PATTERNS OF CORONARY ARTERY DISEASE AMONG CARDIAC PATIENTS REFERRED FOR COMPUTED TOMOGRAPHY ANGIOGRAPHY AT MUHIMBILI HOSPITALS.

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MMed (Radiology and Imaging) Dissertation

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Department of Radiology and Imaging

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By

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A Dissertation Submitted in Complete Fulfillment of the Requirement for the Degree of Master of Medicine in Radiology and Imaging of

Muhimbili University of Health and Allied Sciences

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CERTIFICATION

The undersigned certify that she has read and hereby recommend for examination of dissertation entitled "**Patterns of coronary artery disease among cardiac patients referred for computed tomography angiography at Muhimbili Hospitals Dar es Salaam, Tanzania Nov 2018 – June 2019, i**n fulfillment of the requirement for the degree ofMaster of Medicine (Radiology) of Muhimbili University of Health and Allied Sciences.

_____

Dr. Lulu Fundikira

(Supervisor)

Date: _____

DECLARATION AND COPYRIGHT

I, **Dr. Fredy F Rutachunzibwa**, declare that this dissertation entitled "**Patterns of coronary artery disease among cardiac patients referred for ct angiography at Muhimbili Hospitals Dar es Salaam, Tanzania Nov 2018 – June 2019** is my own original work and that it has not been presented and will not be presented to any other university for similar or any other degree award.

Signature_____ Date_____

DEDICATION

Education has no end

ABSTRACT

Background

Coronary artery disease(CAD) is the leading cause of death in many advanced countries with its prevalence increasing among developing countries. In 2001 CAD was responsible for 7.3million deaths and 58million disability-adjusted life years lost worldwide. Invasive coronary angiography (ICA) is widely used as a reliable technique to diagnose CAD. Due to its superior spatial and temporal resolution. However it is invasive and expensive procedure associated with mortality and morbidity(1).

In comparison, the application of Coronary Computed TomographyAngiography (CCTA) in the diagnosis of coronary artery disease (CAD), allows for excellent visualization of anatomical details of coronary artery and its branches and is the only imaging modality which has been widely used in the diagnosis of CAD with high diagnostic accuracy.

High quality coronary computed tomography angiography(CCTA) (64slices and above) is not only able to provide reliable information of coronary luminal changes ,but also has the potential to visualize morphological changes of coronary arterial walls, characterize atherosclerotic plaques and identify non stenotic plaques . Despite satisfactory results achieved, CCTA has the disadvantage of high radiation dosing which leads to cancer.

Furthermore, Coronary Computed Tomography Angiography (CCTA) plays as a gateway to decide who should go for Invasive Coronary Angiography (ICA) and also performing CCTA is a cost effective strategy in the management of patients.

On top of that, in a study of Coronary Computed Tomography Angiography(CCTA),there is a component of Coronary artery calcium score(CACS) that is performed prior to CCTA and it intends to determine the presence of coronary artery calcifications, although studies have shown that CACS alone cannot be relied upon, in making decision especially to risky and symptomatic patients(2).

Objective:

Patterns of coronary artery disease among cardiac patients referred for Computed coronary tomography angiography at Muhimbili Hospitals Dar es Salaam, Tanzania Nov 2018 – June 2019.

Methodology:

This wasdescriptivecross-sectional studythat involved220 individuals selected from Patients referred for CCTA at MNH.Dependent variables included (plaque, calcifications, stenosis and occlusion) while Independent variables included (age, gender, hypertension and cigarette smoking), wereanalysed using Chi square or fishers test p value of<0.05, was considered significant.

Structured Questionnaires were used to collect data which later were analyzed using SPSS version 23.

The images were reported by me and later on were approved by the Senior Radiologist

Results:

A total of 220 patients above 50 years were recruited into the study. 49.1% of men were found to have CAD more than female while 57.4% of diabetic patients were found to have CAD than non-diabeticpatients, 78.3% of patients who were smokers had CADand lastly patients above 60 years had CAD more than patients with less or equal to 60 years

Furthermore,in a sample size of 220, all patients underwent coronary Computed tomography angiography but 124 patients underwent Coronary calcium protocol and CCTA.Out of 124, 72 patients had no coronary artery calcifications while 52 patients had coronaryartery calcifications.

Therefore in a group of 72 patients. Many patients (94.4%) were found to have no coronary calcifications, hence were found to have no CAD on CCTA,however few patients 5.6% without coronary calcifications were found to have soft plaque on CCTA,therefore were confirmed to have CAD.

Among the coronary arteries,the most affected one was LAD whose total plaques were 45.28%, followed by RCA 27.78% and the least one was RI which had 4.7% of plaques.The most affected part of the vessel was the proximal part however middle and distal segments were less affected and also most of the plaques were eccentric in location.

Conclusion:

Coronary CT Angiography is non invasive and reliable technique to detect and estimate the degree of obstruction,number of affected arteries and pattern of their affection**.**

Recommendations:

There should be routine use of CCTA in patients suspected with CAD as it acts as a gateway totherapeutic invasive angiography**.**

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LIST OF ABBREVIATIONS

ACS	-	Acute Coronary Syndrome
ACS	-	Acute Coronary Syndrome
AHA	-	American Heart Association
ALARA	-	As Low as Reasonably Achievable
ASCVD	-	Atherosclerotic Cardiovascular Disease
BMI	-	Basal Metabolic Index
CABG	-	Coronary Artery Bypass Graft
CAC	-	Coronary artery Calcium
CA	-	Cornus artery
CACS	-	Coronary Artery Calcium score
CAD	-	Coronary Artery Diseases
CCTA	-	Coronary Computed Tomography Angiography
CT	-	Computed Tomography
DM	-	Diabetes Mellitus
FRS	-	Framingham Risk Score
HDL	-	High density lipoprotein cholesterol
HDL	-	High density lipoprotein cholesterol
HU	-	Hounsfield Unit
ICA	-	Invasive Coronary Angiography
IVA	-	Inferior Interventricular artery
JKCI	-	Jakaya Kikwete Cardiac Institute
LM	-	Left main coronary artery
LAD	-	Left anterior descending
LCX	-	Left Circumflex artery
LDL	-	Low density lipoprotein cholesterol
MACE	-	Major Adverse Cardiac event
MAMC	-	Mloganzila Academic and Medical Center
MDCT	-	Multi detector Computed Tomography

MI	-	Myocardial Infarction
MNH	-	Muhimbili National Hospital
MUHAS	-	Muhimbili University of Health and Allied Sciences
NCCT	-	Non contrasted Computed Tomography
NCP	-	Non calcified plaque
OHCA	-	Out of hospital Cardiac Arrest
PCI	-	Percutaneous Coronary Intervention
RCA	-	Right coronary artery
RI	-	Ramus Intermedius artery
SA	-	Sinoatrial nodal artery
SCAD	-	Spontaneous Coronary Artery Dissection
SPSS	-	Statistical Package for Social Sciences
STEMI	-	ST-elevation Myocardial Infarction
VSD	-	Ventricular Septal Defect

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I would like to express my gratitude to God whose guidance led me to write my dissertation proposal.

