Computed tomography pulmonary angiography findings in clinically suspected pulmonary embolism patients at Muhimbili National Hospital Tanzania

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COMPUTED TOMOGRAPHY PULMONARY ANGIOGRAPHY FINDINGS IN CLINICALLY SUSPECTED PULMONARY EMBOLISM PATIENTS AT MUHIMBILI NATIONAL HOSPITAL TANZANIA.

By

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A Dissertation Submitted in (Partial) Fulfillment of the Requirements for the Degree of Master of Medicine (Radiology and Imaging) of

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CERTIFICATION

The undersigned certifies that she has read and hereby recommends for acceptance by the Muhimbili University of Health and Allied Sciences the dissertation entitled **"Computed tomography pulmonary angiography findings in clinically suspected pulmonary embolism patients at Muhimbili National Hospital Tanzania from August – March 2018"** in(partial) fulfillment for the Degree of Masters of Art in Health Policy and Management of the Muhimbili University of Health and Allied Sciences.

_____

Dr. LULU FUNDIKIRA

Supervisor

Date _____

DECLARATION AND COPYRIGHT

I, SYLVIA BEDAS NSATO, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any university for similar or any other degree award.

Signature: _____Date: _____

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DEDICATION

For God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout and on His wings only have I soared.

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ABSTRACT

Background:

Pulmonary embolism is a blockage in the pulmonary artery, the blood vessel that carries blood from the heart to the lungs. The blockage is commonlycaused by a blood clot, and is potentially life threatening because it can prevent blood from reaching the lungs. Diagnosing or excluding pulmonary embolism on clinical signs and symptoms is difficult since most of these clinical manifestations are nonspecific. Therefore, the need for accurate diagnostic tests to exclude or confirm pulmonary embolism is apparent. As a matter of fact, Computed tomography pulmonary angiography (CTPA) is becoming the Gold standard of care at many institutions for the evaluation of patients with suspected pulmonary embolism.

The study assesses the imaging findings on Computed tomography pulmonary angiography (CTPA) in patients clinically suspected of PE in relation to demographics, risk factors and clinical presentation**.**

BROAD OBJECTIVE:

To assess CT Pulmonary Angiography (CTPA) findings among patients clinically suspected of pulmonary embolism attended CT UNIT at MNH Tanzania from August to March 2018.

METHODOLOGY:

A cross-sectional hospital based descriptive study conducted at the Radiology Department, Muhimbili National Hospital Daresalaam Tanzania from August 2017 to March 2018. The study includedpatients who were referred by clinicians with a clinical suspicion of pulmonary embolism (PE)and presented to Radiology department for Computed tomography pulmonary angiography (CTPA). Structured questionnaires were used for recording patient's demographics, clinical information, and imaging findings. The study was performed on 128 slices (64 slices each), images interpreted by the researcher and a consultant radiologist. Data analysis conducted using Statistical Package for Social Sciences (SPSS) version 20. Statistical Association was done by using cross tabulation, and Chi-square test used to compare proportions. P value of < 0.05 was considered statistically significant.

RESULTS

A total of seventy four patients participated in this study, of which 27(36.5%) were male and 47(63.5%) female. The patients' mean (SD) age was 51.2(±15.8) years old, ranges from 15-80 years old. Majority of the patients were in the age group of 61 years old and above 25(33.8%). Hemoptysis was found to be highly related with PE, 12(85.7%, P=0.0001). Although dyspnea was not statistically significance, this parameter showed high magnitude, and it was found in all 25 patients diagnosed with PE through CTPA.

There was no statistical significant relationship between PE risk factors; immobilization 24 (33.8%, P=0.987), deep venous thrombosis 1 (33.3%, P=0.987), pregnancy 1 (33.3%, P=0.987), and pulmonary embolism (PE).

The Multi detector computed tomography pulmonary angiography (DCT-PA) radiological findings in acute pulmonary embolism patients which were strongly significantincluded, central filling defect which was 6 (100%, P=0.0001), and acute angle intraluminal filling defect 5(100%, P=0.0001). Another finding was complete occlusion 3(100%, P=0.001). In addition, there was strong significant relationship between chronic PE with linear filling defect 15 (93.8%, P = 0.001) and eccentric filling defect 13 (100%, P = 0.0001).

Conclusion.

Twenty five (33.8%) out of 74 patients were found to have PE in this study. CTPA revealed significant radiological findings in both acute and chronic pulmonary embolisms. MDCT-PA was found to be a useful diagnostictool in the work – up of patients suspected of having PE hence ensures a proper diagnosis and appropriate management to patients, thus saving many patients lives.

Recommendations.

CTPA is the gold standard of care for evaluation of patients with suspected pulmonary embolism. I recommend CTPA to be requested to all patients suspected with PE, as CTPA significantly shows radiological finding in acute and chronic PE. Since there are limited documentations about CTPA in diagnosing PE in developing countries including Tanzania, it is therefore vital to understand this study to assess the diagnostic role of CTPA in the management of patients with suspected PE. Moreover we urge that findings from this research be able to provide baseline database for Researchers wishing to conduct a similar study in developing countries, particularly sub-Saharan Africa.

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LIST OF ABBREVIATIONS

MNH	Muhimbili National Hospital.
PE	Pulmonary Embolism.
VTE	Venous Thromboembolism.
DVT	Deep Venous Thrombosis.
CT	Computed Tomography.
CTPA	Computed Tomography Pulmonary Angiography.
IV	Intravenous fluid
CUS	Compressive venous ultrasonography
CM	Contrast Media.
CUS	Compression Ultrasonography.
MMed	Masters of Medicine
SPSS	Statistical Package for social Sciences.
MRI	Magnetic Resonance Imaging
VQ	Ventilation Perfusion.
OC	Oral Contraceptives
COPD	Chronic Obstructive Pulmonary Disease.
USA	United States of America
UK	United Kingdom

DEFINITION OF TERMS: DEFINITIONS OF TERMS

EMBOLISM:

Is an obstruction of an artery, typically by a clot of blood or an air bubble

PULMONARY EMBOLISM (PE):

It is the total or partial obstruction of one or more pulmonary arteries by a single or multiple Thrombotic or non-thrombotic emboli.

VENOUS THROMBOEMBOLISM (VTE):

Is the formation of blood clots in the veins. When a clot forms in deep veins, usually in legs, it is called a deep vein thrombosis or DVT. If that clot breaks loose and travels to the lungs, it is called a Pulmonary Embolism or PE.

EMBOLUS:

It is a blood clot that dislodges and circulates through the blood stream.

COMPUTED TOMOGRAPHIC ANGIOGRAPHY (CTA):

This is a non-invasive radiological method of studying the vascular structures by injecting radio opaque water soluble contrast media into the arteries and taking X- ray images by a CT machine. X- Ray beams from many angles are used to create a series of detailed body cross-sectional images.

