhimbili National hospital from September 2018 to February 2019**.**

SPECIFIC OBJECTIVES:

1. To determine the socio-demographic and risk factors of patients with stroke referred for CT angiography from September 2018 to February 2019.
2. To determine the angiographic patterns in patients with stroke referred for CT angiography from September 2018 to February 2019.
3. To determine the common vascular territories affected in a patient with stroke referred for CT angiography from September 2018 to February 2019.
4. To determine the association between socio-demographic factors, risk factors and CT angiographic findings in patients with stroke referred for CT angiography from September 2018 to February 2019**.**

CHAPTER TWO

METHODOLOGY

Study Design:

Hospital-based descriptive Cross-sectional study

Study duration:

This study was conducted from September 2018 to February 2019.

Study Area:

The study was conducted in the Radiology department, Muhimbili National Hospital. It is the top tertiary referral hospital in the country with the bed capacity of at least 1400, well-staffed and with all the medical specialties and most of the super-specialties departments.

With an exception of Fluoroscopy, Radiology and Imaging department at MNH has all the primary imaging modalities including MRI, CT scan, Ultrasound, Plain radiography, and Mammography.

Study population:

All stroke patients referred for CTA at Muhimbili National Hospital Radiology department.

Sampling technique:

Convenience sampling method

Inclusion criteria: -

-All consented patients diagnosed with stroke aged 18-100 years**.**

-All patients with no known history of contrast allergies

Exclusion criteria: -

-Patients under 18 years of age.

-Patients who have contrast allergy

-Patients with renal impairment

Variables:

Independent variables – Age

-Gender

-Diabetes mellitus

-Hypertension

-Alcohol consumption

-Cigarette smoking

Dependent variables -Stenosis

-Occlusion

-Aneurysm

Sample size estimation:

The sample size was calculated using the Fisher's formula

$$n = \frac{z^2 p (100-p)}{E^2}$$

Where:

n =estimated sample size

z = significance level at 5% (1.96)

p = estimated at 0.32% (prevalence obtained from the study by Walker et al (35))

E = margin of error (1.25%)

$$n = \frac{(1.96^2 \times 0.32 (100-0.32))}{(1.25)^2}$$

n= 78

n x (100÷(100- 10%))

Thus estimated sample size for the study will be 86 patients

Research instrument and method:

All eligible participants underwent NCCT followed by CTA using Siemens Somatom definition Flash 128 slices dual scanner (Frankfurt, Germany, MFD October 2015).

The scanning method was by helical acquisition using slice thickness of 0.6mm, slice spacing of 0.4mm, collimation of 128x0.6mm and window level 350/50.

A patient was positioned in a supine position and a coverage area selected was from the base of the skull through the vertex with the arch of the aorta included.

Patients received a non-ionic water-soluble contrast (dose was calculated according to the body weight with a maximum dose of 100mls) which was delivered via an antecubital vein at a rate of 5ml/sec using an injector pump.

Axial images were obtained after contrast injection, and the reformation of the images was done at the workstation. The image acquisition time was approximately 3-4sec. All images were obtained considering ALARA.



20-year-old female presenting with right sided weakness.

Brain CT Angiography showing non-visualization of the left MCA beyond the proximal part (occlusion at the proximal left MCA)

Data collection and analysis:

All consented stroke patients who were referred to the MNH Radiology department for a CTA were enrolled in the study.

The PI evaluated imaging findings and these were proof-read by the Radiologist. When a difference arose in interpretation, a senior Radiologist was consulted and results recorded after consensus was reached.

Well written questionnaires were used to collect details of the patients and imaging findings.

Data entry and analysis was done using SPSS and categorical data analyzed using chi-square.

Ethical consideration:

An introductory letter was given to the respective authority to allow the researcher to conduct the study in the CT unit. The researcher did a self-introduction to the patients, and an explanation of the study was given. Request to participate in the survey was made to patients reaching the inclusion criteria and only consented individuals were taken into account. Interviews were conducted taking into account the privacy of the patient. Names were excluded from the study. The private investigator and the Radiologist interpreted the images. Data was handled with confidentiality and stored in a secured place.

Ethical clearance:

Before research was conducted, this proposal was presented to the Radiology department, MUHAS. Ethical approval was sought from the Research and Publication committee of Muhimbili University of Health and Allied Sciences. Ethical clearance was also obtained from MNH to allow the study to be carried out using the hospital facilities.

Study limitations:

There is no current data regarding CTA findings in stroke patients in East Africa. It was, therefore, difficult to obtain an actual prevalence of the angiographic findings.