Secondly, I acknowledge and appreciate my supervisor Chief Dr Lulu Fundikira for her countless efforts in directing and mentoring me to achieve my proposal. I also extend my heartfelt gratitude to Dr Fredrick Lyimo of MNH, for his readiness to assist my study.

Lastly but not least, countless regards goes to my wife Dr.RogatheOlomi, thank you for unconditional support, and to my parents for their prayers and encouragement.

CHAPTER ONE

1.0 Introduction

1.1 Background

Coronary artery disease (CAD) is the leading cause of death in many advanced countries with its prevalence increasing among developing countries.In 2001 CAD was responsible 7.3million deaths and 58million disability-adjusted life years lost worldwide.Invasive coronary angiography (ICA) is widely used as a reliable technique to diagnose CAD. Due to its superior spatial and temporal resolution.However it is invasive and expensive procedure associated with mortality and morbidity(1).

In comparison,the application of Coronary CT Angiography in the diagnosis of CAD,allows for excellent visualization of anatomical details of coronary artery and its branches and is the only imaging modality which has been widely used in the diagnosis of CAD with high diagnostic accuracy.

High quality CCTA (64slices and above) is not only able to provide reliable information of coronary luminal changes ,but also has the potential to visualize morphological changes of coronary arterial walls,characterize atherosclerotic plaques and identify non stenotic plaques.

Furthermore, Coronary Computed Tomography Angiography (CCTA) plays as a gateway to decide who should go for Invasive Coronary Angiography (ICA) and also performing CCTA is a cost effective strategy in the management of patients

On top of that, in a study of Coronary CT Angiography(CCTA),there is a component of Calcium score(CACS) that is performed prior to CCTA and it intends to determine the presence of coronary artery calcifications, although studies have shown that CACS alone cannot be relied upon, in making decision especially to risky and symptomatic patients(2).

1.2 Literature Review

Studies have shown that patients with older than 65 years old are at higher risk of developing Coronary Artery Disease(CAD), as opposed to patients with less than 65years old(3).

Symptomatic Individuals with chest pain, cerebral vascular diseases and peripheral vascular diseases have been found to have Coronary Artery Disease(CAD) following Coronary Computed Tomography Angiography (CCTA)(4).

Patients with diabetes mellitus type 2 associated with hypertension have been found to be at risk of developing Coronary Artery Disease(CAD)(5).

Studies have shown that Individuals with greater Basal Metabolic Index(BMI) have greater prevalence, extent and severity of Coronary Artery Disease(CAD)(6).

Individuals with medically treatable risk factors including; diabetes, hypertension and dyslipidemia have been observed to have non obstructive Coronary Artery Disease(CAD)(7).

Studies have shown that asymptomatic patients at high risk of coronary diseases, undergoing Kidney Transplant shows severe Coronary Artery Disease(CAD) post Coronary Computed Tomography Angiography(CCTA)(8).

Survivors of out of the hospital cardiac arrest, studies have shown to have angiographic evidence of coronary artery lesions or angiographic evidence of acute coronary syndrome(9)..

Coronary Computed Tomography Angiography(CCTA) is used to classify patients with Coronary artery disease(CAD)into non obstructive plaque with lumen narrowing <50% or obstructive plaques with severe stenosis>50%(10).

Coronary CT Angiography(CCTA) has been used to determine the association between coronary artery tortuosity and coronary artery diseases(CAD)(11)

Studies have shown that the patterns and plaques in the coronary arteries have been well evaluated by Coronary Computed Tomography Angiography(CCTA)(12)

Studies have shown that Left Anterior Descending (LAD) is the most commonly occluded of the coronary arteries. It provides the major blood supply to the inter-ventricular septum and thus bundle branches of the conducting system. The result is impairment or death infarction of the conducting system(13).

In symptomatic patients referred for Coronary Computed Tomography Angiography (CCTA), studies have shown that the absence of coronary artery calcium, reduces but does not fully eliminate the occurrence of obstructive Coronary Artery Disease CAD(14).

In ischemic stroke patients without chest pain, Coronary Computed Tomography Angiography (CCTA) findings of Coronary Artery Disease (CAD) provide additional risk discrimination over Coronary Artery Calcium Score CACS(15).

Studies have shown that,coronary plaque burden measured by CCTA independent of stenosis is a significant independent predictor of coronary artery diseases events and mortality(16)

Also recent studies have shown that,CCTA has been recently evaluated for its ability to assess coronary artery characteristics including plaque composition.And identification of the relationship between plaque compositionand patient clinical presentations may provide insight into the pathophysiology of coronary artery plaque,thus assisting identification of vulnerable plaques which are associated with acute coronary artery syndrome(17)

Studies have shown that Coronary CT Angiography has been used to evaluate different patterns of coronary artery diseases among patients with unstable angina(18)

Studies have shown that CCTA has been used to determine the relationship of extent and severity of Coronary artery diseases to risk of incident major adverse cardiac events(defined as death, myocardial infarction and late revascularization)(19).

Also studies have shown that cost effectiveness and post ICA complications ,could be avoided by the use of CCTA because its non expensive and non invasive(20).

Studies have shown that,the use of CCTA has been able to act as a gate away to decide over patients who will benefit for Invasive Coronary Angiography(ICA)(21).

Studies have shown that Coronary Computed Tomography has been increasingly used in the diagnosis of coronary artery diseases due to improved spartial and temporal resolution.Diagnostic performance of CCTA has been significantly improved with the technological development in Multislice CT Scanners from the early generation of 4 Slices to 320slices(22).

Studies have shown that Coronary CT Angiography has been able to classify patterns of coronary artery diseases into none,mild moderate and severe coronary artery calcifications(23)

Studies have also shown that Coronary CT Angiography has been used to determine the extent and distribution of coronary artery plaques and calcified plaques have been common followed by mixed and soft plaques being the last(24).