CHAPTER ONE

1.0. INTRODUCTION

1.1 BACKGROUND

Pulmonary embolism is a blockage in the pulmonary artery, the blood vessel that carries blood from the heart to the lungs. The blockage is usually a blood clot, and is potentially life threatening because it can prevent blood from reaching the lungs.

Medically it is potentially fatal condition, which an embolism, usually a thrombus originate from one of the deep veins of the legs or pelvis, blocks one or more pulmonary arteries, causing impaired blood flow and increased pressure to the right cardiac ventricle. PE and DVT are considered two entities of the same condition, where both are; VTE – Venous Thromboembolism. This is a frequently occurring disease, with an incidence of 1-3 per 1000 inhabitants per year in Western Society, which makes it the third most common cardiovascular disorder in industrialized countries(1)

Clinically symptoms are severaland the most common symptoms are; Dyspnea, pleuritic chest pain that worsens with breathing, cough and hemoptysis. On physical examination signs that accompany pulmonary embolism are tachycardia, pleuritic rub, accentuated second heart sound and neck vein distention.

Diagnosing or excluding pulmonary embolism(PE) on clinical signs and symptoms is difficult since none of these clinical manifestations are specific. In less than 30% of patients presenting with clinically suspicious suggestive of thedisease can be confirmed by objective testing. Therefore, the need for accurate diagnostic tests to exclude or confirm is paramount (2)

Recently, Computed tomography pulmonary angiography (CTPA) has received remarkable consideration as a modern technology for diagnosing PE due to high sensitivity and capability of detecting the signs and symptoms of the disease by 95% (3)(4)

Computed tomography pulmonary angiography (CTPA) is becoming the standard of care at many institutions for the evaluation of patients with suspected PEand remains the gold standard method for diagnosis of PE. (5)(6).

And this is true, even in our set up as developing country; use of CTPA is now increasing despitethe challengesof being expensive, few experts, and limited availability of MDCT in Tanzania hospitals.

For the past 40 years, physicians have used ventilation / perfusion (V/Q) imaging to diagnose potentially life threatening pulmonary embolism (PEs). This is done using nuclear Medicine technique utilizing a gamma camera. It involves injecting both a radioactive tracer and having the patient inhales a radioactive gas. If the lungs are working properly, the air flow seen on the ventilation scan will match the blood flow seen on the perfusion scan. A mismatch between the ventilation and perfusion scan (V better than Q) could indicate a blockage or PE. Although V/Q scanning uses radioactive materials, the amount of patient radiation exposure is low.However its disadvantage is that pulmonary embolism (PE) is not directly visualized but rather its effect on perfusion and ventilation, hence additional diagnostic techniques like computed tomography pulmonary angiography (CTPA) are required.

However, over the past 10 years, CT angiography (CTPA) has begun replacing V/Q in most medical centers and community hospitals. Since CTPA is faster, and produces sharper images, which many believe, make the results easier to interpret. Also at most hospitals, a CT scan service is available 24 hours, while nuclear medicine technicians need to perform a V/Q study may not be on call, especially on night and weekends as per most of hospital setups.Currently evidence show that for outpatients presenting to emergency departments, withsuspected PE can be safely ruled out by multislice computed tomography angiography (CTPA) with no need for leg CUS. (7)

And the fact cannot be denied that, nuclear medicine facilities are very few, to conduct these tests.

CTPA is considered the current clinical reference standard and the method of choice for imaging the pulmonary vasculature and the evaluation of patients with suspected PE. (8)

Performing CTPA involves an intravenous injection of iodine – containing contrast agent at a high- rate using an injector pump. Images are acquired with the maximum intensity of radio-opaque contrast in the pulmonary arteries. A normal CTPA scan will show the contrast filling the pulmonary vessels, appearing as bright white. Any mass filling defect, such as an embolus, will appear dark in place of the contrast, filling /blocking the space where blood should be flowing

into the lungs. Thus, filling defects involving pulmonary arteries can be considered diagnostic of embolism(9)

On CT, acute PE may manifest as complete arterial occlusion, with the affected artery often being enlarged, or as partial defect, that are often centrally located.

A typical imaging characteristic of chronic PE can be mosaic patterns of lung attenuation, that is, areas of ground – glass attenuation mixed with areas of normal lung attenuation suggesting a redistribution of blood flow. (8)

Most patients suspected to have PE, whose CTPA are negative for PE,have other pathological findings (alternative findings) including; consolidation (Which includes pneumonia or infections), malignancy (including mass or metastases), nodules (excluding calcified nodules or granulomata), pneumothorax, emphysema (including COPD), pleural effusion, atelectasis, or bronchiectasis. (10)

The most common non – PE findings on CTPA scan in a study done in UK in 2009 and 2015 are; Pleural effusion 25.8%, consolidation 25.0%, emphysema 22.0%, and atelectasis 22.0%, an incidental lung nodule was found in 4.5% of CTPA scans and a CTPA was considered normal, with no abnormal findings reported in 16.7% of cases. (10)

Advantages of CTPA includes direct visualization of the emboli, the current MDCT scanners allows the coverage of the entire chest within 1 mm or sub- millimeters resolution within a short single breath hold less than 10 seconds, this high resolution allows evaluation of pulmonary vessels down to sixth- order branches, provide an alternative diagnosis in patients without PE, being able to detect other lung diseases, and it is a cost- effective procedure.

Although CTPA is cost effective and widely available, it has some limitations, which includes; high breast radiation exposure (a particular concern in premenopausal women), contraindicated to patients who are allergic to CM (Iodine), patients with renal insufficiency, pregnant women, and severe obesity(11), (12)

Despite the popularity of the approach, raising concern about CTPA is radiation exposure suggested that the actual amount of exposure and the risks of radiations induced when using the CTPA is not negligible. (13)

Medical treatment for acute PE is thrombolytic therapy, its indications remain uncertain. The most widely accepted indication for thrombolytic therapy for PE is in patients with hypotension secondary to massive PE.(14)

For many years, anticoagulants have been used to cure the disease despite its risk of bleeding. (2)(15)

Tanzania being a developing country has limited number of CT scan technology with most machines located in big cities, there is limited experience and knowledge regarding the CTPA in patients suspected with PE, currently no locally done study is available. However, there is an increase of CTPA requests from attending physicians, thus the need to understand the imaging findings for a fast diagnosis and adequate clinical management of patients.

Based on the advantages of using CTPA in detecting PE, this study attempts to assess the imaging finding on CTPA for patients with suspected PE at Muhimbili National Hospital (MNH) setting in Tanzania and to determine the demographic characteristics as well as associated risk factors of these patients, hence ensures a proper diagnosis and appropriate management to patients, thus saving many patients lives.

