CLINICAL CHARACTERISTICS, COMPUTED TOMOGRAPHY ANGIOGRAPHY PATTERNS AND ASSOCIATED COMPLICATIONS OF INTRACRANIAL ANEURYSMS AMONG PATIENTS ATTENDING MUHIMBILI ORTHOPEDIC INSTITUTE

Aisha Mahfoudh, MD

MMed (Radiology) Dissertation

Muhimbili University of Health and Allied Sciences

October, 2024

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
DEPARTMENT OF RADIOLOGY AND IMAGING

CLINICAL CHARACTERISTICS, COMPUTED TOMOGRAPHY ANGIOGRAPHY PATTERNS AND ASSOCIATED COMPLICATIONS OF INTRACRANIAL ANEURYSMS AMONG PATIENTS ATTENDING MUHIMBILI ORTHOPEDIC INSTITUTE

BY
AISHA MAHFOUDH, MD

A dissertation submitted in (Partial) fulfilment of the requirements of the degree of Masters in Medicine (Radiology) at
Muhimbili University of Health and Allied sciences.
October, 2024

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled "**Clinical characteristics, computed tomography angiography patterns and associated complications of intracranial aneurysms among patients attending Muhimbili Orthopedic Institute**" In (Partial Fulfillment of the requirements for the degree of Master of Medicine (Radiology) of Muhimbili University of Health and Allied Sciences.

_____

Dr. Mechris Mango MD, MMed (Radiology)

Supervisor

_____

Date

_____

Dr. Ugumba Kwikima MD, MMed, MSc. Neuroradiology

(Supervisor)

_____

Date

_____

Dr. Sylvia Bedas Nsato MD, MMed Radiology

(Co-Supervisor)

_____

Date

DECLARATION AND COPYRIGHT

I, **Aisha Mahfoudh**, declare that this dissertation is my own **original** work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature ……. Date ……

This dissertation is a Copyright material protected under the Berne Convention. The copyright Act 1999 and other international and national enactments, on that behalf, an intellectual property. It may not be reproduced by any means, if full or part, except for short extracts in fair dealing; for research or private study, critical scholarly review or discourse with an acknowledgement, without written permission from the Directorate of Postgraduate Studies, on behalf of both the author and Muhimbili University of Health and Allied Sciences.

- ACKNOWLEDGEMENT

First, I would like to thank Allah the Almighty for giving me patience, strength, hope and ability to complete this work.

I would love to thank my supervisors Dr. Mechris Mango, Dr. Ugumba Kwikima and Dr. Sylvia Nsato for their unconditional support, guidance and encouragement and time.

Many thanks to the Radiology department at MOI and the Radiology department at MUHAS.

I would also like to thank the MUHAS management through the Director of Postgraduate Studies who granted permission for this study.

Immense gratitude to my colleagues the radiology residents at MUHAS class of 2021-2024

DEDICATION

This work is dedicated to:

My parents, Amina Suleiman Saleh for her immense support and prayers. My late father Mahfoudh Haji, May his soul rest in paradise. My husband and daughters for their patience and love.

ABSTRACT

Background: Intracranial aneurysms, characterized by localized dilatation of the arterial wall in the brain, affect approximately 3% of the population and are a significant cause of non-traumatic subarachnoid hemorrhage.(1,2) This study, conducted at the Muhimbili Orthopedic Institute (MOI) in Tanzania, explored cerebral aneurysm patterns using computed tomography angiography (CTA), filling a critical gap in localized research. Findings revealed that aneurysms were more common in females (73.3%) and in those aged 50 and above (70%). Hypertension emerged as a key risk factor, present in 69.2% of cases. Most aneurysms were solitary (89.1%) and saccular (76.1%), with medium-sized aneurysms (5-10 mm) being the most prevalent. The anterior communicating artery (AComA) was the primary site, also associated with a heightened risk of rupture, especially as 47.9% of cases involved subarachnoid hemorrhage.

This research highlights a need for targeted prevention strategies and tailored treatment protocols for patients at MOI, improving healthcare outcomes in Tanzania. As the first comprehensive study of its kind in this region, it sets a precedent for future research that can enhance patient management, reduce complications, and establish more precise treatment approaches for cerebral aneurysms in similar healthcare contexts.

Objective: The aim of the study was to determine the clinical characteristics, radiological patterns, and associated complications of intracranial aneurysms among patients attending MOI with a diagnosis of intracranial aneurysm by CT angiography between January 2023 and April 2024

Methodology: The study was a hospital based retrospective cross-sectional study conducted at Muhimbili Orthopedic Institute. It was done by determining clinical presentation, the radiological patterns of intracranial aneurysms by using CTA and determining the factors associated with having an aneurysm and ruptured an.

The sample was 71 patients 18 years and above who were suspected of having an ICA referred for CTA. A checklist was used to collect the demographics, clinical presentation of the study population.

The CTA images were read, and findings were saved for analysis. In this study STATA version 27 was used for analysis.

Results: The study recruited a total of 71 patients among these patients, 63% were females. The age range between 20 and 80 years with a mean of 52 years. Most of the patients were between 50 to 59 years. Most (73.2%) had hypertension. Forty-six (64.78%) had intracranial aneurysms and majority (73.3%) were female (p = 0.047). Solitary (89.1%), and saccular aneurysms (76.1%) were more common. Anterior communicating artery (ACOM) was the most common site for aneurysms (37%). A significant correlation was found between female gender and having an aneurysm (p-value = 0.047). Also, Acom was the most common location with ruptured aneurysm compared to cavernous segment of ICA which showed non-rupturing despite being large.

Conclusion: The study showed a significant predominance of females in the population with intracranial aneurysms (ICAs), emphasizing the necessity to investigate gender-specific risk factors. Furthermore, the specific risk associated with the anterior communicating artery (ACOM) aneurysms, which are prone to rupture and cause subarachnoid hemorrhage despite their small size, underscores the importance of site-specific considerations in the risk assessment and management of ICAs. These findings are crucial for refining clinical practices and guiding future research on the epidemiology and treatment of intracranial aneurysms.

Recommendation: It is recommended to develop targeted screening programs for high-risk groups, particularly older adults and females, to detect intracranial aneurysms (ICAs) early. Given the higher rupture risk of small anterior communicating artery aneurysms, screening and monitoring should be prioritized in these cases.

TABLE OF CONTENTS

CERTIFICATION i
ACKNOWLEDGEMENT iii
DEDICATION iv
ABSTRACT v
LIST OF TABLES x
LIST OF FIGURES xi
LIST OF FIGURES LIST OF ABBREVIATIONS xii
DEFINITION OF TERMS xiii
CHAPTER ONE 1
1.0INTRODUCTION 1
1.1 BACKGROUND 1
1.2 PROBLEM STATEMENT 4
1.3 RATIONALE 4
1.4 CONCEPTUAL FRAMEWORK 6
1.5 JUSTIFICATION 7
1.6 RESEARCH QUESTIONS 7
1.7 OBJECTIVES 7
1.7.1 Broad Objective 7
1.7.2 Specific objectives 7
CHAPTER TWO 9
2.0 LITERATURE REVIEW 9
2.1 Patients' sociodemographic characteristics 9
2.2 Risk factors of the study population. 9
2.3 Clinical presentations of the study population. 10
2.4 Radiological patterns of cerebral aneurysm 10
2.5 Complications of cerebral aneurysms 12
CHAPTER THREE 14
3.0 METHODOLOGY 14
3.1 Study design 14
3.2 Study period 14
3.3 Study area 14

3.4 Study population 14
3.4.1 Inclusion criteria 14
3.4.2 Exclusion criteria 14
3.5 Sampling and sample size estimation 15
3.5.1 Sampling technique 15
3.5.2 Sample size estimation 15
3.6 Sampling Strategy 16
3.7 Data collection tools and techniques 16
3.7.1 Data collection tool 16
3.7.2 Imaging and evaluation 18
3.8 Data collection process 18
3.9 Pre-testing of data collection tools. 18
3.10 Variables 18
3.10.1 Independent variables 18
3.10.2 Dependent variables 19
3.11 Data analysis 19
3.12 Reliability and validity issues 22
3.13 Ethical considerations 22
3.14 Dissemination plan 22
CHAPTER FOUR 23
4.0 RESULTS 23
4.1 Patients' characteristics suspected of ICA referred for brain CT angiography at MOI (N = 71) 23
4.2 Clinical presentations among patients suspected of ICA referred for brain CT angiography at MOI (N = 71) 24
4.3 CTA patterns of cerebral aneurysms among patients suspected of ICA referred for brain CT angiography at MOI (n = 46) 25
4.4 Locations of fusiform aneurysms. (N=12) 26
4.5 Patients' characteristics with its association on the presence of intracranial aneurysms (N= 71) 27
4.6 Factors associated with rupture of aneurysms based on the patients' characteristics. 29

4.7 Factors associated with the intracranial aneurysm status i.e. ruptured or unruptured based on CT angiography patterns (n = 46) 31
CHAPTER FIVE 34
5.0 DISCUSSION: 34
CHAPTER SIX 38
6.0 CONCLUSION AND RECOMMENDATION 38
6.1 Conclusion 38
6.2 Recommendations 38
6.3 Limitation of the study 39
7.0 REFERENCES 40
8.0 APPENDIXES 45
APPENDIX I: DATA COLLECTION FORM- RADIOLOGY DEPARTMENT 45
APPENDIX II. CONSENT FORM (ENGLISH VERSION) 48
APPENDIX III: CONSENT FORM (SWAHILI VERSION) 50
APPENDIX IV: ETHICAL LETTERS 52

LIST OF TABLES

Table 1: Analysis of variables.....21
Table 2: Patients' characteristics suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024(n = 71).....23
Table 3: The CTA patterns of cerebral aneurysms among patients suspected of ICA referred for brain CT angiography at MOI (n = 46).....25
Table 4: Association between the presence or absence of intracranial aneurysm on patients' characteristics. (n = 71).....28
Table 5: Association of the intracranial ruptured or unruptured with patient's characteristics.....30

LIST OF FIGURES

Figure 1: Conceptual Framework; Source: Principal investigator 2023.....6
Figure 2: Clinical presentations among patients suspected of ICA at MOI (N=71)...24
Figure 3: Locations of the fusiform aneurysms. (N=12) 26
Figure 4: Showing the complications of intracranial aneurysms in CTAs (N= 46) 27
Figure 5: CT angiography of a female patient 57 years old hypertensive presented with headache: (Axial plane) There is a well-defined lobulated mass with contrast enhancement similar to that of blood vessels at the right cavernous sinus. 33
Figure 6: 3D VR CT angiography of a 46 years old female known with hypertension presented with headache: A saccular aneurysm at the left M1 bifurcation ..33

LIST OF FIGURES LIST OF ABBREVIATIONS

CA	Cerebral Aneurysm
CTA	Computer Tomography Angiography
DSA	Digital Subtraction Angiography
ICA	Intracranial aneurysm
MOI	Muhimbili Orthopaedic Institute
MRA	Magnetic Resonance Angiography
SAH	Subarachnoid Haemorrhage
UIAs	Unruptured Intracranial Aneurysms

DEFINITION OF TERMS

Cerebral aneurysm: A **cerebral or intracranial aneurysm** is an abnormal focal dilation of an artery in the brain that results from a weakening of the inner muscular layer (the intima) of a blood vessel wall.

Radiological patterns: The characteristic appearances or arrangements of structures or lesions on medical imaging studies such as X-rays, CT scans, MRI scans and ultrasound

Subarachnoid haemorrhage: A subarachnoid haemorrhage is bleeding in the subarachnoid space of the brain.