Coronary CT Angiography has shown that,most affected vessel is the LAD,while LAD and LCX are less affected,and the most affected segment is the proximal segment(25)

Studies have shown that Coronary Computed Tomography Angiography (CCTA) has been introduced as a more contemporary adjuncts to coronary calcium score(CACS), offering the ability to determine measures of stenosis, severity and atherosclerotic features, findings may enable improved risk stratification than over CACS(26).

Patients suspected of Acute Coronary Syndrome(ACS), non-calcified plaques detected by Coronary Computed Tomography Angiography (CCTA) are more prevalent and the absence of coronary calcium does not reliably exclude the presence of atherosclerosis(27).

1.3 Problem Statement

Clinicians in Tanzania are not fully aware of the importance of referring patients for Coronary Computed Tomography Angiography (CCTA), as a diagnostic tool for patients with coronary artery disease, instead they opt for Invasive Coronary Angiography (ICA), which is used for diagnosis and therapeutic as well. This has led to mismanagement and financial burden to the patients.

A study done by Mladen Jukic et al and Ladislav Pavic et al, have shown that Coronary Computed Tomography Angiography (CCTA) is the fastest and only growing application for Computed Tomography in the United States with approximately 500000 Americans undergoing CCTA yearly. However diagnostic Invasive Coronary Angiography (ICA) is now recommended more or less only if the results of non-invasive testing suggest high likelihood of significant 3 vessel disease, severe affliction of left anterior descending or single remaining patent vessel and if there is a proven large area of ischemia especially if accompanied with dyspnea or congestive heart failure(21).

Studies have shown that Coronary Computed Tomography Angiography(CCTA) has emerged as an effective non-invasive method for direct visualization of coronary arteries with high diagnostic performance compared with Invasive Coronary Angiography(ICA)(28).

It has also been shown that in a study to explore the cost effectiveness of two alternative strategies that is Coronary Computed Tomography Angiography versus Invasive Coronary Angiography(CCTA VS ICA) to rule out significant coronary artery diseases(CAD) in the pre-operative evaluation, 71.2% of ICA and 3.56% of post ICA complications could have been avoided by initial pre-operative CCTA associated with financial saving(20).

However with Coronary Computed Tomography Angiography(CCTA), acts as a gateway to decide who should go for Invasive Coronary Angiography(ICA), studies have shown that with CCTA, can detect and grade coronary vascular lesions, can grade the severity of vascular lesions into none luminal stenosis, non-obstructive plaques with luminal narrowing of less or equal to 50% and obstructive plaque with maximum stenosis greater or equal to 50%(10).

Tanzania as one of the developing countries, currently there are no studies that have been done on the findings of coronary arteries in patients referred to CCTA.

1.4Rationale of the Study

The presence of coronary artery disease has been associated with cardiovascular risk events. With the presence of Coronary Computed Tomography Angiography (CCTA) will be helpful to diagnose both asymptomatic and symptomatic, hence making a way for timely coronary intervention.

I believe findings from this study will enable more clinicians to utilize it as first line of investigations, hence reducing risk of invasive procedure therefore better outcome and proper medical decision towards patient care.

Also with more utilization of this investigation, will reduce the financial burden for the patients, upon taken for direct invasive coronary angiography (ICA) prior to Coronary Computed Tomography Angiography (CCTA).

1.4.1Research questions

1. What are the risk factors for CAD to patients referred for CCTA?
2. What is the relationship between Coronary artery calcifications and Coronary artery angiographic findings in patients with CAD?
3. Which vascular territory is most affected in patients with CAD undergoing CCTA?
4. What is the pattern of Coronary Angiography in patients with CAD undergoing CCTA?

1.5 OBJECTIVES:

1.5.1 Broad Objective

To determine pattern of coronary artery disease among cardiac patients referred for computed tomography angiography at Muhimbili national hospitals from November 2018 to June2019.

1.5.3Specific Objectives

1. To determine risk factors for CAD in patients referred for CCTA at Muhimbili hospitals from November 2018 to June 2019.
2. To determine the relationship between coronary artery calcifications and coronary artery angiographic findings in patients with CAD referred to CT Unit at Muhimbili hospitals from November 2018 to June 2019.
3. To determine the territorial distribution of coronary angiographic findings to patients with CAD referred for CT Unit from November 2018 to June 2019.

4. To determine patterns of coronary angiographic findings in patients with CAD referred for CT unit at Muhimbili hospitals from November 2018 to June2019.

CHAPTER TWO

2.0 MATERIALS AND METHODS

2.1Study Design

The study was hospital based, descriptive cross sectional study, and it was conducted between November 2018 to June 2019. The data collecting tool was a well-structured questionnaire.

2.2 Study Population, area and duration.

The study population was, the patients suspected with CAD referred for coronary angiography at CT Unit.

Study areas were at MAMC and MNH referral teaching hospitals located in Ubungo and Ilala districts respectively.

These hospitals were chosen because they received referral patients from all regions in Tanzania, referred by JKCI (Jakaya Kikwete Cardiac Institute), Regional hospitals, District hospitals and Faith based hospitals.

2.3 Sampling and sample size

Convenient non probability sampling technique was used to get the desired sample size, which involved all cardiac patients with coronary artery diseases referred for Coronary CT Angiography.

2.4 variables

Independent variables-Age

-Gender

-DM

-Cigarette smoking

Dependent variables-Plaque

-Calcifications

-Stenosis

-Occlusion

Sample size for this study focused only on Cardiac patients with coronary artery disease referred for CT coronary Angiography at MAMC and MNH Radiology Department.

20% Prevalence (Journal of Cardiology and Clinical Research), published on 17th Feb 2017 was considered as statistically significant in this observational study. No local study was carried out; however such studies were carried out in other countries with multiple prevalence,

N=Sample size

Z=1.96

P=20%

E=Marginal error 5%

$n=Z^2P(100-P)/E^2$

=1.96x1.96x0.2 (1-0.2)/ (0.05x0.05)

=245

2.4.1 Inclusion criteria

1) All cardiac patients referred by physicians for Coronary CT Angiography at JKCI(Heart Institute within MNH) and MAMC.

2) All patients with no known contrast allergy.

3) Patients above 50 years.

4) Cardiovascular risk factors like; smoking, DM, dyslipidemia and hypertension.

5)Patients whose signed the consent form

2.4.2Exclusion criteria

Non eligible patients including

1. Patients with history of Cardiac Surgery, including Cardiac bypass surgery and Implanted cardiac devices.
2. Patients with history of Organ transplantation.
3. Patients with history coronary intervention within the past 6 months.
4. Patients with history of contrast Induced nephropathy.
5. Patients with history of elevated serum creatinine greater than 1.5mg/dl.
6. Patients with known contrast allergic reaction.
7. Patients less than 50 years old

2.5 Ethical consideration

Ethical clearance to conduct the study was obtained from Muhimbili University Ethical Committee. Permission to conduct the study at MNH and MAMC Radiology department were obtained from MNH and MAMC authority respectively. Written informed consent was used to study participants. Information recorded in questionnaire and clinical forms were used only for the study and not otherwise.