1.2. LITERATURE REVIEW

Pulmonary Embolism is a common acute cardiovascular disorder occurring in adults and associated with high morbidity and mortality rates. It is frequently fatal if left untreated or misdiagnosed, due to pulmonary bed obstructions that can result in acute right ventricular (RV) failure, and eventually death. Most patients die within the first hours of presentation,thus early diagnosis is of vital importance.PE hasbeen reported to have annual incidence rate of 23 – 69 per 100,000 adult population.(16)**,**and 2 – 3 per 1000 adult per year(17)

In US it is the third most common cardiovascular cause of death, following heart attack, and stroke, accounting for 100,000 to 300,000 estimate deaths per year, and overall 3 month mortality rate of 15-17%, and the estimate annual economic burden of PE exceeds $ 8.5 billion, therefore incidence rate of PTE is important because PTE is associated with significant morbidity and mortality in hospitalized patients, as well as economic burden.(18)(11)

In Europe an estimated 370,000 PE- related deaths occur annually.(18)Despite increasing interest in PTE, data on recent trends in PTE incidence are limited.(19)

In Africa, PE has been reported in 3.8% of autopsied patients in Nigeria, and incidence rate of 0.032% over a 5-year period in Black Africans at a tertiary hospital in Kenya. (20)

A study undertaken at a university affiliated hospital in Cameroon reported a 32.4% incidence of PE in patients with clinical suspicion of PE, using CTPA. In an autopsy series conducted in an adult population in Cape Town between 2001 and 2005, PTE was found to be third most common cause of natural death in females. The true prevalence of PE in South Africa however, remains largely unknown. (18)

Little is known about the occurrence of acute PE in Sub- Saharan settings and in Africa in general, considered rare it has often been diagnosed based on clinical symptoms in patients with or without evidence of DVT on Doppler ultrasound. This has largely been due to lack of diagnostic facilities over the years. But now with the introduction of MDCT, it has proved to be a useful diagnostic tool in investigating suspected cases of acute PE.(21)

PE usually arise from thrombi that originate in deep venous system of lower extremities; however, they rarely also originate in the pelvic, renal, upper extremity veins, or the right heart chambers (see the image below). After traveling to the lung, large thrombi can lodge at the bifurcation of the main pulmonary artery or lobar branches and cause hemodynamic compromise. Pulmonary embolism is not a disease in and of itself. Rather, it is a complication of

underlying venous thrombosis. Under normal conditions, micro thrombi (tiny aggregates of red cells, platelets, and fibrin) are formed and lysed continually within the venous circulation system.(22)

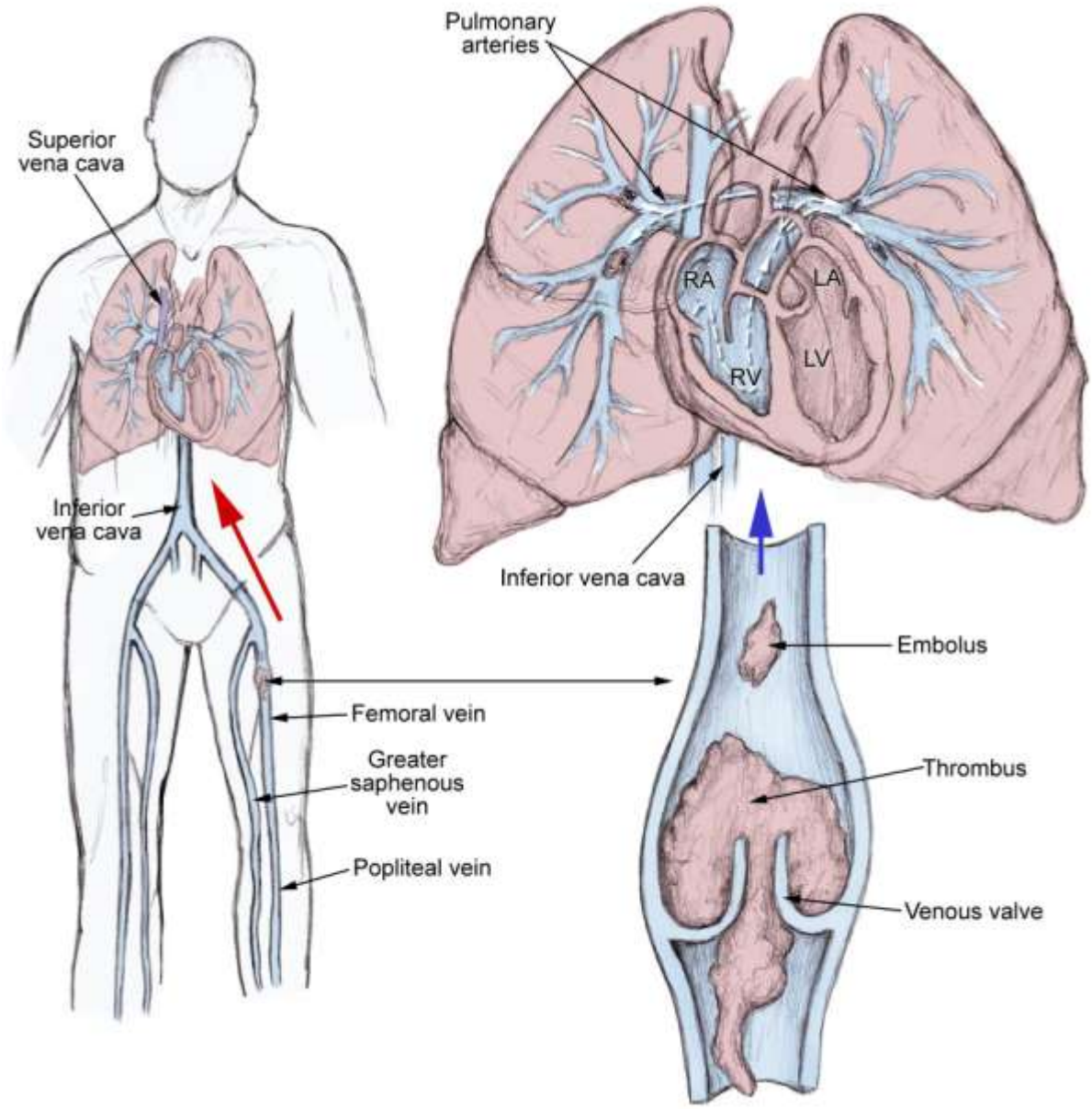


Fig 1.Diagram of Embolus course.