Associated complications: Refers to additional medical issues or problems that arise as a result of an existing condition or disease. These complications can be caused by the primary condition itself, its treatment, or other factors related to the patient's health.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

An aneurysm is a vascular disorder which develops from a weak point in the arterial wall resulting in a localized dilation.(1) It is characterized by localized structural deterioration of the arterial wall, disruption of the media and loss of the internal elastic lamina.(1,2) When this occurs in arteries supplying the brain it is referred to as an intracranial or cerebral aneurysm.(2)

There are different theories which have incorporated combined explanation for formation of intracranial aneurysms which include hemodynamic stress, endothelial dysfunction, and inflammation and in some cases due to presence of microorganisms. (35,36)

Cerebral aneurysms (CA) occur in 3 – 5% of the general population and account for about 80 – 85% of subarachnoid hemorrhages arising from non-traumatic causes. (2)

Over the years, several risk factors for the development of cerebral aneurysm have been identified. These include but are not limited to, old age, hypertension, smoking, being female, and having a family history of developing aneurysms. (3,4)

Women who have reached menopause are said to be at a higher risk of CA than those not at menopause.(4,5) This phenomenon can be explained by decreased estrogen, which enhances inflammatory reactions.(4,5) And therefore, it is suggested that using hormone replacement therapy (HRT) is protective against SAH.(5)

Hypertension associated with hemodynamic stress is normally accompanied with aneurysms at sites like the posterior cerebral artery. (3,4,6)

Smoking has been shown to induce an inflammatory response which consequently leads to degradation of the extracellular matrix and affects subsequent aneurysm formation. (3)

Expert recommendation suggests regular screening of CAs among patients with first degree relatives as this group is 1.7% more likely to form aneurysms. (7)

An intracranial aneurysm may result in headaches from stimulation of pain fibers adjacent to the affected vessel. (8)

The type of the headache/pain and associated complication depends on the location of the aneurysm. Nerve compression is the mechanism for headaches. (8) Like compression of the third cranial nerve causes periorbital pain with ptosis (drooping of the upper eyelid), (8,9) while compression of the fifth cranial nerve causes trigeminal neuralgia (characterized by electric shock-like facial pain). (8,10)

The most dreaded complication is rupture of the aneurysm resulting in sub-arachnoid hemorrhage (SAH). (6) Aneurysmal rupture is associated with an approximate mortality rate of 50% and 30-50% rate of neurologic morbidity among those who survive. (6)

Several radiographic imaging modalities have been used to visualize the size and morphologic features of intracranial aneurysms. These modalities include computer tomography angiography (CTA), magnetic resonance angiography (MRA), and angiography by direct intra-arterial catheterization (catheter angiography). (11)

CTA

The cerebral vasculature in relation to the brain and the bones at the base of the skull can be seen by rotating thinly sliced, contrast-enhanced 3D images generated by the software used in CTA. Additionally, CTA is noninvasive, cost-effective and can be done immediately following routine unenhanced CT brain scans in patients with suspected aneurysmal SAH if you compare it with other imaging modalities. When selecting a course of therapy, it is crucial to understand the geometric relationship between the aneurysm and the parent vessel and how the aneurysm neck incorporates arterial branches. This is a significant benefit of CT angiography over traditional DS angiography, and it is crucial in the surgical design of the ideal surgical approach. As a result, surgeries can be better planned. (13)

MRA

This technique uses serial axial MR images to form a 3D representation of vascular anatomy. It does not need intravenous contrast media. 3Tesla MRA is more sensitive than 1.5 Tesla MRA in detecting intracranial aneurysms (29)

DSA

It is the standard method for locating cerebral aneurysms. The entire cerebral vasculature is dynamically studied, and it provides the best spatial resolution. It accurately describes aneurysm characteristics such as shape, contour, regularity, sac size, and aneurysm neck measurements. However, DSA is less frequently accessible, invasive, expensive, and radiation intensive. (30) The latter modality is considered the gold standard.

With the help of CTA imaging, this study will add to our understanding of the cerebral aneurysm patterns at MOI.

Understanding the patterns and side effects of cerebral aneurysms will lay the groundwork for developing preventative strategies or protocols adapted to the patient's demands. The study's conclusions will also be applied to patient management, which will enhance patient outcomes and satisfaction.

1.2 PROBLEM STATEMENT

There have been several studies, in various settings, on the patterns of cerebral aneurysms detected using computer tomography (CT) and Magnetic Resonance imaging (MRI) technology. (11–13) There has been, however, less data on aneurysmal patterns detected by CT or MRI in Tanzania. Furthermore, several studies to assess complications arising from intracranial aneurysms have been conducted elsewhere. (11,14), less is known on complications of cerebral aneurysms in our setting. This study conducted at the Muhimbili Orthopedic Institute (MOI) in Tanzania has yielded valuable insights into the patterns of cerebral aneurysms using computed tomography angiography (CTA) imaging. This research is particularly significant in the MOI setting because MOI treats a high volume of patients with cerebral aneurysms, yet prior to this study, there was limited understanding of the specific patterns and complications of these aneurysms within this patient population. By examining these patterns through CTA imaging, the study provides a much-needed localized perspective on cerebral aneurysms in Tanzania.

1.3 RATIONALE

Understanding the detailed imaging patterns of cerebral aneurysms is crucial for developing preventive measures. This study helps to identify high-risk features and potential complications early, allowing for the formulation of targeted prevention strategies tailored to the specific needs and conditions of patients at MOI. The findings from this study will contribute to refining and improving treatment protocols. By understanding the nuances of aneurysm patterns in this setting, clinicians can adopt more precise and effective treatment approaches, which are critical for improving patient outcomes and satisfaction.

Effective management of cerebral aneurysms relies on accurate diagnosis and understanding of the condition's progression. The insights gained from this study will aid in better patient management, ensuring that interventions are timely and appropriately matched to the patient's condition, thereby reducing the risk of adverse outcomes.

Cerebral aneurysms are associated with high rates of mortality and morbidity, primarily

due to complications such as ruptures. This study's exploration of aneurysm patterns and complications is a vital step toward mitigating these risks. By identifying specific factors that contribute to adverse outcomes, healthcare providers can take proactive steps to prevent complications, saving lives and improving the quality of life for patients.

Despite the prevalence of cerebral aneurysms treated at MOI, this is the first study to systematically explore their patterns and complications using CTA imaging in this setting. As such, it paves the way for future research and establishes a foundation for continued advancements in the understanding and treatment of cerebral aneurysms in Tanzania and similar contexts.

In conclusion, this study at MOI not only advances the understanding of cerebral aneurysms through detailed CTA imaging but also provides a critical framework for improving patient care through enhanced preventive measures, treatment protocols, and overall patient management. By addressing a significant gap in localized research, the study contributes to better healthcare outcomes and sets a precedent for future investigations in the region.

1.4 CONCEPTUAL FRAMEWORK

The conceptual framework below illustrates some risk factors for the development of intracranial aneurysms. These include, but are not limited to, age, sex, hypertension, smoking, diabetes mellitus and alcohol intake. Patients with intracranial aneurysms, if left untreated or managed, develop radiological complications such as subarachnoid hemorrhage, hydrocephalus, intraventricular hemorrhage, stroke or intraparenchymal hemorrhage. Patients may, however, present to the hospital with these complications, from which they were investigated and diagnosed with cerebral aneurysm.

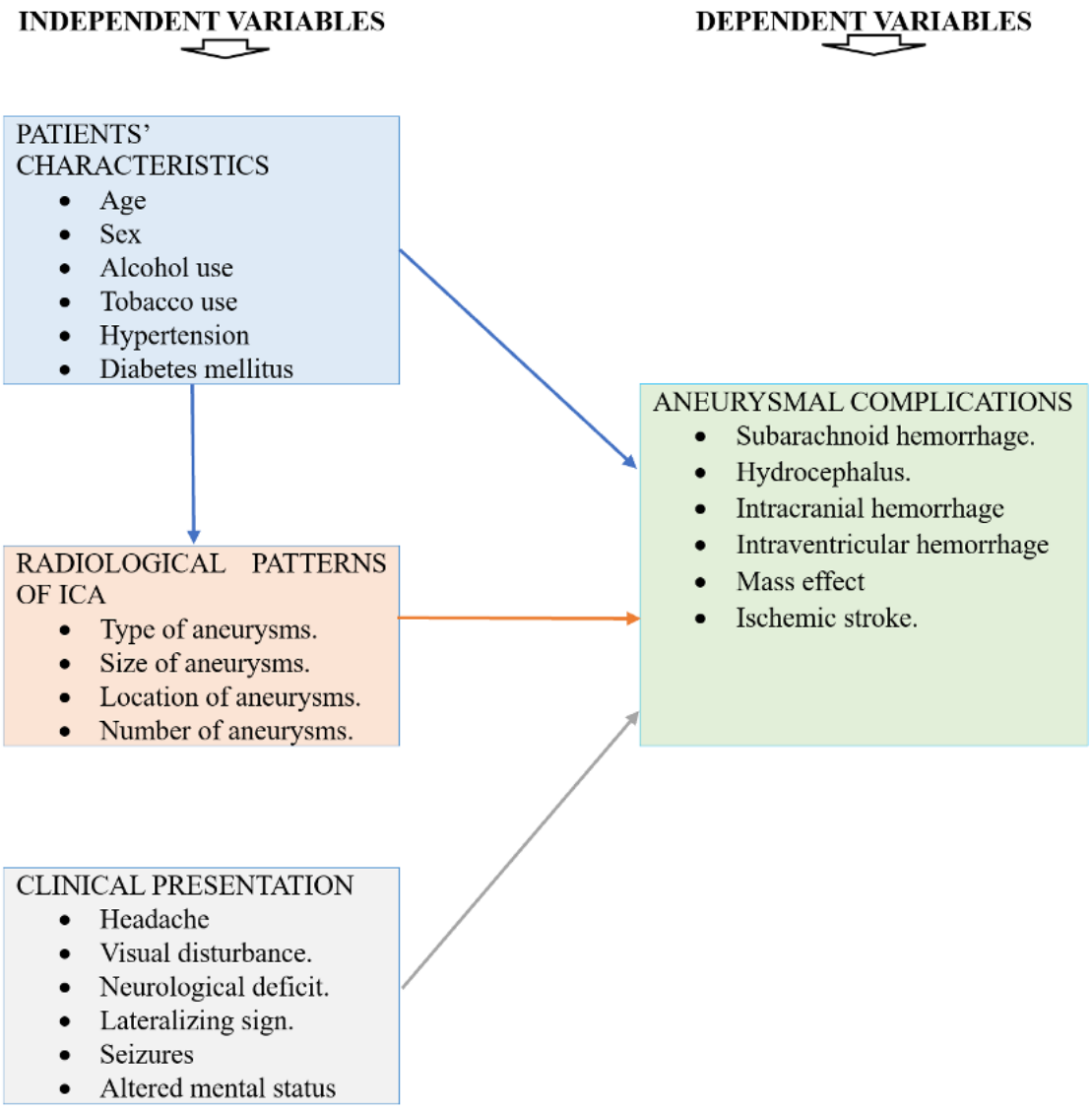


Figure 1: Conceptual Framework; Source: Principal investigator 2023.

1.5 JUSTIFICATION

With such high mortality and morbidity rates among those experiencing aneurysmal complications, it is imperative to understand how to prevent these complications. Muhimbili Orthopedic Institute (MOI) receives a large number of patients with cerebral aneurysm. Despite this, there has not been a study to understand the patterns and associated complications of these aneurysms. This study identified the radiological patterns of cerebral aneurysms and complications of the aneurysms among patients who underwent CTA at MOI. For the This would allow preventive measures to be structured and tailored according to patterns identified in each patient.