2.6 Research Instruments.

2.6.1 Questionnaires and CCTA findings recording forms

Self-administer questionnaires (appendix 1) were used to collect patients information.

2. 7CCTA Imaging Techniques and Evaluation

2.7.1 Imaging Techniques

The equipment used for CCTA include;

KV120, mAs 70, field of view 26cm to 35cm scan mode, axial reconstruction partial scan an ECG gated prospective each 75% or 50% of R-R interval with helical acquisition using slices thickness of 3mm slice spacing of 3mm, 0.6mm (MNH 128 slices CT) and 0.625mm (MAMC CT) collimations and 410/10

Window levels using MDCT-Siemens Soma tom definition Scanner, Frankfurt, Germany, MFD Oct 2010) at MNH and GE Optima CT 660-SE

62KW, 64 slices Duo camera Scanner, GE Health care Tokyo Japan

Corporation MFD April 2016 at MAMC.Both CT Machines have injector pumps.

Before a patient underwent CCTA, there were questions that a patient would be asked like.

1. If a patient was allergic to contrast.
2. If a patient was having high levels of creatinine and a proof of lab creatinine result would be checked.
3. If a patient had any claustrophobia.

If the patient was fit for the examination,then he or she would be explained on the whole process of examination,from entering the gantry until he walked out of it.

So before the patient entered the gantry,he would undergo HR (Heart rate examination), and normally the HR was supposed to be between 65 to 70b/min).

If the HR was higher,the patient was counseled to relax and rest,then he would come for recheck .If HR was still higher,then T.metoprolol 100mg stat would be instituted to him,after an hour,HR would be rechecked.

So if HR was normal,a patient will be told to change the clothes in a special room then a nurse will cannulate the patient.

There after the patient was instructed to lie on the examination table,then the cannula was connected to a patient line,then the patient line was connected to dripping chamber,the dripping chamber was connected to a duo injector pump,that contained normal saline and the contrast(nonionic contrast iopamidol).The contrast was administered based on weight (2mls/kg) while the normal saline was given 40mls.

When the patient lied on the examination table,the ECG leads would be placed at the bilateral supraclavicular regions and at the iliac wings in order to monitor the ECG tracing during examination.

Then the patientwas told that the table would slide in and out of the tunnel rotating around the patient, containing detectors located opposite to each other in a gantry.

Furthermore the patient was told that, the technologist would stay in a separate control room operating the scanner and monitor the examination in direct visual contact with the ability to hear or communicate with the patient with the use of the speakers.

2.7.2 MDCT Coronary Angiography Protocol

NOTE: Normally a technologist would do anon-contrasted study first before CCTA, whose aim was to visualize the presence of coronary artery calcifications, and whencompleted,CCTA would start as follows;

Contrast injection (iopamidolnon ionic contrast 2mls /kg followed bysaline chaser that was given after 9seconds) would be done via injector pump.The aim of saline chaser was to dilute the contrast in the right heart chamber so that the right coronary artery could easily be visualized.

The scan was started by bolus triggering in the ascending aorta,during the course of the study either Prospective or Retrospective ECG gated was used.

Prospective ECG gated was used when the patient Heart rate was stable ranging from 63.64 or 65 b/pm.The advantage of this was short time duration and good image resolution.

If the Heart rate was abnormally high,the patient would be given 100mg stat of metoprolol before and if during examination the heart rate was still high,the patient would be instructed by a machine to hold breath for some seconds and Retrospective ECG gated was used.

Retrospective ECG gated was time consuming with much radiation exposure than prospective but the image quality couldn’t be affected by artifcatsand with retrospective, editing could be done especially when the heart rate was abnormally high.

When the scanning process was over,the technologist would do reconstruction formats and only two would be done.

1) **Trans axial**

This consisted of 2 dimensional image stacked in alongitudinal (cranial,caudal or axis) direction.

The usefulness of this reconstruction enabled me to depict coronary artery anatomy from straightcaudal cranial perspective.

The major advantage of this format was that the image information content displayed minimum likelihood of distortion and errors consequent to post processing and maximum resolution.

2) MPR(MultiplanarReformattion)

This was an alternative high resolution reconstruction format that allowed displayed of planar images at any angulation section,so this would permit axial plane,orthogonal plane and oblique that followed better the arterial course in the thorax.

2.7.3 Interpretation and reporting of CCTA

Interpretation should be made on 3 dimensional cardiac-specific interpretation software equipped to display recommended image reconstruction formats.

Images were reviewed in the appropriate post processing formats.

The data set should be previewed for artifacts.

Non contrasted studies should be reviewed before contrast studies.

Therefore during reporting the coronary tree was examined systematically.

Lesions were reviewed in multiple planes and conceptualized in 3 dimensions.

Lesions were assessed for origin, plaquequality and morphology of plaque, not just for stenosis severity.

Extra coronary cardiac and thoracic anatomy should be examined within the cardiac field of view(29).

All this were done by principal investigator and validated by Senior Radiologist

NOTE:

During reporting I experienced image artifacts that interfered with image interpretation and the artifacts were caused by;

1. Body motion
2. Respiratory motion
3. Arrhythmia
4. Stair step artifact (31)

If these artifacts caused me not to report,I would ask the patient to repeat the examination, some agreed while some did not,to those who did not wish to repeat,I and Senior Radiologist.

Images for Coronary Angiography (Appendix 3).

2.8 Data Analysis

Data was analyzed by using the Statistical Package for Social Science (SPSS), for windows version 23

Dependent variables included (plaque,calcifications, stenosis and occlusion), and independent variables included (age, gender, hypertension,cigarette smoking and Diabetes mellitus were analysed using Chi square or Fishers exact test.

All analysis were two sided and a p value of <0.005 was taken as a cut off point for statistical significance.

CHAPTER THREE

3.0 RESULTS

In this current study,all patients who underwent CCTA were hypertensive with high levels of cholesterol

Also female patients who underwent CCTA were slightly more than the male patients

Variables	Frequency	Percentage
Age;<60	97	44.1
>60	123	55.9
Female	112	50.9
Male	108	49.1
Hypertension	220	100%
Diabetes	47	21.4%
Smoking	23	10.5%
High cholesterol	220	100%

Table 1: Socio-demographic factors to patients undergoing CCTA

The table below shows that,patients with diabetic and smoking were more affected with coronary artery diseases compared to non diabetic and non smokers respectively

However male patients and patients above 60 years old were seen to be more affected than female patients and patients less than 60 years old.