The incidence of PE rises with age, increasing dramatically after the age of 60 years and approaching approximately 1 in 100 in very old. In the absence of risk factors PE is rare in children under 15 years of age (< 5 per 100,000). (23)

A study done in USAby J. A Heit et al reveal that VTE is predominantly a disease of older age; and it is rare prior to late adolescence. They reported that incidence rate increased markedly with age for both men and women, and for both DVT and PE. The overall age – adjusted incidence rate is higher for men (130 per 100,000) than women (110 per 100,000). Male: Female sex ratio is 1.2: 1). Incidence rates are somewhat higher in women during childbearing years, while incidence rates after age 45 years are generally higher in men.(24)

It is reported in study done in Tunisia that, in most cases victims were male (65 %) compared to females, and the victims were aged between 21 and 87 years with an average age of about 52 years. (25)

In East Africa, a tertiary referral hospital study shows that PE is a frequent cause of mortality in Kenya, but its characteristics are hardly reported in Sub Saharan Africa. The study reveals mean age at diagnosis at 40.8 years (range: 5-86 years) with a peak at 30-50 years.

The female: male ratio is 1.13:1 Female predominated between 20 and 50 years, with a male predominance after 50 years. (20)

Another study done in Kenya reports, more female patients with clinically suspected PE as compared to males. Female representing 74 (67%) of all participants while males are 36 (32.7%), with male to female ratio 1:2.1. (26)

Based on these studies, it shows demographically, the incidence rate of PE increases markedly with age, with higher incidence rate in women during child bearing age, and after age 45 years the incidence is generally higher in men.

There are a number of risk factors associatedwith PE, these risk factors are categorized in many ways, and in this study we will look them in these three categories, summarized in the table below; (22)

1. Acquired risk factors.
2. Hereditary risk factors and
3. Probable risk factors

Acquired risk factors	**Hereditary risk factors**	**Probable risk factors**
Reduced mobility Advanced age Cancer Acute medical illness Major surgery Trauma Spinal cord injury Pregnancy and Postpartum hemorrhage Polycystic Vera Ant phospholipid antibody syndrome Oral contraceptives Hormone placement.T. Heparin Chemotherapy Obesity CVC Immobilizers or cast	Ant thrombin deficiency Protein C deficiency Protein S deficiency Factor V Leiden Activated protein C resist - ance without factor V. L. Prothrombin gene mutation Dysfibrinogenemia Plasminogen deficiency.	Elevated levels of lipo - Proteins Low levels of tissue Factors- - Pathway inhibitors - Elevated levels of hocysteine; factor VIII, IX, and XI; fibrinogen; and

A study by John. A. Heit et al reports that, VTE is a complex (multifactorial) disease, involving interactions between acquired or inherited predispositions to thrombosis and VTE risk factors, including increasing patient age and obesity, hospitalization for surgery or acute illness, nursing-home confinement, active cancer, trauma or fracture, immobility or leg paresis, superficial vein thrombosis, and, in women, pregnancy and puerperium, oral contraception, and hormone therapy.(23)

According to British Thoracic Society, risk factors are classified traditionally into major and minor categories; otherwise the most common risk factor is DVT involving 85% of cases followed by thrombosis of iliac and renal veins and the IVC. (27)

Ethnicity is an important risk factor with a significantly higher incidence among Caucasians and African Americans than among Hispanic persons and Asian – Pacific Islanders. However approximately 25% to 50% with first time VTE have an idiopathic condition without a readily identifiable risk factor.(26)

A study doneby Tambe J. et al, regarding reality of PE in Sub – Saharan Africa reports that thromboembolic phenomenon are the leading risk factors identified in their study population, of the 12 patients with CT angiograms positive for PE, 11(91.7%) had at least one identifiable thromboembolic risk factor. The relative risk of the occurrence of PE with respect to the thromboembolic risk factors was 14.4. (21)

A study done in Kenya shows, 19 patients with clinical history of DVT (17.3%), out of whom 11 (57%) had PE. Patients with DVT history are 5.2 times more likely to have PE on MDCT-PA, and DVT is found to be significantly associated with PE (p- value 0.001). More over patients with history of previous venous thromboembolism (VTE) are 8.8 times more likely to have PE on CTPA and this is also significantly associated with PE (p value 0.028). History of immobilization for 3 days or more is also found to have an added likelihood of 5.6 times of having PE on CTPA although it was not statistically significant (p value 0.121). History of malignancy is significantly associated with PE on MDCT-PA (p value 0.020). From this study no patient with PE post-surgery is reported, that may be due to the wide spread practice of DVT prophylaxis and physiotherapy post-surgery in their setup.(26)

So far there is no unique risk identified in our setup especially in East African countries, and particularly in Tanzania, as there is no reported literature and little are known about PE, prevalence, as well as common imaging findings.

Lungs are organs found in the chest on the right and left side, on either side of the heart and other mediastinal contents. It is the essential organ of respiration, divided into different parts called lobes. The right lung has 3 lobes, called upper, middle, and lower. The left lung has two lobes, the upper and lower.(28)

There are 2 functionally distinct circulatory pathways. These are pulmonary vessels which convey deoxygenated blood to the alveolar walls and drain oxygenated blood to the left side of the heart, and the bronchial vessels which are derived from the systemic circulation and supply oxygenated blood to the lung interstitium. The pulmonary arteries can be categorized by the standard anatomical descriptions which labels pulmonary arteries as; Main, Lobar, Segmental, and sub- segmental branches, corresponding to first-order, second- order, third- order, and fourth – order pulmonary arteries respectively. The commonly used term central pulmonary arteries refer to the arteries from the main pulmonary trunk to the lobar branches. The main pulmonary artery bifurcates at the level of fifth thoracic vertebral into the left and right pulmonary artery, which further subdivide into the lobar, segmental, and sub- segmental arteries.(28)(26)

Clinical presentation of PE is variable and non-specific, symptoms and signs depends upon the size of embolism and co-morbidity.Common symptoms include; Acute on set of dyspnea, Pleuritic chest pain, Cough and Hemoptysis. Signs includes Tachycardia, Tachypnea, Hypoxia, and signs of right ventricular dysfunction / Pulmonary hypertension are (bulging neck veins or elevated neck veins, left parasternal lift, accentuated pulmonic component of second heart sound/ a right sided gallop). (22)

A study in UK by Progress M. et al, reports that signs and symptoms of DVT are highly suggestive of PE, about 79% of patients who presents with PE have evidence of DVT. Thus, when either condition is suspected further testing must be considered. The possibility of massive pulmonary embolism should be considered in patients who have sudden onset of near syncope or syncope, hypotension, extreme hypoxemia, electromechanical dissociation, or cardiac arrest.(22)

In a study done in Nigeria, reports that,PE presents as an acute onset of dyspnea with or without hemoptysis, pleurisy chest pain or collapse with shock in the absence of other causes. Sinus tachycardia is common as are alterations of blood gases. Abnormalities may be seen on electrocardiogram, and scoring system similar to that for DVT has been devised.(29)

In Kenya a study by Nduta et al, reports that, all patients studiedpresented with dyspnea, the proportion of patients presenting with difficulty in breathing was significantly higher than that presenting with either chest pain, or hemoptysis. However they reported that, there was no significant association between the clinical history and the status of the CTPA (p – value >0.05).(26)

The diagnosis of PE remains one of the most difficult problems confronting clinicians, because most of clinicians diagnose PE only basing on of clinical features especially in our setup as developing countries due to poor economy, lack of facilities e.g. CTPAin most of our hospitals, and paucity of data from low income.