1.6 RESEARCH QUESTIONS

What are the clinical characteristics, computed tomography angiography patterns, and associated complications of intracranial aneurysms among patients attending Muhimbili Orthopedic and Neurosurgical Institute between January 2023 and April 2024?

1.7 OBJECTIVES

1.7.1 Broad Objective

To determine the patients' characteristics, clinical presentation, computed tomography angiography patterns and associated complications of intracranial aneurysms among patients attending Muhimbili Orthopedic and Neurosurgical Institute between January 2023 and April 2024.

1.7.2 Specific objectives

1. To determine patients' characteristics among patients suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024.
2. To determine clinical presentations among patients suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024.
3. To determine CTA patterns of cerebral aneurysms among patients suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024.

4. To determine complications of aneurysms among patients suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024.
5. To determine factors associated with intracranial aneurysms and rupture based on patients' characteristics data and CT angiography findings among patients with ICA at MOI between January 2023 and April 2024

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Patients' sociodemographic characteristics

When examining the age distribution in the occurrence of intracranial aneurysms, the older age group tends to be affected more than the younger age group. In a Kenyan study on patterns of cerebral aneurysms, most patients were 50 years and older.(13) Similarly, after adjusting for sex and comorbidity effects, a systematic review and meta-analysis by Vlak et al reported a higher prevalence of cerebral aneurysm among patients aged 40 years and above compared to those younger than 40 years (PR – 2.8).(15)

Literature suggests that women tend to develop cerebral aneurysms more commonly than men. In a cohort study constituting 1789 patient-years of follow up, women were found to have a statistically significant higher risk of developing aneurysms compared to men (1.15% - 1.96% versus 0.03% – 0.04%, respectively). (4) A review on the prevalence of unruptured intracranial aneurysm revealed similar findings. In the review, a prevalence ratio (PR) of 1.57:1 was reported for women compared to men. (15) The ratio remained to be significant even after adjusting for age and comorbidity (PR - 1.61). (15)

2.2 Risk factors of the study population.

It is believed that hypertension contributes to the development of UIAs by raising the hemodynamic stress on cerebral vessel walls and causing subsequent vessel wall remodeling. (39)

In a recent review, Chalouhi et al. identified numerous pathways by which cigarette smoke may cause ICA development and rupture. Most of these pathways are related to inflammation. (3) Reactive oxygen species (ROS) generation, immune cell activation, and elevation of pro-inflammatory mediators may all be contributing factors in the formation of intracranial aneurysms. (41)

However, some studies found that there is no correlation between hypertension, smoking, alcohol use, and the prevalence of UCAs was not statistically significant, except for age, sex, and SAH history. (1)

Smoking and hypertension also increase the chance of having multiple intracranial aneurysms and hence increases the rupture risk. (38)

Patients with HIV showed a risk of developing an intracranial aneurysm, but this was found to be an unusual manifestation of the disease in the vascular system. It was noted that there were some changes in the vascular wall. (44)

2.3 Clinical presentations of the study population.

The symptomatology of cerebral aneurysm can be grouped into two categories depending on whether the aneurysm is unruptured or ruptured. In several studies, the most common symptom manifested by unruptured aneurysms is headache, estimated to occur in 36% of patients. (16–18) This is followed by ischemic cerebrovascular events such as transient ischemic attacks (TIAs) and stroke occurring in about 17.6%. Cranial nerve deficits such as isolated oculomotor nerve palsies and visual losses, are estimated to occur in 15.4%. (16,18) Acute headache and isolated cranial nerve III palsy were seen as warning signs of impending aneurysm rupture. (27) It should be noted that symptoms of unruptured cerebral aneurysms are a rare occurrence, and most are identified incidentally. (16)

The typical clinical presentation of ruptured cerebral aneurysms in imaging is that of subarachnoid hemorrhage (SAH) which presents as a sudden and severe headache, commonly reported by patients as “the worst headache in my life.” (16,17)

Accompanying features may include vomiting, photophobia, a depressed and altered mental status, seizures and increase in intracranial pressure which may be fatal due to cerebral herniation and parenchymal ischemia. (16–18). Symptoms related to subdural hematomas and parenchymal hemorrhages are less common. (16)

2.4 Radiological patterns of cerebral aneurysm

According to their number, intracranial aneurysms can be categorized into solitary or multiple. Ohashi et al, reported that 79.3% of all aneurysms were solitary aneurysms and 21.7% were multiple.(19) Similar findings were found by Nabaweesi et al, on the patterns of cerebral aneurysm in a Kenyan population, where solitary aneurysms in the cerebral vasculature to constitute 86% of all aneurysms, the remaining being multiple

aneurysms.(13) Following SAH, multiple intracranial aneurysms are associated with a worse outcome than solitary aneurysm cases. (37)

The arteries of circle of Willis (70% to 90%) are the most common part where intracranial aneurysms develop. (30) In a study done by Beck et al it was found that most common location of unruptured aneurysms was the middle cerebral artery (MCA) occurring in 34.7% and 30.4% of aneurysms with <7mm and >7mm, respectively. (20) A study by Osawa et al, found that aneurysms located in in the anterior cerebral artery were more common among men than women. (21) Most aneurysms occur in the anterior circulation (93.4%) while 6.6% occur in the posterior circulation according to a study in Kenya by Nabaweesi et al. (13)

In Pennsylvania, the United States, researchers looked at more than 245 aneurysms and found that smaller aneurysms (less than 10 mm in diameter), which make up 27% of all aneurysms, are more common than larger aneurysms (more than 10 mm). (22)
While anterior circulation artery aneurysms are more commonly seen, most are small. This was noted by Osawa et al, who reported most small sized aneurysms (less than 6mm) were located in the anterior circulation while the giant aneurysms (more than 25mm in diameter) were located in the internal carotid artery.(21) Congruent with these findings, is a Japanese study which reported a mean size of 7.6mm, majority of the aneurysms (48.2%) ranging between 5 – 10mm in size.(19) Size and location of intracranial aneurysms are frequently thought to be the best predictors for future aneurysm rupture. (4,31-33)
Orz Y, et al found that the AComA is the highest-risk site for aneurysm rupture, and it is recommended that any size of AComA aneurysm should be investigated for surgical or endovascular treatment when detected. Most of the small, ruptured aneurysms are located at the AComA. Additionally, most of the aneurysms at the DACA, PComA, and ICB (67%, 56%, and 71%, respectively) ruptured despite being smaller than 7 mm in diameter. (40). The same results were seen in a study done by Nabaweesi et al. The study found that the anterior communicating artery is the most common site for intracranial aneurysms and most rupture despite being small i.e., under 5mm. (13)

When it comes to types of aneurysms, they are classified into four basic types, which include saccular, fusiform, dissecting, and mycotic (34). Among the intracranial aneurysms, the saccular type accounts for 90% (29). In an Iranian study done on the types of cerebral aneurysms, saccular aneurysms was accounted in 306 cases, fusiform in 60 cases, dysmorphic in 66 cases, infectious in 6 cases and unknown in 27 cases.(23) The frequency of each type was also saccular in 65.8% individuals, fusiform in 12.9% individuals, dysmorphic in 14.2% individuals, infectious in 6 (8.4%) individuals and unknown in 78 individuals who had more than one lesion.(23) It should be noted that the most common lesion in men and women was saccular with the frequency of 162 and 144 (75% vs. 57.8%), respectively.(23) Thirty-one fusiform aneurysms occurred in 25 patients. Forty- seven saccular aneurysms occurred in 35 patients. Twelve infectious aneurysms occurred in 6 patients. Fifteen traumatic aneurysms occurred in 12 patients in an American study. (24)

2.5 Complications of cerebral aneurysms

The most dreadful complication of cerebral aneurysms is rupture of the aneurysm leading to subarachnoid hemorrhage (SAH). In the United States, approximately 27,000 persons develop SAH from a ruptured aneurysm each year, resulting in an incidence rate of 1 in 10,000 and commonly observed in women than men (2:1).(2) A systematic review of the worldwide incidence of SAH due to cerebral aneurysm reported an overall incidence of 7.9 per 100,000 person-years.(25) Region-wise Asia had the highest incidence (10.4 per 100, 000), followed by North America and New Zealand with a rate of 8.5 per 100,000 person-years.(25) Africa had the least incidence of 4.1 per 100,000 person-years, however, this may be attributed to inclusion of only one Nigerian study in the review.(25)

A study done by Marvin Darkwah et al, showed that in patients with aneurysmal SAH 48.9% were presented with IVH. And these patients had poorer clinical conditions and outcomes. The study also suggested that the location of the ruptured aneurysm in the anterior circulation predicted the occurrence and severity of IVH. (43) Abdulazim et al found that 14 days after an aneurysmal subarachnoid hemorrhage 30% of patients can present with delayed cerebral ischemia, which is a major determinant for poor

neurological outcome. (42) Some studies reported other complications of cerebral aneurysms to include convulsions, hydrocephalus, neurological deficits at 11.6%, 9% and 6.5%, respectively, (23) and headaches (45%), cranial neuropathies (16%), nausea/vomiting (15%) and visual changes (13%). (24)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study design

This was a hospital-based retrospective cross-sectional study using secondary data

3.2 Study period

Study was conducted between January 2023 and April 2024

3.3 Study area

This was conducted at Muhimbili Orthopaedic Institute - Department of Neurosurgery and Radiology. MOI is located in the Upanga area, within Ilala Municipality in Dar es Salaam region. The facility has a bed capacity of 362 and is the most advanced facility in the country specialized in orthopaedics and neurosurgery. The institute is equipped with imaging equipment including MRI and CT machines. A Picture Archive and Communication (PACS) system is available which enabled the study to be conducted and produced reliable data.

Patients with suspicions of intracranial aneurysms undergo imaging where the first imaging modality is CT angiography of the brain to look for any aneurysms if present.

3.4 Study population

This study was conducted among patients suspected of intracranial aneurysm and referred for brain CT angiography at MOI January 2023 and April,2024.

3.4.1 Inclusion criteria

- The patients who underwent CT angiography who were clinically diagnosed with intracranial aneurysm and were confirmed by CTA.

3.4.2 Exclusion criteria

- Age below 18 years
- Patients with history of trauma and cancers
- Patients with incomplete clinical history and radiological reports.

3.5 Sampling and sample size estimation

3.5.1 Sampling technique

Retrospectively, the study included all eligible patients who underwent CTA for several reasons between January 2023 and April 2024.

3.5.2 Sample size estimation

Sample size calculator module for cross-sectional studies from https://openepi.com/ was used as shown by the table below:

Sample Size:X-Sectional, Cohort, & Randomized Clinical Trials				
Two-sided significance level(1-alpha):			95	
Power(1-beta, % chance of detecting):			80	
Ratio of sample size, Unexposed/Exposed:			1	
Percent of Unexposed with Outcome:			5	
Percent of Exposed with Outcome:			36	
Odds Ratio:			11	
Risk/Prevalence Ratio:			7.2	
Risk/Prevalence difference:			31	
	Kelsey	**Fleiss**	**Fleiss with CC**	
Sample Size - Exposed	27	26	32	
Sample Size-Non Exposed	27	26	32	
Total sample size:	54	52	64	

Kelsey et al., Methods in Observational Epidemiology 2nd Edition, Table 12-15
Fleiss, Statistical Methods for Rates and Proportions, formulas 3.18 &3.19
CC = continuity correction
Results are rounded up to the nearest integer.
Print from the browser menu or select, copy, and paste to other programs.