		CAD		P- value
Risk Factors	Category	Yes (%)	No (%)	
DM	Yes	27(57.4)	20(42.6)	<0.001
	No	48(27.7)	125(72.3)	
Smoking	Yes	18 (78.3)	5(21.7)	<0.01
	No	57(28.9)	140(71.1)	
Sex	Male	53 (49.1)	55(50.9)	<00.00
	Female	22(19.6)	90(80.5)	
Age	>60	49(39.8)	74(60.2)	<0.045
	≤60	26(26.8)	71(73.2)	

Table 2: The table demonstrates risk factors associated with CAD to patients referred for CCTA

In our study of 220 patients, 94.4% of patients with CACs Score of zero had no CAD on CCTA.

However 5.6% patients without coronary calcifications had CAD on CCTA.

Also all patients with coronary calcifications had 100% CAD on CCTA.

Coronary artery calcification	CCTA	
	CAD (%)	Normal (%)
CAC present	52 (100)	0 (0.0)
CAC absent	4 (5.6)	68 (94.4)

Table 3: The relationship between CCTA and Coronary calcium findings

In thisstudy, the most affected coronary artery was LAD followed by RCA, while the least affected coronary artery was RI.

Coronary arteries	Number of vessel with plaque	Percentage of vessel with plaque
RCA	35	27.78
LM	12	9.5
LCX	16	12.69
LAD	57	45.23
RI	6	4.7

Table 4: The table demonstrates territorial distribution of coronary angiographic findings to patients referred for CT Unit.

In our study,it showed that among the affected non stenotic coronary arteries,the calcified plaques were the commonest compared to mixed plaques and non calcified plaques.

The table below shows that,calcified plaques were more common compared to mixed plaques among the non stenotic coronary arteries.However there was no non calcified plaque present among the non stenotic coronary arteries.

Non stenotic coronary arteries	Plaque composition		
	Non calcified N (%)	Mixed N (%)	Calcified N (%)
RCA		7 (36.8)	12 (63.15)
LM			11(100)
LAD		14(45.16)	17(54.8)
LCX		3(30.0)	7(70.0)
RI			1(100)

Table 5:The table demonstrates plaquecharacteristics in the non stenotic Coronary arteries.

The table below shows that the most common affected segment among the non stenotic coronary arteries was the proximal segment while the rest of other segments were less affected.

However most of the plaques were eccentric in location while less plaques were concentric.

Non stenotic coronary arteries	Location of plaques N (%)	Plaque configuration N (%)
RCA	Proximal 12 (63.15)	12 (100) Eccentric
	Mid 7(36.8)	2 (28.57) Concentric 5 (71.43) Eccentric
LM	Proximal 11 (100)	11 (100) Eccentric
LAD	Proximal 17(54.8)	17 (100) Eccentric
	Distal 14(45.16)	7 (50.0) Concentric 7 (50.0) Eccentric
LCX	Proximal 7(70)	7(70) Eccentric
	Distal 3(30)	3(30) Concentric
RI	Proximal 1 (100)	1 (100) Eccentric

Table 6: The table demonstrates affected coronary segments and eccentricity of the plaques in the non stenotic coronary arteries.

The table below shows that mixed plaques were more common among the stenotic coronary arteries compared to calcified and non calcified plaques.

Stenotic coronary arteries	Plaque composition		
	Non calcified N (%)	Mixed N (%)	Calcified N (%)
RCA	0(0)	13 (81.25)	3 (18.75)
LM	0 (0)	1 (100)	0(0)
LAD	3(11.5)	15 (57.7)	8 (30.8)
LCX	0(0)	4 (66.7)	2 (33.3)
RI	0(0)	5 (100)	0 (0)

Table 7: The table demonstrates plaque characteristics in the stenotic coronary arteries

The table below shows that the commonest affected segments among the stenotic coronary arteries was the proximal segment which was also associated with different degree levels of stenosis,most notably in the RCA and LAD.However most of the plaques were seen to more eccentric than concentric.

Stenotic coronary arteries	Location	Degree of stenosis	Plaque configuration
RCA	Proximal 13(81.25)	Mild 4 (30.77) Moderate 5 (38.46) Severe 3 (23.08) Occlusion 1(7.69)	12(92.31) Eccentric 1(7.69)Concentric
	Mid 3(18.75)	Mild 2 (66.67) Moderate 1(33.33)	2(66.67)Eccentric 1(33.33)Concentric
LM	Proximal 1 (100)	Severe (1 (100)	1 (100) Eccentric
LAD	Proximal 15 (57.7)	Mild 5 (33.33) Moderate 5 (33.33) Severe 3 (20.0) Occlusion 2 (13.33)	13(86.67) eccentric 2(13.33)Concentric
	Mid 8 (30.8)	Mid 5 (62.5) Moderate 3(37.5)	8(100) Eccentric
	Distal 3 (11.5)	Mild 3 (100)	3(100) Concentric
LCX	Proximal 4 (66.7)	Moderate 3 (75.0) Severe1 (25.0)	4(100) Eccentric
	Distal 2 (33.3)	Mild2 (100.0)	2(100.0) Concentric
RI	Mid 5 (100)	Occlusion 5(100)	5 (100) Eccentric

Table 8: The table below shows location of plaques,degree of stenosis and eccentricity of plaques in the stenotic coronary arteries.

CHAPTER FOUR

4.0 DISCUSSION

In this current study, all of the patients recruitedwere hypertensive with high levels of cholesterol,therefore hypertension and high level of cholesterol could not be assessed as risk factors, due to the absence of non-exposed risk group

In the present study,CAD was found more in diabetic patients 27(57.4%) than non diabetic patients 48(27.7%) which was statistically significant(P<0.001).Exactly as Akira et al(5).,reaveled that in a total of 327 diabetic type 2 patients with average age between 68.3+_8.9 years underwent CCTA,61% of patients had significant coronary artery stenosis.

In the current study,18(78.3%)smokers were found to have CAD compared to 57(28.9%)non smokers with CAD, this was statistically significant (p<0.001).Similar findings were found in a study done by Miura et al(30),who compared non smokers and current smokers and found out that the number of stenosed coronary arteries were higher in smoking group than in non smoking group(p=0.009).

In the current study,patientsabove 60 years(39.8%) were found to have more CAD compared to 26(26.8%) patients less or equal to 60 years.Similar findings were also seen in a study done by Qi et al(1) which showed that patients over 65 years old were 2.5 times more likely to have CAD on CCTA relative to patients under 45 years of age.