Since clinical signs and symptoms for PE are nonspecific; therefore, patients suspected of having pulmonary embolism – because of acute onset dyspnea, pleuritic chest pain, cough, hemoptysis, with signs of tachycardia, tachypnea, hypoxia, signs of right ventricular dysfunction, or presence of risk factors of PE, - must undergo diagnostic tests until the diagnosis is established or an alternative diagnosis is confirmed.

Around 80% of Patients with PE have signs of DVT, and approximately 50% of Patients proven proximal DVT have an associated PE.(30)

Wells scores for clinical probability of DVT and PE are useful tools for the road to diagnose Patients suspected with PE. Modified Wells criteria for PE of < 4 points is low probability,

> 4 is highly probability, and for DVT > 2 points DVT is likely, < 1 point DVT is unlikely. The wells criteria are shown in the following tables:

Well score: clinical probability of PE. (Appendix I)

Well score: clinical probability of DVT. (AppendixII)

A study done in Tehran Iran by Mohammed et al, using Wells criteria on diagnosing PE reported that; the most common symptoms were dyspnea (70.7%), and chest pain (60.6%). Among the patients with modified wells criteria, 36 patients (36.4%) had scores < 4 points, and 63 (63.6 %) had scores greater than 4 points, as from their study, they concluded that majority of Patients with PE had Wells score of 2 – 6 points and those Patients with Wells score less than 4 had a positive CTPA. (31)

Laboratory studies associated with PE may demonstrate elevated serum D – dimer (sensitive, nonspecific). ECGFrequently demonstrates tachycardia; may also see T – wave inversions in anterior leads (V1 – V4) or S1 Q3 T3. (12)

In general,the diagnosis will base on;

1. The clinical assessment of suspected PE including risk factors, (Wells criteria), 2.V/Q Lung scanning, 3.Pulmonary Angiography, 4. Venous ultrasound imaging studies of the leg. 5. D-dimers for the Diagnosis of venous thrombosis, 6. Spiral CT Angiography, 7.CTPA.

Confirmation of PE with a definitive test is very important due the fact that it is a life-threatening condition, which mostly results into sudden death; its treatment is associated with a significant risk of bleeding.

Radiologic imaging plays a key role in the diagnosis of PE so as a matter of fact CTPA is the current imaging study of choice and gold standard method to confirm the presence of emboli as intra luminal filling defects in the contrast enhanced pulmonary artery branches.

This study will base on the confirmatory radiological diagnosis of PE by CTPA, where by diagnosis is confirmed by direct visualization of thrombus in a pulmonary artery, where it appears as a partial or complete intraluminal filling defects within the Main pulmonary artery, Lobar, Segmental, and Sub – segmental branches(28)

A Study done in Kenya by Nduta et al, reported that anatomically PE is found more commonly in the sub – segmental arteries followed by segmental, lobar and finally MPA.(26)

PE is a life – threatening condition if not diagnosed early. The overall mortality rate in untreated patients is 30%, with approximately 10% of patients dying within one hour of the event. Hemodynamically unstable patients have the highest mortality rate, which can be as high as 58%.

Clinical record report shows that PE can vary significantly depending on the level of obstruction of the vascular bed. The overall condition of the patient underlying lung or heart disease has signs and symptoms of PE (3)

The famous classical signs and symptoms of patients with PE are of one with acute shortness of breath (dyspnea) 73%, pleuritic pain 66%, coughing 43%, leg swelling pointing towards DVT 33%, leg pain 30%, hemoptysis 15%, palpitations 12%, wheezing 10%, and angina like pain 5%. In case of massive PE, there could be circulating collapse (hypertensive shock).

In the extreme point, the person with small peripheral embolism may have few or even no complaints at all. Since the individual symptoms and signs have a little sensitivity, there is no single symptoms, clinical signs, or even a combination of these can be used safely to confirm the diagnosis, because the signs and symptoms are nonspecific and serve only to raise the suspicion of PE.(34)

Other tests such as electrocardiogram, chest X- ray, and arterial blood gas analysis may show signs of PE; there is no sensitive rule to the diagnosis of PE. The important diagnostic tests in the early days such as ventilation – perfusion pulmonary angiography have the limitation that they are invasive and costly and less accurate when used as standard test.

1.3. PROBLEM STATEMENT:

Although PE has existed for decades, appropriate methods to examine the presence of the disease have been accompanied with many challenges, particularly in developing countries. In these countries clinicians base on medical history to diagnose patients with PE due to inadequate technology, knowledge, and lack of fund to invest in the technology.(35)