The following values were assumed:

Confidence level: 95%

Power of study: 80%

Ratio of sample: Unexposed/Exposed =1

In several studies, most common symptom manifested by unruptured aneurysms is headache, estimated to occur in 36% of patients.(16–18)

A contingency of 10% is set to cater for patients with missing CT data

= 64 + (10% x 64)

= 70.4

N adjusted = 70 patients

The sample size was 71 patients

3.6 Sampling Strategy

This study utilized convenient sampling. Patients aged 18 years and above who underwent CT angiography of the brain at MOI were conveniently enrolled in this study.

3.7 Data collection tools and techniques

3.7.1 Data collection tool

This study utilized a developed structured data collection tool having four sections; patient demographics and risk factors, patient clinical presentation, radiological patterns, and complications of intracranial aneurysm. The tool was developed by the Principal Investigator (PI). Patient clinical notes, reports and radiological images were used as a source of data throughout the study period.

Section 1: Sociodemographic characteristics and risk factors

The following sociodemographic information and risk factors were collected in this section: age of the patient, gender, being hypertensive, alcohol intake, cigarette smoking and diabetes mellitus.

Section 2: Patient clinical presentation

Under this section, the following data was collected as clinical presentations; headache, vomiting, visual disturbances, neurological deficit was divided as those with seizures and altered mental status (loss of consciousness) and (stroke) weakness of any side of the body.

Section 3: Radiological patterns

In this section, CTA findings were collected. This included radiological features such as number, type, size, and location of intracranial aneurysms.

Number of aneurysms was divided into: Solitary and multiple

Types were divided into saccular and fusiform aneurysms

According to size: We grouped the sizes into 4 (45)

- Small <5mm
- Medium 5 to 10mm
- Large 10 to <25mm
- Giant >25mm

According to location: We divided them into

1. ACA: Acom and A2
2. ICA: Supraclinoid, cavernous and anterior clinoid segments
3. MCA: M1 and MCA bifurcation
4. PCA: PComA
5. Basilar: Basilar tip

Section 4: Complications of intracranial aneurysms

In this section, complications which can be seen by imaging arising from intracranial aneurysms were documented.

The following are possible radiological complications; ruptured aneurysm which can be seen as subarachnoid hemorrhage, hydrocephalus, intraparenchymal hemorrhage,

intraventricular hemorrhage, mass effect by the large/giant aneurysms to the optic chiasm and ischemic stroke.

Section 5: Factors associated with intracranial aneurysms and rupture based on patients' characteristics data and CT angiography findings

This section showed factors associated with intracranial aneurysms and rupture based on patients' characteristics data and CT angiography findings among patients with ICA at MOI between January 2023 and April 2024.

3.7.2 Imaging and evaluation

The CTA images at MOI were acquired by a CT scan Somatom dual-source CT scanner, equipped with a 128-slice detector made by Siemens in Munich Germany.

3.8 Data collection process

Data was collected through clinical notes in patients with aneurysms and those who underwent CTA for other reasons. During the study, patient characteristics were collected. The medical history of the patient was also collected from the system. Radiographic (CTA) patterns were obtained from the reports and by reading radiological images from radiological electronic records from respective departments at MOI. To overcome observer bias, the PI and a senior radiologist read the radiological findings and only when both agree, the findings were recorded. Clinical characteristics and radiological complications were obtained from patient records and images.

3.9 Pre-testing of data collection tools.

To assure data quality, data collection was pre-tested on 10 patients diagnosed with ICA and underwent CTA at MOI.

3.10 Variables

3.10.1 Independent variables

The independent variables in the study were the demographic characteristics of the patients which included age, sex, smoking history, history of alcohol use and clinical characteristics; hypertension, diabetes mellitus.

3.10.2 Dependent variables

Radiological patterns of the intracranial aneurysms are dependent variables; they include

Number of aneurysms was divided into: Solitary and multiple

Types were divided into: saccular and fusiform aneurysms

According to size: We grouped the sizes into 4 (45)

- Small <5mm
- Medium 5 to 10mm
- Large 10 to <25mm
- Giant >25mm

According to location: We divided them into

1. ACA: Acom and A2
2. ICA: Supraclinoid, cavernous and anterior clinoid segments
3. MCA: M1 and MCA bifurcation
4. PCA: PComA
5. Basilar: Basilar tip

In this study the dependent variables include associated complications of the intracranial aneurysms, which are seen in CTA which include subarachnoid hemorrhage, hydrocephalus, intraparenchymal hemorrhage, intraventricular hemorrhage, mass effect and ischemic stroke.

3.11 Data analysis

The Statistical Package for Social Sciences (SPSS) version 27 was used to manage, store and analyze data collected from this study. Descriptive statistics were used to summarize the data for the study participants' socio-demographic characteristics. Frequencies and percentages were used to present categorical variables such as age groups. The central tendency and measures of variability such as mean, median, mode and standard deviation were used for continuous variables like age.

Descriptive statistics were used to summarize the data for CT findings of the study participants. Frequencies and percentages were used to present the patterns of intracranial aneurysms and complications.

Age was categorized as less than 50 years and more than or equal to 50 years.

The Chi-square test and Fisher exact test were used to investigate the association between the sociodemographic characteristics, risk factors and radiological patterns with complications. A p-value of <0.05 was considered significant.

The table below summarizes the proposed analysis method according to objectives of this study

Table 1: Analysis of variables

Objective	Variable to be assessed	Method of analysis
To determine patients' characteristics suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024.	- Age - Sex - Hypertension - Smoking - Alcohol - Diabetes mellitus	Continuous data: Means and standard deviations Categorical data: Frequency distribution and percentage
To determine clinical presentations among patients suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024.	- Headache - Visual disturbance - Lateralizing sign - Seizures	Frequency distribution table and percentages
To determine CTA patterns of cerebral aneurysms among patients suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024.	- Presence of aneurysm - Aneurysm status - Number - Type - Size - Location	Frequency distribution and percentage Continuous data for the neck size
To determine complications of aneurysms among patients suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024.	- Subarachnoid hemorrhage - Intraparenchyma hemorrhage - Hydrocephalus - Intraventricular hemorrhage (extension) - Ischemic stroke - Mass effect to the optic chiasm	Frequency distribution and percentages

To determine factors associated with intracranial aneurysms and rupture based on patients' characteristics data and CT angiography findings among patients with ICA at MOI between January 2023 and April 2024	- Age - Sex - Hypertension - Cigarette smoking - Location of aneurysm - Size of aneurysm - Multiple aneurysms - Intraparenchymal haemorrhage - Ischemic stroke	Chi square for univariate analysis

3.12 Reliability and validity issues

3.13 Ethical considerations

Ethical clearance was sought from MUHAS Institutional Review Board (IRB). Permission to conduct the study was also sought from MOI authorities.

Access to medical records in the MOI radiology department and archived medical records was requested. Due to the study being retrospective, a waiver of consent was given by the IRB and filed accordingly.

Confidentiality of participant information was maintained and anonymity maintained by using numbers instead of names in the checklist.

3.14 Dissemination plan

This dissertation shall be submitted to Muhimbili University for partial fulfilment of the Master of Medicine in Radiology program. The Muhimbili Medical Research Ethics Council, MNH Director of Training and Research, the Teaching, Research and Consultancy Coordination Unit of MNH, Dean School of Medicine and the Director of Postgraduate Studies will get the results.

The research findings will be published in regional or international publications with copyright held by the University and the Principal investigator.

CHAPTER FOUR

4.0 RESULTS

4.1 Patients' characteristics suspected of ICA referred for brain CT angiography at MOI (N = 71)

The study recruited a total of 71 patients among these patients, 63% were females. The age range between 20 and 80 years with a mean of 52 years. Most of the patients were between 50 to 59 years. Most (73.2%) had. hypertension. Those who had a history of alcohol use and smoking were 9 (19.6%) and 5 (10.9%) respectively. (Table 2).

None of the patients had diabetes in the study population. Three had HIV, one had Rheumatic heart disease, and one had a history of heart disease, and 1 was a patient with recurrent seizures (not shown in the table)

Table 2: Patients' characteristics suspected of ICA referred for brain CT angiography at MOI between January 2023 and April 2024(n = 71).

Variable		Frequency	Percentage
Sex	M	26	36.6
	F	45	63.4
Age (years)	Mean ± SD = 52±12, Minimum = 20	Maximum = 80	
Hypertension	Yes	52	73.2
	No	19	26.8
Cigarette smoking	Yes	5	7
	No	66	93
Alcohol use	Yes	14	19.7
	No	57	80.3

4.2 Clinical presentations among patients suspected of ICA referred for brain CT angiography at MOI (N = 71)

Most of the patients were presented with headache (90.1%) followed by altered mental status (49.3%) and vomiting (31.0%). The least common presentation was stroke (15.5%). (Figure: 2)

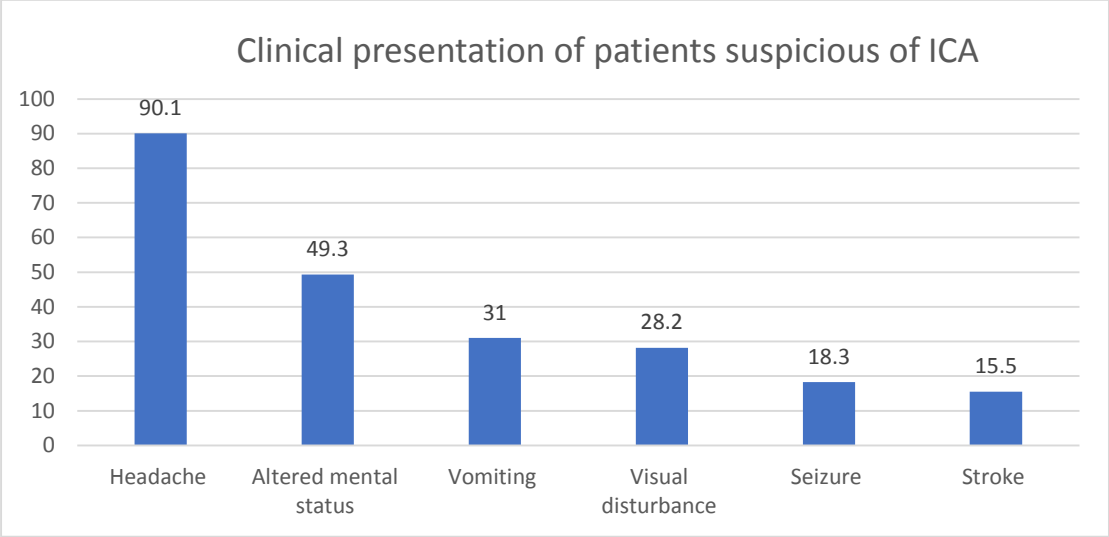


Figure 2: Clinical presentations among patients suspected of ICA at MOI (N=71)

4.3 CTA patterns of cerebral aneurysms among patients suspected of ICA referred for brain CT angiography at MOI (n = 46)

This study shows that most patients had solitary intracranial aneurysms (41; 89.1%) Saccular aneurysm was the most common type (76.1%). Most of the aneurysms were medium in size (>5 to 10mm) and the anterior circulation had the most aneurysms where ACOM (37%) was the commonest location. (Table 3)

Table 3: The CTA patterns of cerebral aneurysms among patients suspected of ICA referred for brain CT angiography at MOI (n = 46)