In the current study showed that male patients 53(49.1%) had CAD than female patients 22(19.6%),and this was statistically significant(p<0.001).Exact findings were seen in a study done byLiu et al(1);showed that 315(70.0%) males had CAD compared to 234(66.7%)female patient.

Also in the current study only 124patients underwent both calcium protocol and coronary angiography protocol.It was found out that, out of 72 patients with zero coronary calcifications,68(94.4%) had no CAD detected on CCTA ,except for 4(5.6%) of patients who had CAD on CCTA.However all patients with coronary calcifications52(100%) had CAD on CCTA,this was statistically significant (p<0.001).Similar findings were also found in a study done by Plank et al(31) which showed that 306(43%)had zero prevalence of coronary artery calcifications, however out of those,100(32.7%)had non calcified plaque only on CCTA.

Also in the present study showed that the most affected vascular territory was LAD which had 57(45.23%) plaques followed by RCA which had 35(27.78%) plaques and LCX which had 16(12.69%) plaques while the least affected vessel was R1 6(4.7%) .Similar findings were also seen in a study done bySuranyi et al(12) that showed the most affected vessel was LAD (46.3%) ,followed by RCA(25.9%) and the least affected vessel was RI which had(1.3%) of total plaques.

Furthermore in the current study showed that the most affected segment in every vascular territory was proximal segment,for example in RCA had 13(81.25%) plaques,LAD had 15(57.7%) plaques, all such plaques were in the proximal segment.Similar findings were seen in a study done byNiazi et al(18) which showed that the proximal segment was the most common diseased coronary segment,for example in LAD had 90(19.1%) and RCA had 63(13.4%)plaques,all of which were in the proximal segments.

On top of that,in the present study among non stenotic coronary arteries,calcified lesions were most common compared to non calcified and mixed plaques.For example,RCA had 12(63.15%) calcified plaques while in LAD had 17(54.8%)calcified plaque,Exact finding was seen in a study done by Elia et al(18),which showed that among 60 coronary non stenotic lesions,calcific plaques were the most common 31(51.5%) compared to non calcified and mixed plaques.

However in the present study,among stenotic coronary arteries, mixed plaques were the most common compared to non calcified and calcified plaques,for example in RCA had 13(81.25%)mixed plaques and LAD had 15(57.7%)mixed plaques.Similar findings were seen in a study done by Elia et al(18),showed among 33 significant lesion which caused luminal stenosis,there were 19(57.5%) mixed plaques,11(33.4%) calcific plaques and 3(9.1%) non calcified plaque with statistical significance (p value<0.05).

In the present study showed that plaque configuration in both stenotic and non stenotic coronary arteries were more eccentric than concentric.For example among stenotic coronary arteries,RCA had 92.31% of plaques in eccentric, LM had 100% of eccentric plaques and in LAD, 86.67% of plaques were eccentric.Similar findings were seen in astudy done by Suranyi

et al(12), that showed for each major vessel 93.5% of plaques in LM,80.2% of plaques in LAD,78.8% of plaques and 77.1% in LCX,all were eccentric.

CHAPTER FIVE

5.0 CONCLUSION

Coronary CT Angiography is non invasive and reliable technique of high ability to detect and estimate the degree of obstruction,number of affected arteries and pattern of their affection.

5.1Study Limitations

Not all vessels werevisualized,this is because of artifacts,most especially motion artifact, although to some patients,the study was repeated while to other patients resisted to have the study repeated.

5.2Recommendations

CCTA should be more utilized by physiciansbecause,it is; non invasive, costeffective,utilizes less radiation dose and it plays as a gateway to decide who should go for Invasive Coronary Angiography (ICA).

Radiology department should have proper awaiting rooms for the patients who attend Coronary CT angiography in order to avoid abnormal high heart rates caused by phobia created by the surrounding unfriendly environment.The environment appears to be overcrowded by different patients who sometimes seemed to be critically ill.This creates tension and phobia among patients referred for Coronary ct angiography.

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APPENDICES

APPENDIX I (A): CONSENT FORM ENGLISH VERSION

TITTLE: CONSENT TO PARTICIPATE IN A STUDY TITTLED CORONARY ANGIOGRAPHIC FINDINGS TO CARDIAC PATIENTS REFFERED FOR CT UNIT.

My name is Dr Fredy F Rutachunzibwa from MUHAS. I am conducting a study on Coronary Angiographic Findings to patients referred to CT Unit at Muhimbili Hospital.

Purpose of the Study

The study aims to establish the usefulness of Ct Coronary Angiography to patients with congenital Heart Malformations, to patients suspected of Acute Coronary Syndrome, whereby can predict the extent of the diseases and can help to stratify patients at risk and not at risk to cardiovascular heart diseases.

Participation

If you agree to participate into the study, you will be required to answer all the questions that will be asked by the investigator inform of interview.

Confidentiality

All information that will be collected from you will be treated confidential and will not be used for any other purpose other than this study.

Risks

We do not expect any harm to happen to you because of joining in this study. You have all the rights to take part or not, in this study. If you choose not to take part in this study of if you decide to stop participating in the study you will continue to be treated normally. You can stop participating in the study at any time, even if you have already given your consent and if for any reason you would wish to come back into the study after withdrawal, we will be ready to accept you to continue with the study. Refusal to participate or withdrawal from the study will not involve penalty or loss of any benefits to which you are otherwise entitled in your management.

Benefits

Taking part in this study, you will contribute towards getting information that will be used to improve your management and reduce the incidence of cardiovascular events.

Your information and others participating in the study will collectively be used by police makers in addressing discrepancies and give a way of improvement.

Who to contact

If you have questions about the study, you can always contact the following

Fredy Rutachunzibwa, MD, Radiology Resident (Principal Investigator)

School of Medicine (MUHAS)

P. O Box 65001, DSM

Mobile phone No, 0714473523

Lulu Fundikira, MD, MMed Radiology (Research Supervisor)

Senior Lecturer at Radiology Department

Muhimbili University of Health and Allied Sciences

Phone +255 715994849

Also if you have any questions about your rights as a participant, you may contact Dr Bruno Sunguya, Director of Research and Publications, P. O Box 65001, DSM

Signature……

Do you agree to participate? Write the word" Yes", if you

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

Signature of participant……..

Signature of Investigator……..