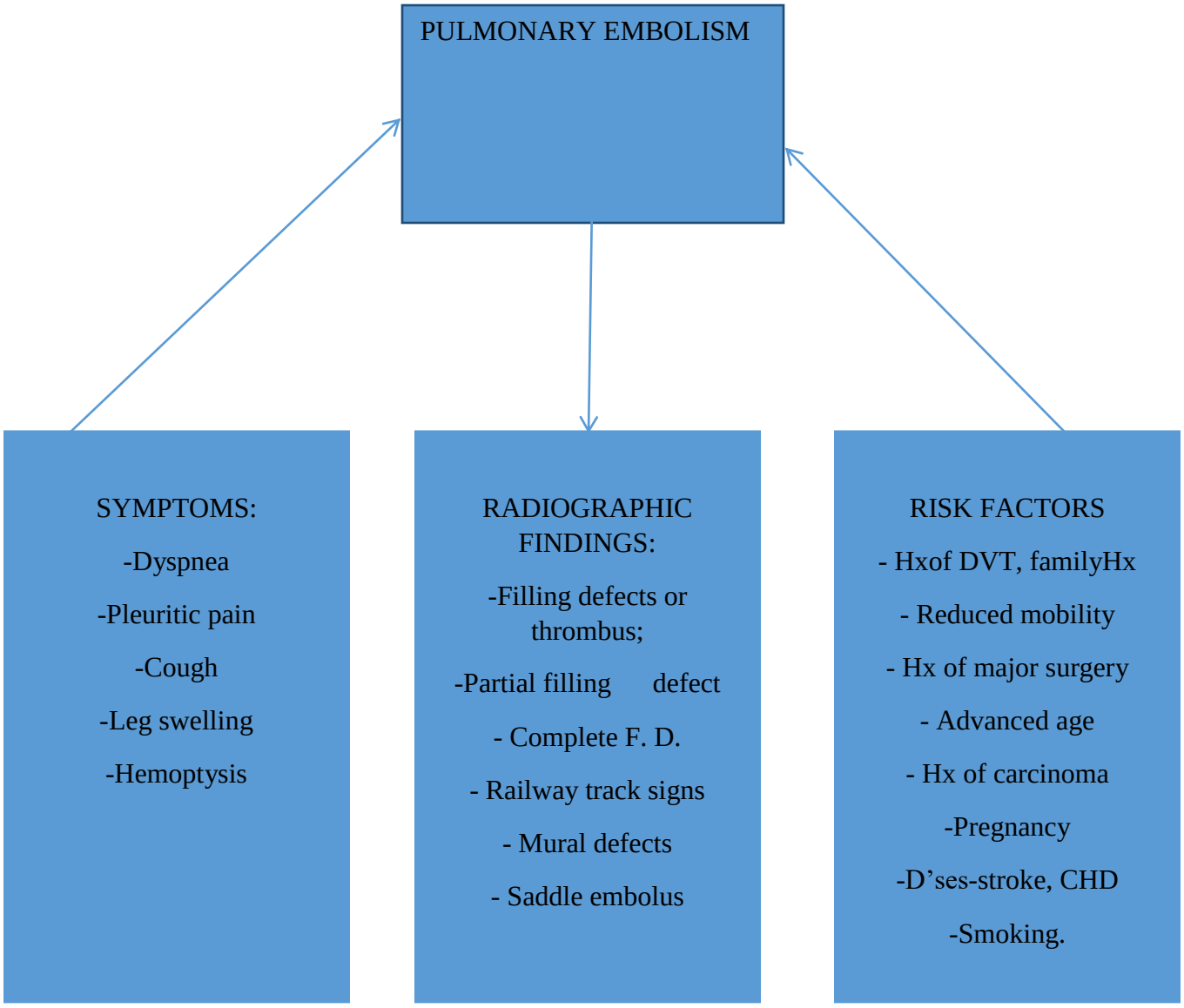
Like many African countries, the diagnosis of PE in Tanzania continues to pose a challenge to both clinicians and radiologists because its signs and symptoms are nonspecific. Up to now, little has been done to know the incidence of PE in Tanzania settings. In adequate consideration, has lead clinicians to diagnose patients based on clinical symptoms with or without further examinations.

The situation is further complicated by lackof advanced diagnostic facility (MDCT) over the years, and as a matter of fact, only few hospitals have this diagnostic facility, hence few medical personnel have this knowledge concerning CTPA on diagnosing PE.

The introduction of CTPA has proven to be a useful diagnostic instrument for examining suspected cases of patients with acute PE.

With this in view, the purpose of this study will be to assess the imaging findings on CTPA for patients with PE or suspected PE attending Muhimbili National Hospital (MNH) in Tanzania, and to determine the demographic characteristics of these patients, as well as associated risk factors.

1.4 CONCEPTUAL FRAME WORK



1.5. RATIONALE OF THE STUDY

Although researches on CT-PA have been carried out elsewhere around the globe for decades, there is limiteddocumentations in the developing country like Tanzania. Although researches on CT-PA have been carried out elsewhere around the globe for decades, there is limited documentations about it in the developing country like Tanzania. Findings will provide baseline database for Researchers wishing to conduct a similar study in developing countries particularly sub-Saharan Africa.

Results of this study will inform clinicians and health experts in the country to use integrated tools when examining patients with suspected pulmonary PE rather than relying solely on standalone methods.

It will emphasize on CTPA as the gold standard tool for the diagnosis of PE. The Common CTPA radiographic patterns of PE gathered in this study will help towards better understanding of radiographic presentation of PE. Theknowledge gathered will help towards synchronization of interpretation of radiographic patterns among health professionals.

This study will sensitize public on this silent killer disease and through it, the government through its health sector has a role to play, in making sure this diagnostic tool is available and educating the public.

Also the study will benefit donors and government to understand the dimension of the disease and support research related to pulmonary embolism, and also to ensure availability of the equipment which is costly.

1.6. RESEARCH QUESTIONS

1. What are the CT Angiography findings in patients with suspected pulmonary embolism?
2. What are associated risk and demographic factors of patients with suspected pulmonary embolism?
3. What are the common signs and symptoms of patients suspected with pulmonary embolism?

1.7 OBJECTIVES

1.7.1. BROAD OBJECTIVES

To determine CT Pulmonary Angiography findings among Patients clinically suspected of PE attended CT UNIT at MNH Tanzania from August to March 2018.

1.7.2. SPECIFIC OBJECTIVES

1. To describe radiological findings of PE on CT Pulmonary Angiography by age and sex among patients clinically suspected of pulmonary embolism attending CT scan unit at MNH from August to March 2018
2. To determine relationship between MDCT-PA findings in acute and chronic PE.
3. To determine common location of pulmonary embolism, relationship between PE and MPA/AO on MDCT-PA
4. To determine clinical presentations of PE among patients clinically suspected of pulmonary embolism attending CT scan unit at MNH from August to March 2018
5. To determine the associated risk factors for PE among patients clinically suspected of pulmonary embolism attending CT scan unit at MNH from August to March 2018

CHAPTER TWO

2.0 METHODOLOGY

2.1 TYPE OF STUDY

The study in this research was a cross sectional hospital based Study.

2.2 STUDY AREA

This study was conducted at the CT unit, Radiology Department Muhimbili National Hospital (MNH). Muhimbili NationalHospital is the leading teaching and referral hospital in Tanzania. Being the tertiary referral hospital it receives referred patients from all hospitals in Tanzania. It is equipped with allthe necessary facilities such as MDCT with CTPAcapabilities which are very valuable for investigating patients with suspected PE.The Siemens Somatorn Definition flash, Frankfurt, Germany scanner, which is a 128 slices duo (64 slices each) with stellar detector was used, where by images was acquired in caudal-cranial direction, with slice thickness of 5mm – 10mm as finest scan, with breath hold technique.

The procedure was conducted by Radiologist Technologist, after correcting information from the patients about; renal function test especially creatinine level, any history of allergy including allergy to contrast media, and any medication that the patient was currently using. The ante-cubital vein used for IV access, and an 18 – 20 – gauge catheter was preferred, the syringe pump with contrast was then fixed to IV cannula after which 80mls – 100mls of contrast medium (370 Iodine) was then infused at 4mls/second, and then images including post contrast images wereacquired**.**

Images displayed and viewed on the work station with a computer software program and was interpreted by using Pac system - clear Canvas / Singo Via, by the Principal investigator, in association with Radiologists. Data was recorded only when the consensus reached between Principle investigator and Radiologists, and all the records were kept on Pac- system.

2.3 STUDY DURATION

The study was conducted from August to March 2018.