Variable		Frequency	Percentage
Number of ICA (n = 46)	Solitary	41	89.1
	Multiple	5	10.97
Type of aneurysm	Saccular	35	76.1
	Fusiform	12	26.19
Size of aneurysm	Small	16	34.8
	Medium	23	50
	Large	4	8.7
	Giant	3	6.5
Location of aneurysm	Acom	17	37
	A3	1	2.2
	Supraclinoid	2	4.3
	Cavernous	8	17.4
	M1	13	28.2
	PComA	5	10.9
	Basilar tip	1	2.2

4.4 Locations of fusiform aneurysms. (N=12)

Majority (90.1%) of fusiform aneurysms were seen in the MCA followed by PCOM (71.8%) which is vertebrobasilar circulation. (Figure 3)

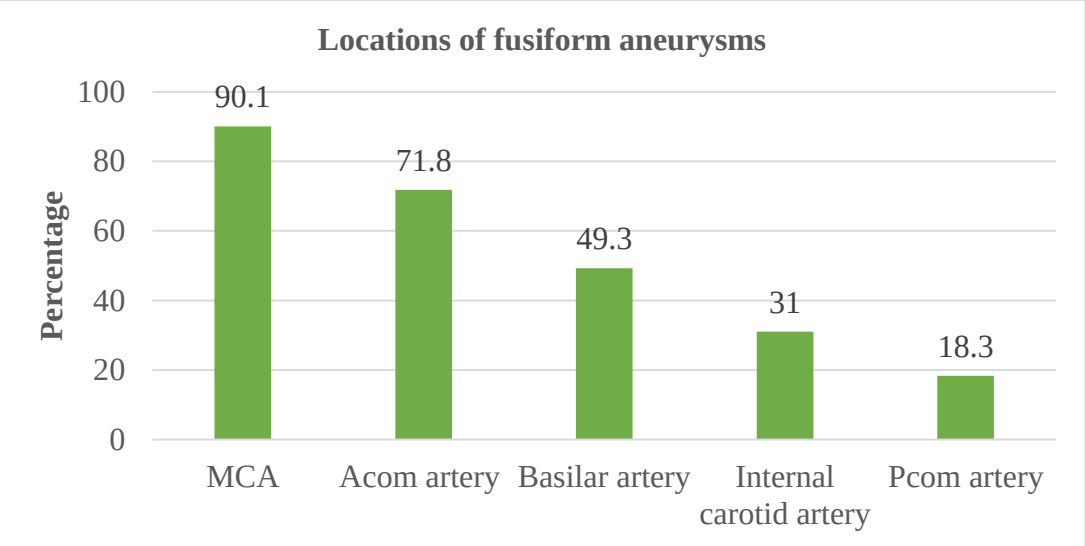


Figure 3: Locations of the fusiform aneurysms. (N=12)

4.4.1 Complications of aneurysms among patients suspected of ICA referred for brain CT angiography

The complications of having an intracranial aneurysm include it being ruptured, in which 47.9% of patients presented with aneurysmal subarachnoid hemorrhage. Followed by intraparenchymal hemorrhage by 25.4%, hydrocephalus 23.9%, intraventricular hemorrhage 23.9%, mass effect on the optic chiasm 11.3% and the least complication was ischemic stroke (1.4%). (Figure 4)

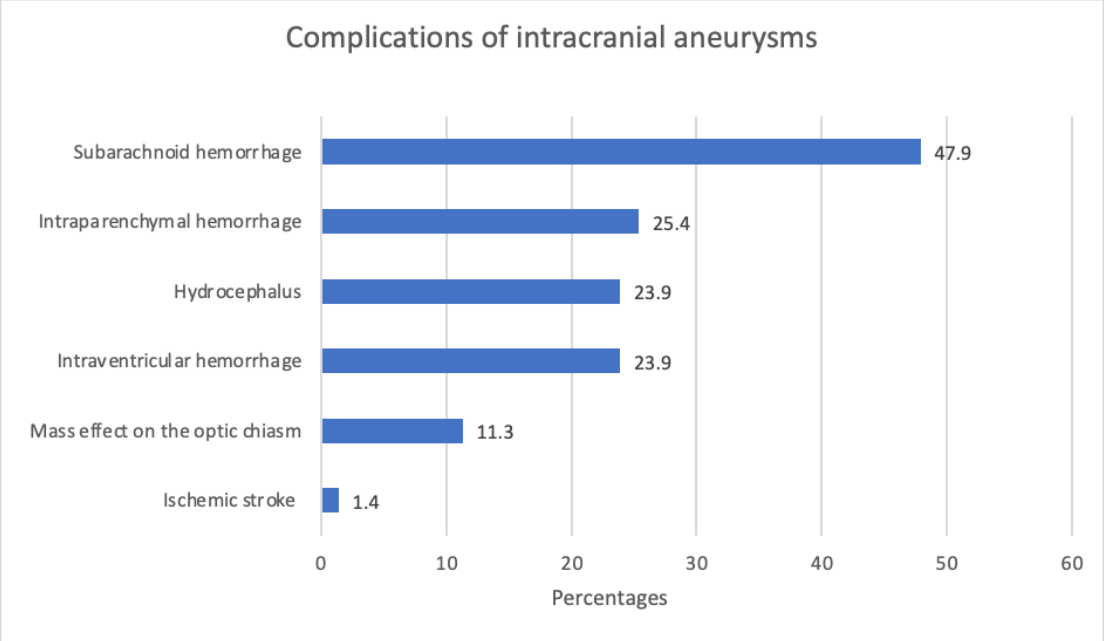


Figure 4: Showing the complications of intracranial aneurysms in CTAs (N= 46)

4.5 Patients' characteristics with its association on the presence of intracranial aneurysms (N= 71)

This shows the association between several factors and the presence of aneurysms. The factors analyzed include age, gender, hypertension, smoking, and alcohol use.

Age

The table shows that more participants aged 50 or older had aneurysms (70.0%) compared to those under 50 (58.1%). However, this difference suggests that age alone may not have a strong association with the presence of aneurysms in this cohort. (Table 4)

Gender (Male and female):

A higher proportion of females (73.3%) had an aneurysm compared to males (50.0%), indicating that females in this study population are more likely to have an aneurysm than males. (Table 4)

Hypertension

Hypertension was present in 69.2% of individuals with aneurysms and 30.8% of those without (p-value = 0.195), the observation was not statistically significant.. (Table 4)

Smoking

All five participants who reported smoking had aneurysms (100%), while none of the non-smokers did (Table 4)

Alcohol Use

Alcohol consumption does not appear to have a significant relationship with aneurysm presence. Among those who reported alcohol use, 64.3% had an aneurysm and 35.7% did not, while among non-drinkers, 64.9% had an aneurysm and 35.1% did not. This indicates that alcohol use is not a key factor in determining aneurysm presence in this population.(Table 4)

Table 4: Association between the presence or absence of intracranial aneurysm on patients' characteristics. (n = 71)

		Aneurysm		**p-value**
Factors		**Present n (%)**	**Absent n(%)**	
Age	<50	18 (58.1)	13 (41.9)	
	>/= 50	28 (70.0)	12 (30.0)	0.296
Gender	Female	33 (73.3)	12 (26.7)	0.047
	Male	13(50.0)	13(50.0)	
Hypertension	Yes	36 (69.2)	16 (30.8)	0.195
	No	10 (52.6)	9 (47.4)	
Smoking	Yes	5 (100)	0 (0)	0.154
	No	41 (62.1)	25 (37.9)	
Alcohol use	Yes	9 (64.3)	5 (35.7)	0.965
	No	37 (64.9)	20(35.1)	

4.6 Factors associated with rupture of aneurysms based on the patients' characteristics.

Age

Within the age group of individuals aged 50 and above, 75.0% have ruptured ICA aneurysms. This suggests a higher proportion of ruptured ICA aneurysms in the older age group compared to the younger group. Both age groups show a higher percentage of ruptured aneurysms compared to unruptured ones, but the proportion of ruptured aneurysms is notably higher in the older age group. Though there was no statistical significance in the rupture status of ICA aneurysms with older individuals. (Table 5)

Gender

Among females, 75.8% (25 participants) had a ruptured aneurysm, while 24.2% (8 participants) had an unruptured one. In males, 53.8% (7 participants) had a ruptured aneurysm, and 46.2% (6 participants) had an unruptured one. Although more females had ruptured aneurysms compared to males, gender does not show a significant association with aneurysm rupture in this group.(Table 5)

Hypertension

Of the participants with hypertension 72.2% had a ruptured aneurysm, and 27.8% had an unruptured one. Among those without hypertension, 60.0% had a ruptured aneurysm, while 40.0% had an unruptured aneurysm. The p-value of 0.465 suggests that hypertension is not significantly associated with aneurysm rupture in this study. (Table 5)

Smoking

The analysis indicates that 60.0% of smokers have ruptured aneurysms, while 40.0% have unruptured aneurysms. In contrast, among non-smokers, 29 participants (70.7%) had a ruptured aneurysm, and 12 (29.3%) had an unruptured one.The p-value of 0.633 suggests that there is no statistically significant association between smoking and aneurysm rupture. This implies that smoking may not be a significant factor influencing aneurysm rupture. (Table 5)

Alcohol Use

The results show that 66.7% of individuals who consume alcohol have ruptured aneurysms, compared to 33.3% with unruptured aneurysms. Among non-alcohol users, 70.3% had a ruptured aneurysm, while 29.7% had an unruptured aneurysm.The p-value

of 1.000 indicates no statistically significant association between alcohol use and aneurysm rupture. This suggests that alcohol consumption does not significantly affect the likelihood of aneurysm rupture. (Table 5)

Table 5: Association of the intracranial ruptured or unruptured with patient's characteristics.

	Aneurysm		**p-value**
Factors	**Ruptured n (%)**	**Unruptured n (%)**	
Age (Years)			
<50	11 (61.1)	7 (38.9)	
>50	21 (75.0)	7 (25.0)	0.318
Gender: Female	25 (75.8)	8 (24.2)	0.171
Male	7 (53.8)	6 (46.2)	
Hypertension Yes	26 (72.2)	10 (27.8)	0.465
No	6(60.0)	4 (40.0)	
Smoking Yes	3 (60.0)	2 (40.0)	0.633
No	29 (70.7)	12 (29.3)	
Alcohol use Yes	6 (66.7)	3 (33.3)	1
No	26(70.3)	11(29.7)	

4.7 Factors associated with the intracranial aneurysm status i.e. ruptured or unruptured based on CT angiography patterns (n = 46)

Number of Aneurysms

The study shows that 100% of individuals with multiple aneurysms experienced ruptures, compared to 65.9% of those with solitary aneurysms. However, the p-value of 0.117 suggests that this difference is not statistically significant. While there appears to be a trend towards a higher likelihood of rupture in multiple aneurysms, the sample size may be too small to confirm this relationship with confidence. (Table 6)

Type of Aneurysm

For both saccular and fusiform aneurysms, the percentages of ruptured and unruptured cases are similar. The p-values of 0.624 and 1.0, respectively, indicate no significant association between the type of aneurysm and rupture status. This suggests that the morphology of the aneurysm (saccular vs. fusiform) does not significantly influence the likelihood of rupture. (Table 6)

Size of Aneurysm

The size of aneurysms shows varying degrees of association with rupture status. While small and medium aneurysms have higher percentages of rupture (75.0% and 82.6%, respectively), large and giant aneurysms show a trend towards being unruptured. The p-value for giant aneurysms (0.024) indicates a significant association, suggesting that larger aneurysms are less likely to rupture. However, the p-values for other sizes are not significant, indicating that size alone is not a definitive predictor of rupture risk. (Table 6)