Most of the data obtained concerning stroke and angiographic findings concern ischemic stroke, and very little data is available for the hemorrhagic stroke and its findings on CTA.

CHAPTER THREE

RESULTS

In this study, a total of 90 patients with diagnosed stroke were enrolled. Of these, 2 had an unknown contrast reaction during angiography and therefore the exam had to be terminated before completion. 4 patients could not afford the cost of undergoing CT angiography. The remaining 86 patients underwent CT angiography successfully.

Table 1: Basic socio-demographics and risk factors for stroke

		Frequency	Percent
Gender	Male	45	52.3
	Female	41	47.7
Age Group	18-30	9	10.5
	31-43	19	22.1
	44-56	23	26.7
	57-69	21	24.4
	70-82	11	12.8
	83-95	3	3.5
Risk Factor	Hypertension	38	67.9
	Alcohol	19	33.9
	Diabetes Millitus	8	14.3
	Cigarette Smoking	7	12.5

In this study, a total of 86 patients qualified. Out of these, males were more (45) compared to females. Participants ages ranged between 18-95 years with the most affected age group being 44-56. The mean age was 52. Among the four modifiable risk factors hypertension was the commonest seen represented by 67.9% followed by alcohol consumption (33.9%).

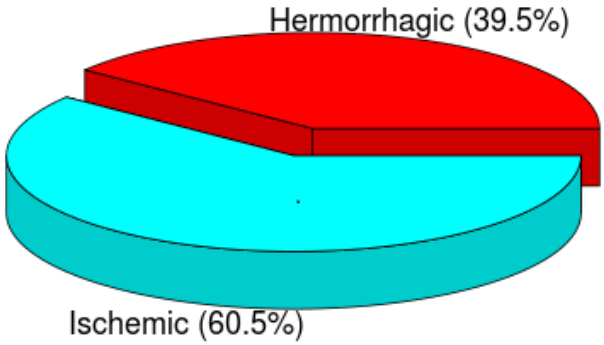


Figure 1: Pie chart of types of strokes

Two main types of stroke were examined with ischemic stroke having a higher prevalence (60.5%) as compared to hemorrhagic stroke (39.5%).

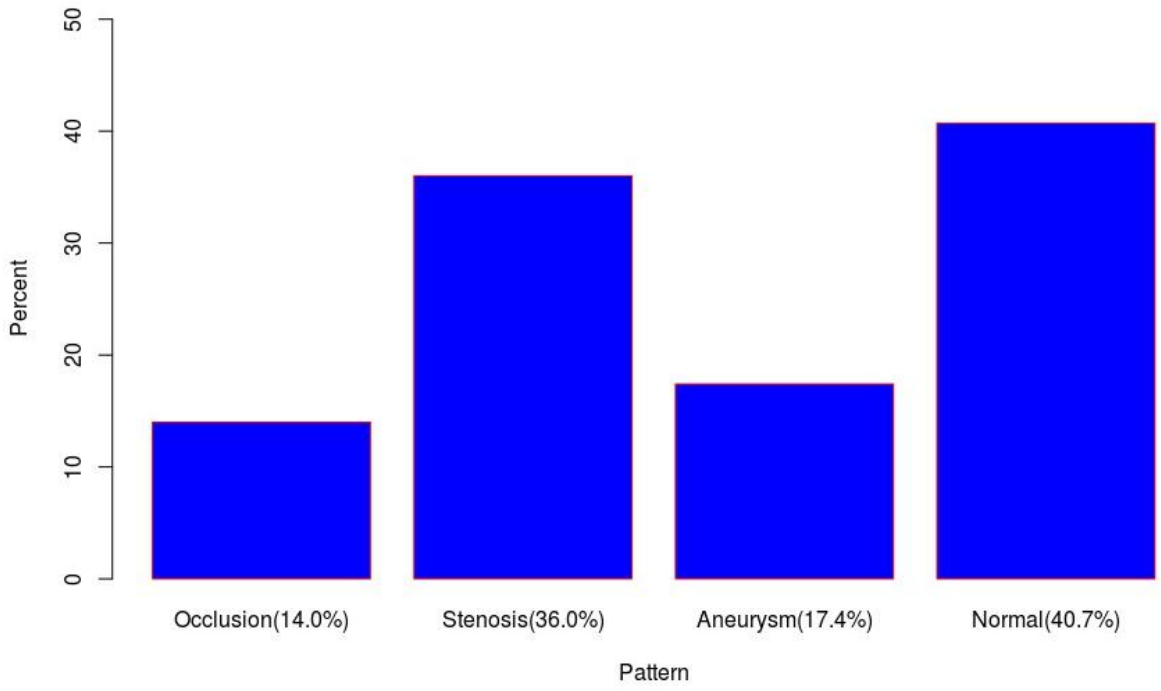


Figure 2: Distribution of Angiographic patterns in stroke patients

The most abnormal angiographic pattern found to be affected in the study was stenosis (36%) followed by aneurysm (17.4%) and the least being occlusion. Some patients had more than one pattern involved found on angiography (13.7%).