2.4 STUDY POPULATION

The study covered all patients referred by clinicians with a clinical suspicious of PE and presented to the Radiology department CT unit for CTPA. The respondents must had no history of allegy to contrast. And study was not captured to patient who did not qualify for service. This study choosed only patients who presented at CT unit for CTPA, after being suspected by clinicians with PE, as a matter of fact it was not possible to meet the exactly no of patient required.

2.5 INCLUSION CRITERIA

- All patients with suspected PE referred by clinicians to the CT unit of Radiology department requesting for CTPA.
- All who had no history of allergy to Iodinated contrast media.
- Patients who has consented and agreed to undergo CTPA
- Only those with suspected PE whose information was collected within the specified period of study.(from August – March 2018)

2.6 EXCLUSION CRITERIA:

- Patients that obtained outside the specified period and
- Patients allergic to Iodine contrast media were not included in this study.

2.7 PATIENTS INVOLVED:

All patients referred by clinicians to the CT unit, with clinical features of suspected PE and who fulfill the inclusion criteria.

2.8 SAMPLING METHOD:

Convenience sampling technique was used, in which selection based on most available sample.

2.9 SAMPLE SIZE CALCULATIONS:

The sample size used in this study consistsof patient visited CT unit department of Radiology, MNH. The study focused on the patient with suspected PE and conducted in the particular period. The Prevalence of PE was 6.9% obtained from a study done in Kenya.(26)

Thesample size determined by the following Fisher's formula:

$n=Z^2P\ (1-P)/E^2$

Where: n= sample size,

Z = (1.96) standard normal variance.

P = Known prevalence rate of PE = 6.9%

E = margin error 5 %

So from the formula $n = \frac{Z^2 P(1-P)}{e^2}$

e = 0.05,

Z=1.96 and

P=0.069

$n = \frac{(1.96)^2 \times 0.069\ (1-0.069)}{(0.05)^2} = 98.712$

n = 100.

n + 5% n = 105

n = 105.

The expected minimum sample was 105 Patients

2.10. COLLECTION OF DATA:

Data was collected through structured questionnaires which were filled by the Investigatorand image evaluation was done by the Investigator and confirmed by an experienced Radiologist. Data was recorded only when consensus reached between the two. Data collection included social – demographics, clinical symptoms which included Dyspnea, Pleuritic chest pain, cough and hemoptysis.

Risk factors assessed was DVT, Previous PE, Family history of DVT / PE, cancer and its treatments, major surgery, trauma, pregnancy and shortly after pregnancy, hormone therapy or birth control pills, coagulation disorders, and immobilization > than 3 consecutive days.

Radiographic features include filling defects:

- Partial filling defect(polo-mint, railway track signs, peripheral acute angle intraluminal filling defects)
- Complete filling defect,
- Linear and web like filling defects
- Mural defect, and
- Saddle embolus.

Common non PE findings were included; pulmonary effusion, consolidation, emphysema, atelectasis, and incidental lung nodules.

2.11. IMAGING AND EVALUATION:

MDCT- PA SCANNING TECHNIQUE:

At the moment, the CT unit, CT system (Siemens Somatom Definition Flash, Frankfurt, Germany) was used. It is a 128 slices (64 slices each), duo withstellar detector.This CT system is used to acquire the imagein caudal – cranial direction. Images of the thorax was acquired in the cranial – caudal direction, with slice thickness of 5 mm to 10 mm, and 0.5mm as finest scan, with breath hold technique, and this is because most emboli are commonly locatedin the lower lobes, if the patient breathes during image acquisition, there is more excursion of the lower lobes compared with the upper lobes. Images were acquired in axial, then sagittal and coronal reconstructions views done in post processes. The ante-cubital was used for IV access, and a18 – 20 – gauge catheter was preferred, the syringe pump with contrast was then fixed to IV cannula after which 80mls – 100mls of nonionic water soluble contrast medium (370 Iodine) infused at 4mls/second, and then post contrast images acquired. Images displayed and viewed on the work station with a computer software program and images interpreted.

The diagnostic criteria for acute PE include:

1. Complete arterial occlusion with failure to pacify the entire lumen; the artery may be enlarged in comparison with pulmonary arteries of the same order of branching.
2. A central arterial filling defect surrounded by IV contrast material
3. Peripheral intraluminal filling defect that makes an acute angle with the arterial wall.

The diagnosis criteria for chronic PE include:

1. Complete occlusion of a vessel that is permanently smaller than pulmonary arteries of the same order of branching
2. A peripheral eccentric filling defect that makes an obtuse angle with the vessel wall.
3. Contrast material flowing through vessels that appears thick walled arteries which are smaller due to recanalization.
4. A band of web in a contrast- filled artery, linear and
5. An intraluminal filling defect with an acute PE morphology that has been present for more than 3 months

   Pulmonary artery enhancement is 33 H (SD 15 H), 87 H (SD 31 H) for acute emboli and chronic emboli respectively. (11)(33)

Both acute and chronic PE was identified as intraluminal filling defects that show a sharp interface with IV contrast medium.

The likelihood ratio to rule in a PE with a filling defect in the segmental or sub segmental branches is 24:1 (range of 12.4 – 46.7), whereas the likelihood to rule it out is 0.11 (range of 0.06 – 0.19), which means that CTPA has the best diagnostic accuracy of all the advanced non – invasive imaging method(30)

A normal CTPA scan show contrast filling the pulmonary vessels appeared as bright white. Any mass filling defect, such as an embolus, appeared dark in place of the contrast, filling /blocking the space where blood should be flowing into the lungs. Thus, filling defects involving the main or lobar pulmonary arteries were considered diagnostic of embolism.(9)

The emboli categorized by the standard anatomical descriptions which labels pulmonary arteries as; Main Pulmonary artery, Lobar, Segmental, and sub- segmental branches,corresponding to first-order, second- order, third- order, and fourth – order pulmonary arteries respectively.

The imaging findings then were interpreted by the Principal Investigator, in association with Radiologists. Data recorded only when consensus reached between them.

2.12 DATA ANALYSIS.

Data analysis was done using the Statistical Package for Social Sciences (SPSS) version 20. Statistical association between demographic, risk factors(history of DVT, reduced motility/immobilization > 3 consecutive days, major surgery, history of carcinoma, pregnancy, and coagulation disorders), clinical features (symptoms of dyspnea, pleuritic chest pain, cough, hemoptysis), and CTPA findings was done using cross tabulations and the chi- squire test was used to compare relationship between demographic, risk factors, clinical presentation and CTPA findings, the ratio was used to compare proportions. P value of < 0.05 was considered statistically significant.

2.13 ETHICAL CONSIDERATION

An introduction letter that introduces the Researcher to the CT unit for conducting the study was handled to respective authority. Confidentiality of the data collected and issues of handling final report were observed. The patient name was not included in designed form during the data collection. The Researcher introduced herself to individual patients and give the explanation of the study, then requested them to participate in the study. The interview was conducted in a private room. The patients who signed the consent were enrolled in the study. The interpretation of the images was be done by Principle investigator and Radiologists.