Location of Aneurysm

The location of the aneurysm significantly influences its rupture risk. Aneurysms located in the Acom (anterior communicating artery) show a significant association with rupture ($p = 0.049$), with 88.2% of these aneurysms being ruptured. Cavernous aneurysms show a significant association with being unruptured ($p = 0.006$), with

75.0% remaining unruptured. Other locations, such as A3, supraclinoid, M1, PComA, and basilar tip, do not show significant associations with rupture status.(Table 6)

Table 6: Association of the intracranial aneurysm status i.e ruptured or unruptured with CT angiography patterns of ICA

	Aneurysm		**p-value**
Patterns	**Ruptured n (%)**	**Unruptured n (%)**	
Number of aneurysms			
Solitary	27 (65.9)	14 (34.1)	0.117
Multiple	5 (100)	0 (0.0)	0.117
Type of aneurysm			
Saccular	25 (71.4)	10 (28.6)	0.624
Fusiform	8 (66.7)	4 (33.3)	1.0
Size			
Small	12 (75.0)	4 (25.0)	0.739
Medium	19 (82.6)	4 (17.4)	0.055
Large	1 (25.0)	3 (75.0)	0.078
Giant	0 (0.0)	3 (100.0)	0.024
Location of aneurysm			
Acom	**15 (88.2)**	**2 (11.8)**	**0.049**
A3	1 (100.0)	0 (0.0)	1.0
Supraclinoid	2 (100.0)	0 (0.0)	1
Cavernous	**2 (25.0)**	**6 (75.0)**	**0.006**
M1	3 (23.1)	10 (76.9)	0.724
PComA	3 (60.0)	2 (40.0)	0.633
Basilar tip	0 (0.0)	1 (100.0)	0.304



Figure 5: CT angiography of a female patient 57 years old hypertensive presented with headache: (Axial plane) There is a well-defined lobulated mass with contrast enhancement similar to that of blood vessels at the right cavernous sinus.

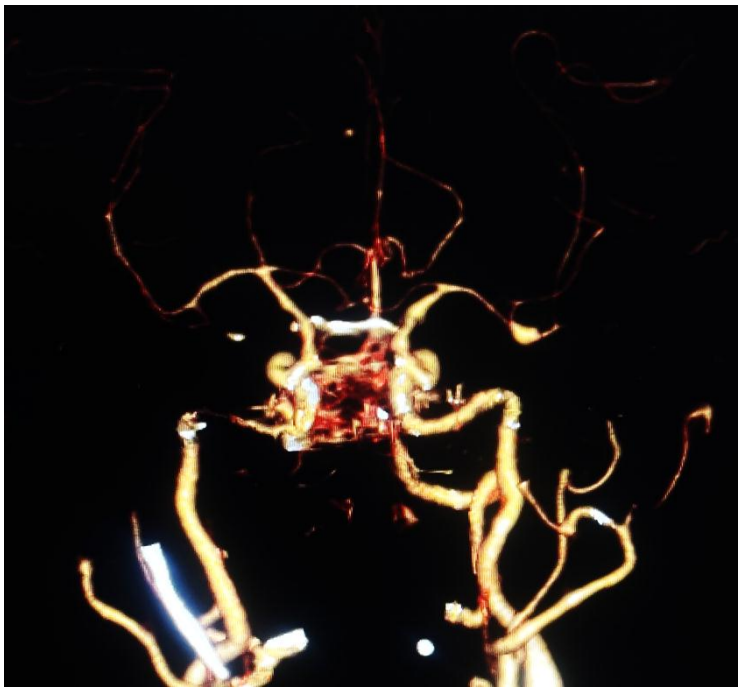


Figure 6: 3D VR CT angiography of a 46 years old female known with hypertension presented with headache: A saccular aneurysm at the left M1 bifurcation.

CHAPTER FIVE

5.0 DISCUSSION:

From this study, the age group of individuals aged 50 and above, 70.0% had aneurysm. Similarly, in a study done in Kenya on patterns of cerebral aneurysms, where most of the patients were 50 years and older (13) and these findings also are similar to a study done by Vlak et al where the higher prevalence of ICA was among patients aged 40 years and above (15) The resemblance of the age in these studies could be due to comparability in inclusion criteria of patients, mostly older individuals. This similarity is due to the inclusion criteria focusing on older age groups, who are at greater risk due to cumulative vascular risk factors and age-related degenerative changes in blood vessels. Consequently, these findings highlight the importance of targeting older populations in screening and preventive strategies for intracranial aneurysms.

The study showed that females (73.3%) tend to develop intracranial aneurysms than men which were similar findings in a cohort study of 1789 patients where women were found to have statistically significant higher risk of developing aneurysms compared to men (4). The same results were obtained from Vlak et al where a prevalence ratio of 1.57:1 was reported for women compared to men. The ratio remained significant even after adjusting for age and comorbidity. (15) The congruence of these findings across different studies can be attributed to several underlying factors. Firstly, hormonal differences play a crucial role in vascular health and disease. Estrogen, which has protective vascular effects, decreases significantly after menopause, leading to an increased risk of vascular conditions, including intracranial aneurysms, in postmenopausal women. This hormonal shift contributes to the higher prevalence of aneurysms in females, as observed consistently in the studies. Additionally, the increased longevity of women compared to men means that women are more likely to reach the age where aneurysms are more common. The cumulative exposure to risk factors over a longer lifespan could contribute to the higher observed prevalence of aneurysms in females.

A higher percentage of individuals with hypertension (69.2%) had aneurysms in this study. This finding is consistent with previous studies which showed that hypertension contributes to the development of intracranial aneurysms by raising the hemodynamic

stress on the cerebral vessel walls and thus causing subsequent vessel wall remodeling. (39)

Although a higher percentage of patients with ICA had hypertension, all individuals who had a history of smoking had aneurysms and a high percentage (64.3%) of the patients with ICA had history of alcohol use, there was no statistical significance being hypertensive, smoker, and alcohol use with having an intracranial aneurysm. These results were like a study by Li J et al that found no correlation between hypertension, smoking and alcohol use with the prevalence of UICA. (1)

The congruence between these findings and those of Li J et al. underscores the complex etiology of intracranial aneurysms. While hypertension is a well-recognized risk factor due to its role in increasing hemodynamic stress and promoting vessel wall remodeling, the lack of statistical significance in the association of smoking and alcohol use with ICA suggests that these factors may contribute to aneurysm formation through more intricate mechanisms or in conjunction with other predisposing conditions. This similarity in findings reinforces the need for a multifactorial approach in understanding and addressing the risk factors for intracranial aneurysms, highlighting the complicated interplay between genetic predisposition, environmental factors, and individual lifestyle choices in the pathophysiology of these vascular anomalies.

On the radiological patterns according to the number of aneurysms, solitary aneurysms (89.1%) were many compared to multiple, the findings are the same as in a study done by Nabaweesi et al in Kenya where 86% of all aneurysms were solitary and the remaining were multiple. (13) Another study by Ohashi et al reported that 79.3% of all aneurysms were solitary and only 21.7% were multiple. (19) Similar findings can be because the formation of aneurysms is often due to localized hemodynamic stress and vascular wall weaknesses, which typically affect a single site initially. This localized nature of aneurysm development explains why solitary aneurysms are more prevalent. The vascular wall may respond to the initial stressor by forming an aneurysm at the most vulnerable point, rather than simultaneously at multiple sites.

In this present study, saccular aneurysms (76.1%) are the predominant type of aneurysms followed by fusiform. A study done in Iran, also showed that saccular

aneurysms accounted for 306 cases where fusiform and other types were 159 cases only. (23) Saccular aneurysms are more likely to be diagnosed because they show symptoms earlier due to their tendency to rupture or compress adjacent structures. This makes them more likely to be detected during diagnostic evaluations prompted by clinical presentation such as severe headaches, neurological deficits, or even subarachnoid hemorrhage. Saccular aneurysms are often more easily visualized and identified on imaging studies like CT angiography (CTA) because of their distinct, berry-like shape. Their protruding sac is more conspicuous compared to the more elongated and diffuse shape of fusiform aneurysms.

Our study found that most of the aneurysms had a size of 5 to 10mm (medium size) by 50%, followed by those less than 5mm. The same findings were seen in a Japanese study which reported that most aneurysms had a mean size of 7.6mm, majority of the aneurysms (48.2%) range between 5- 10mm (19) Another study showed that most aneurysms were small less than 6mm and are commonly seen in the anterior circulation. (21)

Regarding location of intracranial aneurysms, the anterior circulation i.e., anterior communicating artery 37% was most common followed by aneurysms in the middle cerebral arteries. Similarly, a study done by Nabaweesi et al found that the anterior communicating artery is the most common site for intracranial aneurysms (13). The findings are congruent because anterior communicating artery (AComA) is located at a crucial point within the circle of Willis, where several arteries intersect, resulting in significant hemodynamic stress. This anatomical positioning subjects the AComA to heightened pressure and turbulent blood flow, which increases its susceptibility to aneurysm formation. Similarly, the middle cerebral arteries (MCAs) are major vessels that branch directly from the internal carotid arteries, experiencing high blood flow and pressure, which also contributes to a higher risk of aneurysm development.

A high percentage of patients with aneurysm were presented with subarachnoid hemorrhage (47.9%) in this study. The second most common complication was intraparenchymal hemorrhage. While other studies reported that ischemic cerebrovascular events such as transient ischemic attacks (TIA) and stroke were the second most common complications after subarachnoid hemorrhage. (16,18) But in this

study only one patient had ischemic stroke as a complication seen in the CTA. Variations in these studies can be due to differences in demographic characteristics of study populations, such genetic background, and comorbid conditions, which could be the influence in the types and frequencies of complications observed. Different populations may have varying predispositions to hemorrhagic versus ischemic events.

Ruptured aneurysms were seen as the common cause of subarachnoid hemorrhage, 47.9% of the patients presented with this complication. In the United States approximately 27,000 persons develop SAH from a ruptured aneurysm, and it is more commonly seen in women than men. The current findings show that females have a high percentage of ruptured aneurysms (75.8%) although there was no statistical significance between being female and having a ruptured aneurysm.

Patients with hypertension showed a 72.2% chance of having an aneurysmal rupture although this did not show any statistical significance. These findings are the same in a study done by Li J, et al where there was no correlation between hypertension, smoking, alcohol use and the prevalence of unruptured intracranial aneurysms. (1)

The most common complication of intracranial aneurysm is rupture, and in this study anterior communicating artery showed a higher risk of rupture (88.2%) than in other locations and it was statistically significant. Congruent with a study done by Nabaweesi et al, that the anterior communicating artery is the most common site for intracranial aneurysm and most rupture despite being small (13). Orz Y, et al also found that AComA is the highest risk site for aneurysm rupture and that any size of AComA should be investigated. (40) The AComA is situated at a critical juncture in the circle of Willis, where blood flow dynamics can lead to increased hemodynamic stress on the vessel walls. The unique anatomical configuration and bifurcation at this site create turbulent blood flow, which can cause localized stress and make the vessel walls more susceptible to aneurysm formation and rupture. The similarity in findings can also be because of comparable patient populations. These factors collectively reinforce the understanding that the AComA is a critical site for aneurysm rupture, necessitating vigilant clinical assessment and management.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The study showed that observed predominance of females in the study population is important, suggesting the need for further exploration into gender-specific risk factors or predispositions associated with intracranial aneurysms (ICAs).