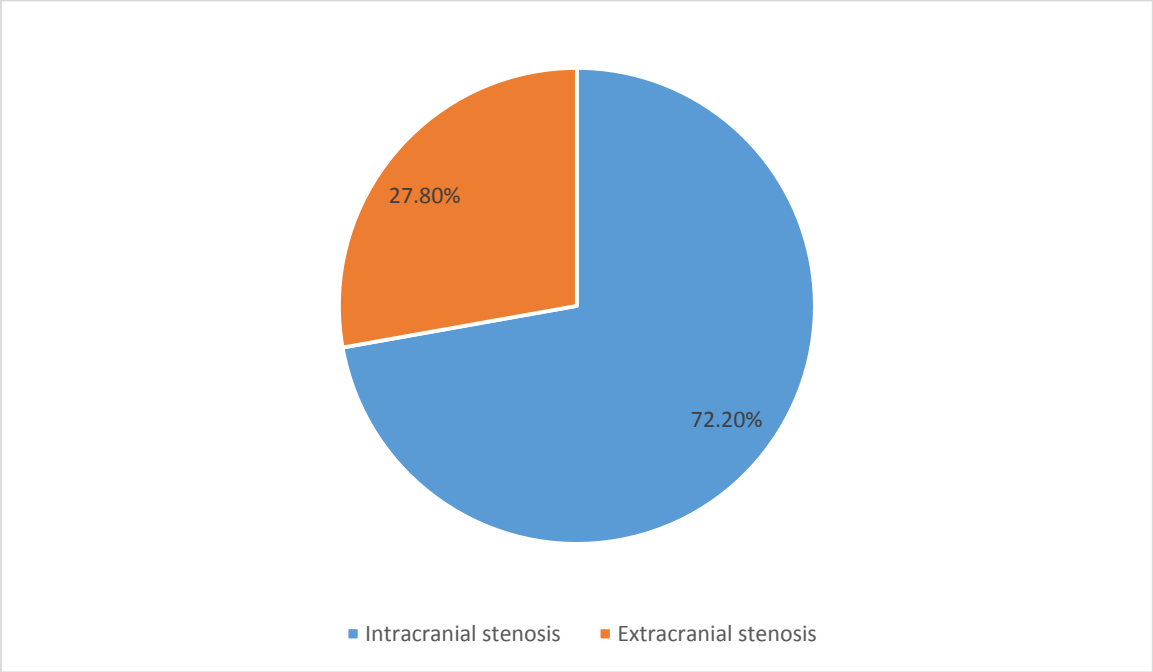


Figure 3: Pie chart showing the distribution of stenosis according to segments

Two distribution categories of stenosis were examined according to the location of the segment, either intracranial or extracranial. Out of all 31 stenotic segments, intracranial stenosis was found to be high with 72.2% as compared to extracranial 27.8%.

Table 2: Frequency distribution of affected Vascular territories in stroke patients

Territory	Frequency (%)
MCA	15(29.4)
ACA	11(21.6)
ICA	9(17.6)
PCA	8(15.7)
EICA	6(11.8)
Vertebral Artery	5(9.8)
PCOM	4(7.8)
ACOM	2(3.9)
BasilarArtery	1(2.0)

Findings indicate that MCA territory is the most common territory affected in stroke (29.4%) followed by ACA, ICA and PCA. The least to be affected was the basilar artery 2%). However, there were some patients who had more than one territory involved simultaneously (17.6%).