Date of signed consent……

APPENDIX I (B): CONSENT FORM: SWAHILI VERSION

RIDHAA YA KUSHIRIKI KATIKA UTAFITI KUHUSU “CT CORONARY ANGIOGRAPHY”CT SCAN YA MISHIPA YA DAMU YA MOYO, ILI KUWEZA KUANGALIA KAMA MISHIPA YA MOYO IMEZIBA AMA LAH, NA KAMA IMEZIBA NI KWA KIASI GANI,LAKINI PIA KUANGALIA KAMA KUNA HITILAFU YA KIMAUMBILE YA MIRIJA YA MOYO KWA WAGONJWA WENYE MATATIZO YA KIMAUMBILE YA MOYO

Habari

KwajinanaitwaFredyRutachunzibwa,nidaktarimwanafunzikutokachuokikuu cha afyanasayansishirikishi cha muhimbili.Ninafanyatafitikatikakuangaliamishipayadamuyamoyokamaimezibaamalahnapiakamakunahitilafuyakimaumbilekatikamirijahiyokwawagonjwawotewanaokujakwaajiliyakufanyiwakipimo cha CT Coronary.

Ushiriki

Kama utakubalikujiungakatikautafiti,utahitajikakujibumaswaliyoteutakayoulizwanamtafitikatikausahili.

Usiri

Taarifazotezitakazokusanywakutokakwakozitahifadhiwakatikahaliyausirimkubwa,nahazitatumikakwamalengotofautinayautafitihuupekee.

Madhara

Ni matumainiyetukuwahakutakuwanamadharayatakayokupatawewekutokananaushirikiwakokatikautafitihuu.Halikadharika,unauhuruwakujitoakushiriki pale utakapoamuahivyo.Nakamautaamuakutokushiriki au ukaamuakusitishakushirikikwakokatikautafitihuuutaendeleakuhudumiwakamakawaida.Unawezakusitishaushirikiwakokatikautafitihuuwakatiwowotehatakamaukisharidhiakushirikinaendapokwasababuyoyoteutaamuakurejeakushirikibasiuamuziwakohuoutapokelewakwamoyomkunjufu.Endapoutakataakushiriki au

utaamuakujitoakushirikikatikautafitihuu,haitapelekeawewekuadhibiwa au kunyimwastahikizakozakimatibabu.

Manufaa

Utakaposhirikikatikautafitihuu,utakuwaumechangiakupatikanakwataarifazitakazosaidiakuongezauborawahudumawanazopewawagonjwawamoyonapiakuboreshazaidimatibabuyakokwakupunguzauwezekanowakupatavifovyaghafla

Maelezoyakopamojanayawashirikiwenginekwapamojayatatumiwanawatunga sera zaafyakatikakuboreshamaeneoyenyeupungufunakuwezeshakutoahudumazilizo bora zaidi.

Kwamawasilianozaidikuhusuutafitihuuwasilianana;

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Aidhakwamaswalizaidikuhusuhakizakokamakushirikiwautafitihuu,unawezakuwasilianana Dr Bruno Sunguya
MKURUGENZI WA TAFITI
MUHAS
P.O Box 65001 DSM
Sahihi……
Je unakubalikushiriki?Andikaneno
“Ndiyo”kamaunakubali…….Mimi……,nimesomanakuelewayaliyomokatikafomuhii.Maswaliyanguyamejibiwa.Ninakubalikushirikikatikautafitihuu
Sahihiyamshiriki……
Sahihiyamtafiti…….
Tareheiliyosainiwafomuyaridhaa……

QUESTIONNAIRE AND OBSERVATIONAL CHECKLIST
MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

SCHOOL OF MEDICINE

DEPARTMENT OF RADIOLOGY

P, O Box 65001 DSM, TANZANIA

QUESTIONNNAIRE AND OBSERVATIONAL CHECKLIST FORM FOR ASSESSMENT OF CORONARY ANGIOGRAPHIC FINDINGS TO PATIENTS REFERED TO CT UNIT
PART 1
PATIENTS DEMOGRAPHICS
AGE,
GENDER

M	F

HYPERYTENSIVE

YES	NO

ON HYPERTENSIVE TREATMENT?

YES	NO

HISTORY OF DIABETES

YES	NO

HISTORY OF SMOKING

YES	NO

CURRENT LABORATORY FINDINGS
LDL (mg/dl)/Mmol/l)

1. RIGHT CORONARY ARTERY
   (i) Plaque: present/absent
   If present: calcified/non calcified/mixed
   : Location: proximal, middle and distal
   (ii) Stenosis: present/absent
   If present: Location - (proximal.middle ,distal)

   Degree (mild, moderate. Severe, occlusion)
   Lesion characterization
   (a) Calcified/mixed/non calcified
   (b) Eccentricity (concentric/eccentric

A) CONUS ARTERY
   (i) Plaque: present/absent
   If present: calcified/non calcified
   Location: (ostial/non ostial)

   (ii) Stenosis: present/absent
   If present: Location - (ostial/ non ostial)

   Degree (mild, moderate. Severe, occlusion)
   Lesion characterization
   (a) Calcified/mixed/non calcified
   (b) Eccentricity (concentric/eccentric

SA nodal artery

   (i) Plaque: present/absent
   If present: calcified/non calcified
   Location: (ostial/non ostial)

   (ii) Stenosis: present/absent
   If present: Location - (ostial/non ostial)
   Degree (mild, moderate. Severe, occlusion)
   Lesion characterization
   (a) Calcified/mixed/non calcified
   (b) Eccentricity (concentric/eccentricity

B) ACUTE MARGINAL ARTERY

(i) Plaque: present/ absent
If present: calcified/non calcified
Location: (ostial/non ostial)

(ii) Stenosis: present/absent
If present: Location - (ostial/non ostial)

Degree (mild, moderate. Severe, occlusion)
Lesion characterization
(a) Calcified/mixed/non calcified
(b) Eccentricity (concentric/eccentric

C) POSTERO LATERAL ARTERY

(i) Plaque: present/ absent
If present: calcified/non calcified
Location: (ostial/non ostial)

(ii) Stenosis: present/absent
If present: Location - (ostial/ non ostial)
Degree (mild, moderate. Severe, occlusion)
Lesion characterization

(a) Calcified/mixed/non calcified
(b) Eccentricity (concentric/eccentric

(E) POSTERIOR DESCENDING ARTERY

(i) Plaque: present/absent
If present: calcified/non calcified
Location: (ostial/non ostial)

(ii) Stenosis: present/absent
If present: Location - (ostial/non ostial)
Degree (mild, moderate. Severe, occlusion)
Lesion characterization
(a) Calcified/mixed/non calcified
(b) Eccentricity (concentric/eccentric