Moreover, the study highlights that age is a crucial factor in the prevalence of intracranial aneurysms, with older individuals being at higher risk. While hypertension, smoking, and alcohol use did not show significant associations with aneurysm presence or rupture, the trends observed warrant further investigation with larger sample sizes. The location and size of aneurysms are critical factors in assessing rupture risk, with anterior communicating artery aneurysms posing a significant risk for rupture.

The prominence of the anterior communicating artery (ACOM) location in ruptured aneurysms highlights crucial site-specific factors that must be considered in risk assessment and management because anterior communicating artery aneurysm has more risk of rupture causing subarachnoid hemorrhage than having an aneurysm in another location, despite it having a small size.

These findings underscore the need for targeted screening and preventive strategies, particularly for high-risk populations, to mitigate the complications associated with intracranial aneurysms.

6.2 Recommendations

Based on the study's findings, it is recommended that targeted screening programs be developed for high-risk populations, particularly older individuals, and females, to identify intracranial aneurysms (ICAs) early. Given the higher rupture risk associated with anterior communicating artery aneurysms, even when small, it is crucial to prioritize screening and monitoring for aneurysms in this location.

Lifestyle changes should be implemented, and comprehensive screening is essential for those with a history of intracranial aneurysm. All individuals considered at-risk should be assessed for the possibility of early surgical intervention.

Further research should be conducted to explore potential gender-specific risk factors for ICAs and to investigate the associations between hypertension, smoking, alcohol use, and aneurysm rupture with larger sample sizes. Additionally, preventive strategies focusing on managing modifiable risk factors and improving early detection through advanced imaging techniques should be integrated into healthcare protocols to reduce complications from ICAs, particularly subarachnoid hemorrhage.

6.3 Limitation of the study

It being retrospective, some information might have been incomplete and biased.

From the report the supraclinoid aneurysms could be cavernous aneurysms and vice versa, the precise location of the aneurysm could not be determined due to unavailability to undergo DSA. This is important because the complications of these aneurysms differ.

7.0 REFERENCES

1. Li J, Shen B, Ma C, Liu L, Ren L, Fang Y, et al. 3D contrast enhancement-MR angiography for imaging of unruptured cerebral aneurysms: A hospital-based prevalence study. PLoS One. 2014;9(12):1–11.
2. Brisman JL, Song JK, Newell DW. Cerebral aneurysms. Curr Surg. 1999;56(4):258–62.
3. Chalouhi N, Ali MS, Starke RM, Jabbour PM, Tjoumakaris SI, Gonzalez LF, et al. Cigarette smoke and inflammation: Role in cerebral aneurysm formation and rupture. Mediators Inflamm. 2012;2012.
4. Juvela S, Poussa K, Porras M. Factors affecting formation and growth of intracranial aneurysms: A long-term follow-up study. Stroke. 2001;32(2):485–91.
5. Mhurchu CN, Anderson C, Jamrozik K, Hankey G, Dunbabin D. Hormonal factors and risk of aneurysmal subarachnoid hemorrhage: An international population-based, case-control study. Stroke. 2001;32(3):606–12.
6. Texakalidis P, Sweid A, Mouchtouris N, Peterson EC, Sioka C, Rangel-Castilla L, et al. Aneurysm Formation, Growth, and Rupture: The Biology and Physics of Cerebral Aneurysms. World Neurosurg. 2019;130:277–84.
7. Rinkel GJ. Intracranial aneurysm screening: indications and advice for practice. Lancet Neurol. 2005;4:122–8.
8. Kwon OK. Headache and Aneurysm. Neuroimaging Clin N Am [Internet]. 2019;29(2):255–60. Available from: https://doi.org/10.1016/j.nic.2019.01.004
9. Finsterer J. Ptosis: Causes, Presentation, and Management. Aesthetic Plast Surg. 2003;27(3):193–204.
10. Lambru G, Zakrzewska J, Matharu M. Trigeminal neuralgia: A practical guide. Pract Neurol. 2021;21(5):392–402.
11. Villablanca JP, Duckwiler GR, Jahan R, Tateshima S, Martin NA, Frazee J, et al. Natural history of asymptomatic unruptured cerebral aneurysms evaluated at CT angiography: Growth and rupture incidence and correlation with epidemiologic risk factors. Radiology. 2013;269(1):258–65.
12. Hashimoto Y, Matsushige T, Kawano R, Shimonaga K, Yoshiyama M, Takahashi H, et al. Segmentation of aneurysm wall enhancement in evolving

unruptured intracranial aneurysms. J Neurosurg. 2022;136(2):449–55.

13. Nabaweesi-Batuka J, Kitunguu PK, Kiboi JG. Pattern of Cerebral Aneurysms in a Kenyan Population as Seen at an Urban Hospital. World Neurosurg. 2016;87:255–65. http://dx.doi.org/10.1016/j.wneu.2015.09.061
14. Futchko J, Starr J, Lau D, Leach MR, Roark C, Pandey AS, et al. Influence of smoking on aneurysm recurrence after endovascular treatment of cerebrovascular aneurysms. J Neurosurg. 2018;128(4):992–8.
15. Vlak MHM, Algra A, Brandenburg R, Rinkel GJE. Prevalence of unruptured intracranial aneurysms, with emphasis on sex, age, comorbidity, country, and time period: A systematic review and meta-analysis. Lancet Neurol. 2011;10(7):626–36. http://dx.doi.org/10.1016/S1474-4422(11)70109-0
16. Alessandro C, Emanuele P, Roberto DB, Silvia TC, Giusepp B. Clinical presentation of cerebral aneurysms. Eur J Radiol. 2013;82(10):1618–22. http://dx.doi.org/10.1016/j.ejrad.2012.11.019
17. Chen R, Wen D, Xiao A, Guo R, You C, Liu Y. Clinical characteristics of intracranial aneurysms in elderly patients over 70 years old: a retrospective observational study. BMC Neurol. 2022;22(1):1–9. https://doi.org/10.1186/s12883-022-02786-z
18. Lonjon M, Pennes F, Sedat J, Bataille B. Epidemiology, genetic, natural history and clinical presentation of giant cerebral aneurysms. Neurochirurgie. 2015;61(6):361–5.http://dx.doi.org/10.1016/j.neuchi.2015.08.003
19. Ohashi Y, Horikoshi T, Sugita M, Yagishita T, Nukui H. Size of cerebral aneurysms and related factors in patients with subarachnoid hemorrhage. Surg Neurol. 2004;61(3):239–45.
20. Beck J, Rohde S, Berkefeld J, Seifert V, Raabe A. Size and location of ruptured and unruptured intracranial aneurysms measured by 3-dimensional rotational angiography. Surg Neurol. 2006;65(1):18–25.
21. Osawa M, Hongo K, Tanaka Y, Nakamura Y, Kitazawa K, Kobayashi S. Results of Direct Surgery for Aneurysmal Subarachnoid Haemorrhage : Outcome of 2055 Patients who Underwent Direct Aneurysm Surgery and Pro ® le of Ruptured Intracranial Aneurysms. 2001;
22. Forget TR, Benitez R, Veznedaroglu E, Sharan A, Mitchell W, Silva M, et al.

A review of size and location of ruptured intracranial aneurysms. Neurosurgery. 2001;49(6):1322–6.

23. Sabouri M, Mahabadi A, Tabesh H, Rezvani M, Kouchekzadeh M, Namazi A. Epidemiologic and Demographic Features, Therapeutic Intervention and Prognosis of the Patients with Cerebral Aneurysm. Adv Biomed Res. 2018;7(1):6.
24. Hetts S., Narvid J, Sanai N, Lawton MT, Dowd CF, Higashida RT, et al. Intracranial Aneurysms in Childhood: 27-Year Single-Institution Experience. Am J Neuroradiol. 2009;30:1315–24.
25. Etminan N, Chang H-S, Hackenberg K, de Rooji NK, Vergouwen MD., Rinkel GJE, et al. Worldwide Incidence of Aneurysmal Subarachnoid Hemorrhage According to Region, Time Period, Blood Pressure, and Smoking Prevalence in the Population A Systematic Review and Meta-analysis. JAMA Neurol. 2019;76(5):588–97.
26. Pera, J., & Ruigrok, Y. M. (2015, January 7). More evidence against alcohol or smoking in patients with unruptured intracranial aneurysm. Neurology, 84(5), 442–443.https://doi.org/10.1212/wnl.0000000000001222
27. Li J, Shen B, Ma C, Liu L, Ren L, et al. (2014) 3D Contrast Enhancement-MR Angiography for Imaging of Unruptured Cerebral Aneurysms: A Hospital-Based Prevalence Study. PLoS ONE 9(12): e114157. doi: 10.1371/journal.pone.0114157
28. Rinkel GJ, Djibuti M, Algra A, et al. Prevalence and risk of rupture of intracranial aneurysms: a systematic review. Stroke 1998; 29: 251-6.
29. Keedy A. An overview of intracranial aneurysms. Mcgill J Med. 2006 Jul;9(2):141-6. PMID: 18523626; PMCID: PMC2323531.
30. Rodriguez-Régent C, Edjlali-Goujon M, Trystram D, Boulouis G, Ben Hassen W, Godon-Hardy S, Nataf F, Machet A, Legrand L, Ladoux A, Mellerio C, Souillard-Scemama R, Oppenheim C, Meder JF, Naggara O. Non-invasive diagnosis of intracranial aneurysms. Diagn Interv Imaging. 2014 Dec;95(12):1163-74. doi: 10.1016/j.diii.2014.10.005. Epub 2014 Nov 22. PMID: 25465118.

31. Joo SW, Lee SI, Noh SJ, Jeong YG, Kim MS, Jeong YT. What is the significance of a large number of ruptured aneurysms smaller than 7 mm in diameter? J Korean Neurosurg Soc. 2009; 45:85–89.
32. Tsutsumi K, Ueki K, Morita A, et al. Risk of rupture from incidental cerebral aneurysms. J Neurosurg. 2000; 93:550–553.
33. Yasui N, Suzuki A, Nishimura H, Suzuki K, Abe T. Long-term follow-up study of unruptured intracranial aneurysms. Neurosurgery. 1997; 40:1155–1159.
34. Jens J. Froelich, Sam Neilson, et al. Size and location of ruptured intracranial aneurysms: A 5 years clinical survey. World Neurosurgery. 2016; 91:260-265.
35. Hudson JS, Hoyne DS, Hasan DM. Inflammation and human cerebral aneurysms: current and future treatment prospects. Future Neurol 2013;8: 663-76.doi:10.2217/fnl.13.40
36. Lehman VT, Brinkjikji W, Mossa-Basha M, et al. Conventional and high-resolution vessel wall MRI of intracranial aneurysms: current concepts and new horizons. J Neurosurg 2018;128:969-81.doi:10.3171/2016.12.JNS162262
37. Rinne, Jaakko M.D.; Hernesniemi, Juha M.D.; Niskanen, Minna M.D.; Vapalahti, Matti M.D.. Management Outcome for Multiple Intracranial Aneurysms: 31. Neurosurgery 36(1):p 31-38, January 1995.
38. Ghosh S, Dey S, Tjoumakaris S, Gonzalez F, Rosenwasser R, Pascal J, Jallo J. Association of morphologic and demographic features of intracranial aneurysms with their rupture: a retrospective analysis. Acta Neurochir Suppl. 2013;115:275-8. doi: 10.1007/978-3-7091-1192-5_48. PMID: 22890680.
39. Morimoto M, Miyamoto S, Mizoguchi A, Kume N, Kita T, Hashimoto N. Mouse model of cerebral aneurysm: experimental induction by renal hypertension and local hemodynamic changes.**Stroke**. 2002; 33:1911–1915. doi: 10.1161/01.str.0000021000.19637.3d
40. Orz, Y., & AlYamany, M. (2015, March). The impact of size and location on rupture of intracranial aneurysms. Asian Journal of Neurosurgery, 10(01), 26–31. https://doi.org/10.4103/1793-5482.144159.
41. Ali, M. S., Chalouhi, N., Ding, D., Dumont, A. S., Hare, J. M., Hasan, D.