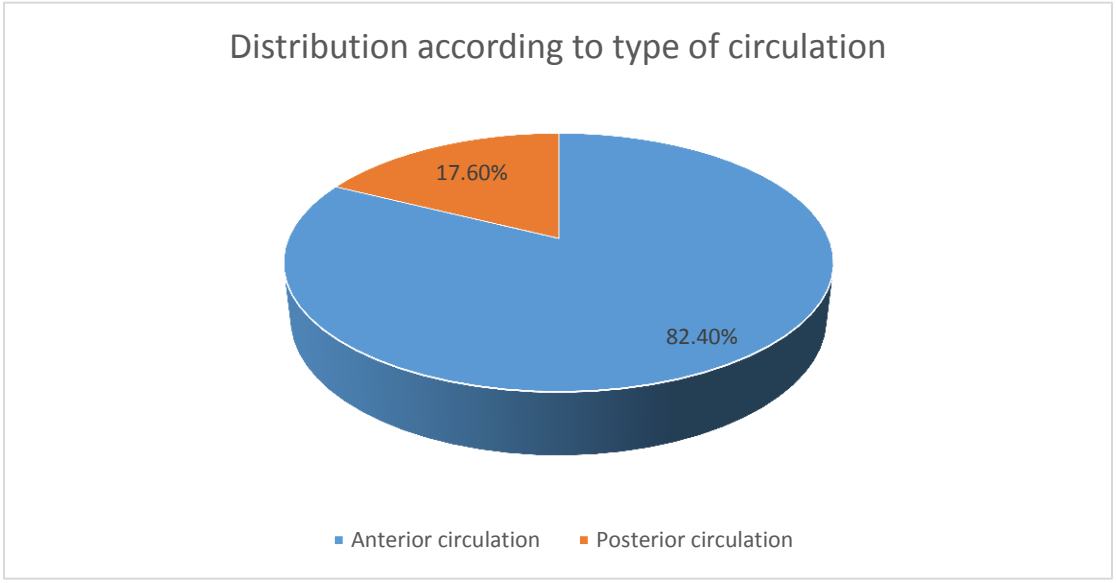


Figure 4: Distribution of the affected vascular territories according to circulation.

The anterior circulation (82.4%) was more affected than the posterior in this study.

Table 3: Association of angiographic patterns, sociodemographic factors and risk factors

		Angiographic Patterns		
		Occlusion	Stenosis	Aneurysm
Risk Factor	Hypertension	7.9% (p=0.149)	50% (p=0.016)	13.2% (p=0.352)
	Alcohol	10.5% (p=1)	31.6% (p=0.646)	21.1% (p=0.733)
	Diabetes Mellitus	25% (p=0.309)	75% (p=0.023)	0% (p=0.341)
	Cigarette Smoking	14.3% (p=1)	28.6% (p=1)	0% (p=0.346)
Socio Demographic	Age: 18-30	11.1%	33.3%	22.2%
	31-43	10.5%	10.5%	21.1%
	44-56	8.7%	39.1%	21.7%
	57-69	28.6%	47.6%	14.3%
	70-82	0.0%	54.5%	9.1%
	83-95	33.3% (p=0.204)	33.3% (p=0.138)	0.0% (p=0.86)
	Gender : Male	20.0%	40.0%	13.3%
	Female	7.3% (p=0.09)	31.7% (p=0.424)	22.0% (p=0.293)

*p-value obtained using a chi-square test

Among all the risk factors, diabetes mellitus was found to have a significant association with stenosis (p-value 0.023) and hypertension with stenosis (p-value 0.015). There was no strong association between cigarette smoking or alcohol intake and any of the angiographic patterns. There was also no association between sociodemographic factors and any of the angiographic patterns.

CHAPTER FOUR

DISCUSSION

CTA having high sensitivity and specificity in the detection and exclusion of patients with large vessel occlusion in hyperacute stroke (27), is one of the most used tools in developed countries to assess patients with stroke especially acute ischemic stroke whose management depends with time. Understanding angiographic findings amongst patients is of great importance. This study aims to determine CT angiographic findings in adult patients with stroke at Muhimbili National Hospital.

A total of 86 patients underwent CT angiography study (45 males and 41 females). The age range was between 18-95. Approximately 60% of angiographic findings were abnormal, of these, the most abnormal pattern was stenosis represented by 36%. This finding is similar to studies done by Bash et al (43) and Lau et al (52). However, it was different from what Rotzinger et al found where the most common pattern was occlusion (42). The high prevalence of stenosis could be attributed to the fact that many of the patients seen had hypertension as their risk factors for stroke which could, in turn, cause hypertrophy and remodeling of vascular wall resulting into stenosis (53).