1. LEFT MAIN CORONARY ARTERY

(i) Plaque: present/absent
If present: calcified/ non calcified
Location: (ostial/non ostial)

(ii) Stenosis: present/absent
If present: Location - (ostial/ non ostial)
Degree (mild, moderate. Severe, occlusion)
Lesion characterization
(a) Calcified/mixed/non calcified
(b) Eccentricity (concentric/eccentricity

A. LEFT CIRCUMFLEX ARTERY (LCx)

(i) Plaque: present/absent

If present: calcified/ non calcified
Location: (proximal, mid and distal)

(ii) Stenosis: present/absent
If present: Location - (proximal, mid and distal)
Degree (mild, moderate. Severe, occlusion)
Lesion characterization
(a) Calcified/mixed/non calcified
(b) Eccentricity (concentric/eccentric

OBTUSE MARGINAL ARTERY (BRANCH OF LCx)

(i) Plaque: present/ absent
If present: calcified/ non calcified
Location: (OM1, OM2, OM3)

(ii) Stenosis: present /absent
If present: Location - ((OM, OM2, OM3)

Degree (mild, moderate. Severe, occlusion)
Lesion characterization
(a) Calcified/mixed/non calcified
(b) Eccentricity (concentric/eccentric

B. LEFT ANTERIOR DESCENDING ARTERY (LAD)

(i) Plaque: present/absent
If present: calcified/non calcified
Location: (proximal, middle and distal)

(ii) Stenosis: present/ absent

If present: Location - (proximal, middle and distal)
Degree (mild, moderate. Severe, occlusion)
Lesion characterization
(a) Calcified/mixed/non calcified
(b) Eccentricity (concentric/eccentricit

DIAGONAL ARTERY (BRANCH OF LAD)

(i) Plaque: present/absent
If present: calcified/ non calcified
Location: (D1, D2, D3)
(ii) Stenosis: present/absent
If present: Location - (D1, D2, D3)
Degree (mild, moderate. severe, occlusion)
Lesion characterization
(a) Calcified/mixed/non calcified
(b) Eccentricity (concentric/eccentric

SEPTAL ARTERY (BRANCH OF LAD)

(i) Plaque: present/ absent
If present: calcified/ non calcified
Location: - (ostial/ non ostial)
(ii) Stenosis: present/absent
If present: Location - (ostial/ non ostial)
Degree (mild, moderate. Severe, occlusion)
Lesion characterization
(a) Calcified/mixed/non calcified
(b) Eccentricity (concentric/eccentricity

C. RAMUS INTERMEDIUS

(i) Plaque: present/ absent
If present: calcified/ non calcified
Location: - (ostial/ non ostial)

(ii) Stenosis: present/absent
If present: Location - (ostial/ non ostial)
Degree (mild, moderate. Severe, occlusion)
Lesion characterization
(a) Calcified/mixed/non calcified

(b) Eccentricity (concentric/eccentricity

APPENDIX II

1.2 Definition of Terms

CT Coronary Angiography - is an Imaging test that looks at the arteries that supply blood to the heart by using contrast material.

Computed Tomography- is an X-ray technique that uses X-ray sensing unit which rotates around the body along with a computer to create cross sectional images. The images are generated by a computer synthesis of x-ray transmission data obtained for many different directions in a given plane.

Coronary Artery Disease- is a disease characterized by narrowing or blockage of the coronary arteries supplying to the heart.

Helical CT/Spiral CT Scanning- a type of CT that creates images at greater speed than conventional CT by continuously rotating a standard x-ray tube around the individual so that data are gathered in a continuous spiral or helix rather than individual slices.

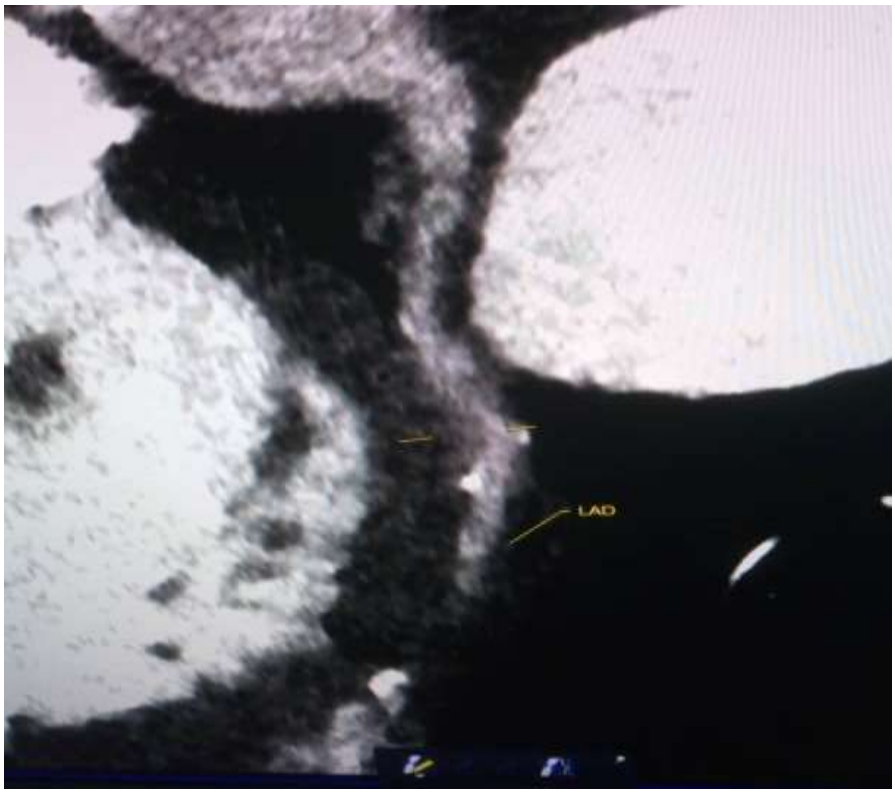
Multi Slice Spiral CT (MSCT)/Multi row detector CT- is a technical evolution of helical CT, it uses CT machines equipped with an array of multiple x-ray detector that can simultaneously image multiple sections during a rapid volumetric image acquisition.

Tomography- is an apparatus for moving an X-ray source in one direction as the film is moved in the opposite direction, thus showing in detail a predetermined plane of tissue while blurring or eliminating detail in other planes.

APPENDIX III

Coronary CT Angiography image demonstrates non stenotic eccentric calcified plaque in the middle segment of RCA.The image was obtained from 128slices Duo CT scan at MNH

CORONARY CT ANGIOGRAPHY(Curved MPR)



It demonstrates multiple eccentric non obstructive calcified plaques in the mid segment LAD