M., Jabbour, P., Lege, A. M., Owens, G. K., Pascale, C. L., Starke, R. M., Thompson, J. W., & Toborek, M. (n.d.). Cigarette Smoke Initiates Oxidative Stress-
Induced Cellular Phenotypic Modulation Leading to
Cerebral Aneurysm Pathogenesis. - CORE. Cigarette Smoke Initiates Oxidative Stress-Induced Cellular Phenotypic Modulation Leading to Cerebral Aneurysm Pathogenesis. CORE.https://core.ac.uk/works/45225647

42. Abdulazim A, Heilig M, Rinkel G, Etminan N. Diagnosis of Delayed Cerebral Ischemia in Patients with Aneurysmal Subarachnoid Hemorrhage and Triggers for Intervention. Neurocrit Care. 2023 Oct;39(2):311-319. doi: 10.1007/s12028-023-01812-3. Epub 2023 Aug 3. PMID: 37537496; PMCID: PMC10542310.

43. Intraventricular Hemorrhage Caused by Subarachnoid Hemorrhage: Does the Severity Matter? Marvin Darkwah
Oppong , Oliver Gembruch , Annika Herten , Roman Frantsev , Mehdi Chihi , Philipp Dammann , Nicolai El
Hindy, Michael Forsting , Ulrich Sure , Ramazan Jabbarli Department of Neurosurgery, University Hospital Essen, Essen, GermanyInstitute for Diagnostic and Interventional Radiology, University Hospital Essen, Essen, Germany Received 29 November 2017, Accepted 23 December 2017, 3 January 2018, Version of Record 27 February 2018

44. Husson, R. N., Saini, R., Lewis, L. L., Butler, K. M., Patronas, N., & Pizzo, P. A. (Year). Cerebral artery aneurysms in children infected with human immunodeficiency virus. Journal Name, Volume(121).

45. Lee GJ, Eom KS, Lee C, Kim DW, Kang SD. Rupture of Very Small Intracranial Aneurysms: Incidence and Clinical Characteristics. J Cerebrovasc Endovasc Neurosurg. 2015 Sep;17(3):217-22. doi: 10.7461/jcen.2015.17.3.217. Epub 2015 Sep 30. PMID: 26526401; PMCID: PMC4626345.

8.0 APPENDIXES

APPENDIX I: DATA COLLECTION FORM- RADIOLOGY DEPARTMENT

1. SOCIODEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENT

Age

i. 20-30
ii. 31-40
iii. 41-50
iv. 51-60
v. 61-70
vi. Above 71

Sex

i. Male
ii. Female

Smoking

i. Yes
ii. No

2. CLINICAL CHARACTERISTICS - RISK FACTORS

Alcohol consumption

i. Yes
ii. No

Hypertension

i. Yes
ii. No

Diabetes mellitus

i. Yes
ii. No

- PRESENTING CLINICAL SYMPTOM

Headache

i. Yes

ii. No

Visual disturbances

i. Yes

ii. No

AMS

i. Yes

ii. No

Seizures

i. Yes

ii. No

Vomiting

i. Yes

iii. No

Lateralizing sign:

i. Yes

ii. No

2. RADIOLOGICAL PATTERNS OF CEREBRAL ANEURYSMS

State of aneurysm

i. Ruptured

ii. Unruptured

Number of aneurysms

i. Solitary

ii. Multiple

Location of aneurysm

i. Cavernous portion of ICA

ii. Supraclinoid portion of ICA

iii. Anterior cerebral artery

iv. Anterior communicating artery

v. Middle cerebral artery

vi. Basilar artery
vii. Posterior cerebral artery
viii. Posterior communicating artery

Size of aneurysms

i. <5mm (small)
ii. 5-10 mm (medium)
iii. 10-25 mm (large)
iv. >25 mm (giant)

Type of aneurysm

i. Saccular
ii. Fusiform

Morphological characteristics (optional)

i. Neck width

3. ASSOCIATED COMPLICATIONS

i. Subarachnoid haemorrhage
ii. Hydrocephalus
iii. Intraparenchymal haemorrhage
iv. Ischemic stroke
v. Mass effect
vi. Intraventricular hemorrhage

8.1 APPENDIX II. CONSENT FORM (ENGLISH VERSION)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS,

MUHAS

ID-NO…….

Consent to Participate in a Study

My name is Dr. Aisha Mahfoudh Haji. I am conducting a study on **CLINICAL CHARACTERISTICS, RADIOLOGICAL PATTERNS AND ASSOCIATED COMPLICATIONS AMONG PATIENTS DIAGNOSED WITH INTRACRANIAL ANEURYSM BY CT ANGIOGRAPHY AT MOI**

Study Purpose

The study is conducted as a partial fulfilment of the requirements for the degree of Master of Medicine in Radiology at MUHAS. The study aims to evaluate the clinical characteristics, radiological patterns and associated complications among patients diagnosed with intracranial aneurysm by CT angiography at Muhimbili Orthopedic Institute. You are being asked to participate in this study because your information on symptoms and findings will be of great help in earlier management of patients with intracranial aneurysms before complications occur. Kindly be honest and true for accuracy of the results that could lead to better intervention and recommendations in the future.

How to be involved

The Patients who agree to participate in this study will be required to sign the consent form, then interviewed after that.

Confidentiality

The information obtained from you will be confidential. No name will appear on any document of this study instead Identification numbers will be used.

Participation and Right to Withdraw

Involvement in this study is voluntary. You can participate or refuse to participate from this study. Refusal to participate from this study will not interfere with your management.

Benefits

Collectively, the findings of this study will provide a statistical evidence-based suggestions and recommendations on importance of knowing the clinical characteristics, radiological patterns and associated complications among patients diagnosed with intracranial aneurysm by CT angiography at Muhimbili Orthopedic Institute which will help in early interventions to reduce morbidity and mortality.

Contact Personally

If you ever have questions about this study, you should contact the Principal Investigator, Dr. Aisha Mahfoudh Haji, Muhimbili University of Health and Allied Sciences, Mobile no.: 0772070617 P. O. Box 65001(email: aisha.m.haji@gmail.com). In case you have questions about your rights of participation in this study, you may contact Dr. Mechris Mango, who is the supervisor of this study.

Participant agrees.

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

Signature of participant ……Date…….……

Signature of Researcher ……..Date…….

8.2 APPENDIX III: CONSENT FORM (SWAHILI VERSION)

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI

KURUGENZI YA TAFITI NA UCHAPISHAJI

FOMU YA RIDHAA

Namba ya utambulisho……..

Ridhaa ya kushiriki kwenye utafiti

Habari. Jina langu ni Dr.Aisha Mahfoudh Haji.Ninafanya utafiti sifa za mgonjwa, radiolojia, na matatizo katika wagonjwa waliogunduliwa na vivimbe katika mirija ya damu katika ubongo katika Taasisi ya Mifupa ya Muhimbili.

Madhumuni ya Utafiti

Utafiti huu unafanywa kama utimilifu wa sehemu ya mahitaji ya Shahada ya Uzamili ya Tiba katika Radiolojia katika MUHAS. Utafiti unalenga kutathmini sifa za mgonjwa, radiolojia, na matatizo katika wagonjwa waliogunduliwa na vivimbe katika mirija ya damu katika ubongo katika Taasisi ya Mifupa ya Muhimbili. Unaombwa kushiriki katika utafiti huu kwa sababu maelezo yako juu ya dalili na matokeo yatasaidia sana katika usimamizi wa awali wa wagonjwa wenye uvimbe katika mishipa ya damu kwenye ubongo kabla matatizo kutokea. Tafadhali kuwa mwaminifu na

mkweli kwa usahihi wa matokeo ambayo yanaweza kusababisha uingiliaji kati bora na mapendekezo katika siku zijazo.

Jinsi ya kushiriki

Ukikubali kushiriki katika utafiti huu, utasailiwa alafu utatakiwa kujibu maswali kutoka kwenye dodoso lililoandaliwa.

Usiri

Taarifa zote zitakazokusanywa kupitia dodoso hili zitakuwa ni siri. Jina lako

Halitatumika badala yake tutatumia namba ya utambulisho.

Uhuru wa kushiriki na haki ya kujitoa

Kushiriki kwenye utafiti huu ni hiari. Unaweza kushiriki au kukataa kushiriki na hii haitakuondolea haki ya kupata matibabu yako.

Nani wa kuwasiliana naye

Kama una maswali kuhusiana na utafiti huu, wasiliana na mtafiti mkuu Dkt. Aisha Mahfoudh Haji, Chuo Kikuu cha Afya na Sayansi ya Tiba Muhimbili, S. L. P. 65001, Dar es Salaam, Simu 0772070617, aisha.m.haji@gmail.com , au msimamizi wa utafiti huu Dr.Mechris Mango.

Kama umekubali kushiriki weka sahihi

Mshiriki amekubali

Mimi..... nimesoma maelezo ya fomu hii nimeyaelewa na nimekubali kushiriki katika utafiti huu.

Sahihi ya mshiriki…… Tarehe ya kutia sahihi…….....

Sahihi ya mtafiti…… Tarehe ya kutia sahihi……

8.3 APPENDIX IV: ETHICAL LETTERS

UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATION

Ref. No.DA.282/298/01.C/1846 Date: 06/08/2023

MUHAS-REC-08-2023-1846
AISHA MAHFOUDH HAJI
SCHOOL OF MEDICINE
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: RADIOLOGICAL PATTERNS AND ASSOCIATED COMPLICATIONS OF INTRACRANIAL ANEURYSMS IN PATIENTS ATTENDING MUHIMBILI ORTHOPEDIC INSTITUTE

Reference is made to the above heading,

I am pleased to inform you that the Chairperson has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 06/08/2023
EXPIRATION DATE OF APPROVAL: 06/08/2024

STUDY DESCRIPTION:
Purpose:
The purpose of this study is to determine the clinical characteristics, radiological patterns and associated complications among patients diagnosed with intracranial aneurysm by CT angiography at Muhimbili Orthopedic Institute

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided: https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2014844.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country,
8. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
9. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
10. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.

Dr. Nahya Salim Masoud,
Chairperson, MUHAS Research and Ethics Committee



MOI
MUHIMBILI ORTHOPAEDIC INSTITUTE

Ref.PA290/338/01/68 **15th AUGUST 2023**

Director post Graduate Studies

MUHAS

POBX 65001

Dar es Salaam

Tanzania.

RE: APPROVAL FOR CONDUCTING STUDY

Reference is made to your letter dated on 11th August, 2023

On behalf of the Management I would like to inform that, your request for **Aisha Mahfoudh Haji with Reg. no. HD/MUH/T.233/2021** has been granted to conduct a study *titled* **Radiological Pattern and Associated Complications of Intranial Aneurysms in Patients Attending** Muhimbili Orthopaedic Institute (MOI).

This letter will introduce you to the Director of clinical support. It's my hope that your stay at MOI will be fruitful. For any clarification contact CRTM +255713764522.

Dr. Joel J Bwemelo, CRTM

For: MOI Executive Director

Cc: Manager Radiology

Cc: I/C Radiology

MUHIMBILI ORTHOPAEDIC INSTITUTE P. O. Box 65474 DAR-ES-SALAAM