Among the stenotic segments studied, there was a higher prevalence within the intracranial segments (72.2%) compared to extracranial segments (27.8%). This was in line with studies done in Kerman (Iran) and India where the intracranial stenosis was represented by 47.6% and 53.3% respectively (38,40) but different from what Nagao et al found (54). The high intracranial segmental percentages seen could be because most of the population involved in my study included blacks which as the study by Caplan et al in Chicago suggested that intracranial involvement was high in blacks than in whites (55).

Among the vascular territories analyzed in this study, MCA was found to be the most affected territory followed by ACA and ICA (29.4%, 21.6% and 17.6% respectively). This finding is similar to studies done in India, Iran, California, Switzerland and Rochester which demonstrated that MCA was the most affected vascular territory (38–40,42,56).

Overall most lesions were found to be in the anterior circulation same findings as to the study by Rotzinger et al(42) and Lau et al (52) but different from the study done in Kerman (40) which found high prevalence in the posterior circulation.

Also in this study, of all the angiographic patterns examined, it was found that hypertension and diabetes mellitus were the only two risk factors with association to stenosis. This could be due to the reason that both hypertension and diabetes are responsible for causing atherosclerotic diseases which are the main cause of stenosis or occlusion. A study was done by Shrivastava et al and Tsivgoulis et al also showed that these two risk factors were strongly associated with stenosis (38,57).

CONCLUSION

Overall, stenosis was the commonest abnormal angiographic pattern seen in patients with stroke with a higher prevalence in intracranial segments (72.2%). Among the vascular territories analyzed, MCA had the highest prevalence of all. Anterior circulation showed high preponderance as compared to posterior circulation. Hypertension and diabetes mellitus were the two risk factors that showed a significant association with the stenosis (p-value <0.05).

RECOMMENDATIONS

CTA is an upcoming method especially in most of the developing set-ups and has been shown to be advantageous when it comes to pinpointing the vascular location of stenosis, occlusion or aneurysm. It is therefore recommended that all patients with stroke symptoms undergo CTA.

It is also recommended that, all patients with hypertension and diabetes with stroke symptoms undergo CTA as it has been demonstrated in this study that there is an association between hypertension and diabetes with stenosis so early management can be initiated in these patients.

This study can be used as a baseline in conducting further review and follow up of patients with stroke and how/if CTA can be of value in predicting the outcome of these patients.

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Appendix I: Checklist

Personal details: Age……

Gender……

History of:

1. Diabetes mellitus Yes……. No……
2. Hypertension Yes……. No….
3. Cigarette smoking Yes…… No……
4. Alcohol intake Yes…… No……

Non-contrast CT findings:

1. Ischemic Yes No

   If yes, is it Acute……. Or chronic……

   If Acute: Location……

   Midline shift……

   Herniation ……..

   If Chronic: Location……

2. Hemorrhage Yes No

   If yes: Location …….

   Ventricular extension…….

   Midline shift……..

   Herniation ……..

   Subarachnoid hemorrhage……..

3. Other findings…….

CTA findings:

1. Patterns:

   1.1. Occlusion Yes No

   If yes, which vessel: EICA…….. ACA……. MCA……. PCA……

   ACom……. PCom……. ICA…….. Vertebral artery…….. Basilar artery……

1.2. Stenosis Yes No

If stenosis present then where: EICA…. ACA……. MCA…… PCA…

ACom……. PCom……. ICA…… Vertebral artery……

Basilar artery…….

1.3. Aneurysm Yes No

If yes: Type ……

Vessel: EICA…… ACA…… MCA…… PCA…….. ACom….

PCom…….



Appendix II: Consent Form: English Version
MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS, MUHAS

Identification No……

Consent to participate in a study:

My name is Dr. Azza A. Naif form MUHAS. I am conducting a study on Cerebral and Neck CT Angiography findings on stroke patients presenting at the Radiology department, Muhimbili National Hospital.

Study Purpose:

I am conducting this study as partial fulfillment for MMed Radiology at MUHAS. But the research is also performed to determine the findings on Cerebral and Neck CT angiography in stroke patients to facilitate early and correct management of stroke and thus reducing morbidity and mortality cases.

Involvement in the study:

Patients or caregivers of the patients who agree to be involved in the research will be required to sign consent forms before CT angiography is conducted.

Confidentiality:

The information obtained from the study will be confidential and will only be used for this study, no names will be used instead of only identification numbers.

Participation and rights to withdraw:

Participation in the study is voluntary. Refusal to participate will not affect your management. Withdrawal, any time of the study, is allowed.

Benefits:

The information obtained from this study will help us to know the sources of stroke, enable early management and therefore improve one's quality of life.

Contact person:

If you have any questions regarding this study, you can contact the following person:

Dr. Azza A Naif (Principal investigator),
Muhimbili University of Health and Allied Sciences,
P.O.Box 65001, Dar es Salaam.
Phone no: 0713264350
OR:
Dr. Hilda Makungu (Study Supervisor),
Department of Radiology and Imaging, MNH
P.O.Box 65000,
Dar es Salaam, Tanzania.
Phone no: 0713296463

Participant/ Relative agrees……

I …… have read the contents in this form. My questions have been answered. I am willing/ I allow my relative to participate in this study.

Signature of the participant/relative……. Date…….

Signature of the researcher……. Date…….

Appendix II: Consent form (Swahili version)
CHUO KIKUU CHA SAYANSI NA AFYA SHIRIKISHI MUHIMBILI

KURUGENZI YA TAFITI NA UCHAPISHAJI

Namba ya utambulisho….

Ridhaa ya kushiriki kwenye utafiti:

Jina langu ni Dr. Azza A Naif natokea chuo kikuu cha afya na sayansi shirikishi cha Muhimbili. Ninafanya utafiti kuangalia matokeo ya tomografia ya mishipa ya kichwa na shingo katika wagonjwa wa kiharusi

Lengo la utafiti:

Dhumuni la utafiti huu ni kwanza kutimiza matakwa ya shahada ya uzamili. Lakini pia, ni kutaka kujus jinsi gani ya kusaidia kupunguza vifo na maradhi katika wagonjwa wa kiharusi ili kuboresha maisha ya mgonjwa.

Jinsi ya kushiriki:

Ukikubali kushiriki katika utafiti huu utatakiwa kusailiwa kabla ya kupelekwa kwenye kipimo cha tomografia ya mishipa.

Usiri:

Taarifa zote zitakazopatikana kupitia utafiti huu zitakuwa ni za siri na kutumika kwa ajili ya utafiti huu tu. Jina halitatumika badili yake namba ya utambulisho itatumika.

Uhuru wa kushiriki na haki ya kujitoa:

Kushiriki kwenye utafiti huu ni kwa hiari. Uamuzi wa kutokushiriki hautoathiri matibabu yako. Unaruhusiwa kujitoa katika muda wowote ule ndani ya utafiti.

Manufaa:

Kushiriki katika utafiti huu utatusaidia kujua chanzo cha ugonjwa wa kiharusi, kusababisha matibabu ya haraka na mapema, na matokeo yake kuimarisha maisha ya mgonjwa.

Mtu wa kuwasiliana nae:

Endapo utakuwa na maswali yoyote kuhusiana na utafiti huu, wasiliana na wafuatao:

Dr. Azza A Naif (Mtafiti mkuu)

Chuo kikuu cha Afya na sayansi shirikishi Muhimbili,

S.L.P 65001,

Dar es salaam, Tanzania.

Nambari ya simu: 0713264350

AU:

Dr. Hilda Makungu (Msimamizi wa utafiti)

Idara ya Radiolojia, MNH

Dar es Salaam, Tanzania.

Nambari ya simu: 0713296463.

Mshiriki/ Ndugu ya mshiriki amekubali……

Mimi…….nimesoma maelezo ya fomu hii, nimeyaelewa na nimekubali/ nimeruhusu ndugu yangu kushiriki kwenye utafiti huu.

Sahihi ya mshiriki/ndugu ya mshiriki…… Tarehe ya kusaini……..

Sahihi ya mtafiti…… Tarehe ya kusaini……

Appendix III: Ethical Clearance

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

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Ref. No. DA.287/298/01A/ 13th September, 2018

Dr. Azza A. Naif
MMed. Radiology
MUHAS.

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED: "CEREBRAL AND NECK ANGIOGRAPHY FINDINGS IN STROKE PATIENTS PRESENTING AT RADIOLOGY DEPARTMENT, MUHIMBILI NATIONAL HOSPITAL"

Reference is made to the above heading.

I am pleased to inform you that, the Chairman has, on behalf of the Senate, approved ethical clearance for the above-mentioned study. Hence you may proceed with the planned study.

The ethical clearance is valid for one year only, from 12th September, 2018 to 11th September, 2019. In case you do not complete data analysis and dissertation report writing by 11th September, 2019, you will have to apply for renewal of ethical clearance prior to the expiry date.

Dr. Emmanuel Balandya
ACTING: DIRECTOR OF POSTGRADUATE STUDIES

cc: Director of Research and Publications
cc: Dean, School of Medicine, MUHAS