2.14 ETHICAL CLEARANCE

Before the research was conducted, the responsible department issued a clearance, permission, and introduction letter that described the purpose of the study.As for this to be fulfilled, proposal presented to the department of Radiology, Muhimbili University of Health and Allied Sciences. Ethical clearance was thereafterobtained from the Research and Publication Committee of the Muhimbili University of Health and Allied Sciences. The patients who met the sampling criteria were requested to fill the required information.

CHAPTER THREE

3. 0 RESULTS

1. Demographic information

A total of 74 patients participated in this study, of which 27(36.5%) were male and 47(63.5%) were female as shown in the Table 1 below.

Table 1:The demographic characteristics of patients clinically suspected of pulmonary embolism attending CT UNIT at MNH Tanzania from August to March 2018.N=74

Demographic characteristics		**N (%)**
Gender	Female	47(63.5)
	Male	27(36.5)
	Total	**74(100)**
Age Group (years)	< 20	1(1.4)
	21-30	7(9.5)
	31-40	12(16.2)
	41-50	18(24.3)
	51-60	11(14.9)
	61+	25(33.8)
	Total	**74(100)**

The prevalence of PE was 33.8% (25), the prevalence of PE by sex showed that, females were23 %(17) while males were10.8 %(8). PE was seen more in female than male patients as depicted in table 2 below.

Table 2: The prevalence of pulmonary embolism by sex among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2018. N=74

		Pulmonary Embolism.			
		Yes (%)	**No (%)**	**Total (%)**	**P-Value**
Gender	**Female (%)**	17(36.2)	30(63.8)	47(100)	1(0.567)
	Male (%)	8(29.6)	19(70.4)	27(100)	
	Total	**25(33.8)**	**49(66.2)**	**74(100)**	

It is found that most of pulmonary embolism fall in the age group of 61+ (28%), and 51-60 (28%), (More patients were found in age from 51- 61+ years old)as depicted in the Figure 1 below.

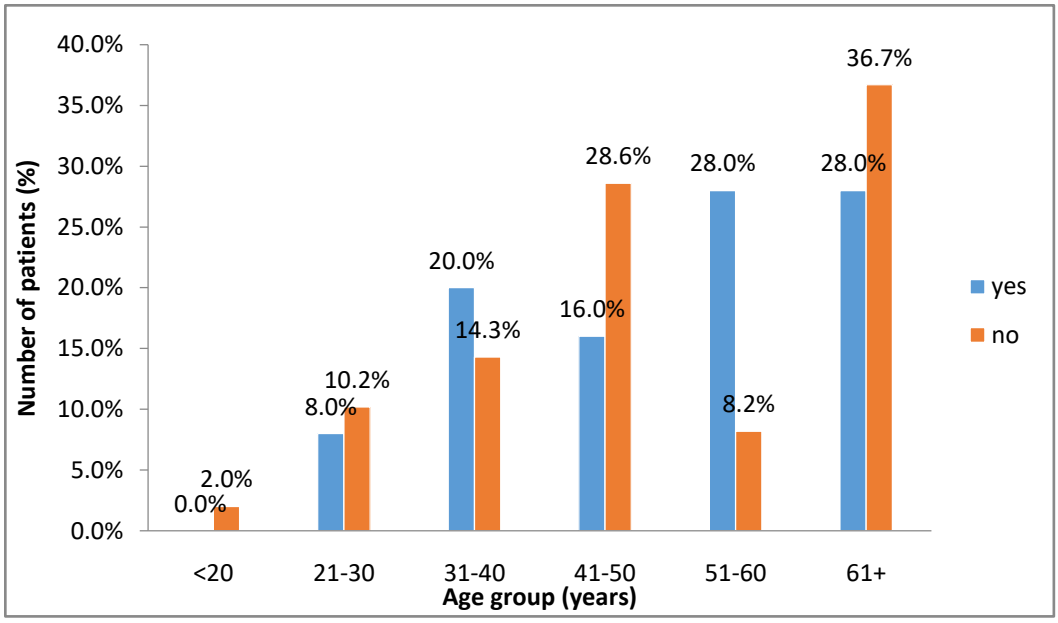


Figure 1: The distribution of age group among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2018. N=74

2. **Radiological findings of PE on CT Pulmonary Angiography among patients attending MNH from August to March 2018.**

The results shown that, most of acute pulmonary embolism patients had central filling defect 6(100%) (P = 0.001), acute angle intraluminal filling defect 5(100%) (P= 0.001) and complete occlusion 3(100%) (P=0.001) had acute pulmonary embolism as shown in the table 3 below:

Table 3: The MDCT-PA findings with acute pulmonary embolism among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2018. N=74

MDCT-PA Findings		Acute Pulmonary Embolism			X^2 (P value)
		Yes (%)	**No (%)**	**Total (%)**	
Central filling defect	Yes	6 (100)	0 (0.0)	6 (100)	**62.5(0.001)**
	No	1 (1.5)	67 (72.1)	68 (100)	
	Total	**7 (9.5)**	**67 (90.5)**	**74 (100)**	
Acute angle intraluminal filling defect	Yes	5 (100)	0 (0.0)	5 (100)	**51.3(0.0001)**
	No	2 (29.0)	67(97.1)	69 (100)	
	Total	**7 (9.5)**	**67(90.5)**	**74 (100)**	
Complete occlusion	Yes	3 (100)	0 (0.0)	3 (100)	**30(0.001)**
	No	4 (5.6)	67(94.4)	71 (100)	
	Total	**7 (9.5)**	**67 (90.5)**	**74 (100)**	

The total number of patients with chronic PE was 18. There was strong significance relationship between chronic PE with linear filling defect 15(93.8%, P=0.0001) and eccentric filling defect 13(100%, P=0.0001) as revealed in the Table 4 below.

Table 4: The MDCT-PA features with chronic PE among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2018. N=74

MDCT-PA Findings		Chronic pulmonary embolism			X^2 (P value)
		Yes (%)	**No (%)**	**Total (%)**	
Linear filling defect	Yes	15 (93.8)	1 (6.2)	16 (100)	**53.5(0.0001)**
	No	3 (5.2)	55 (94.8)	58 (100)	
	Total (%)	**18 (24.3)**	**56 (75.7)**	**74 (100)**	
Eccentric filling defect	Yes	13 (100)	0 (0.0)	13 (100)	**49.1(0.0001)**
	No	5 (8.2)	56 (91.8)	61 (100)	
	Total (%)	**18 (24.3)**	**56 (75.7)**	**74 (100)**	

It was found that PE was commonly distributed to segmental arteries, followed by sub-segmental and lobar arteries, RPA and LPA. There was no patient found with PE on MPA / trunk. PE was more evident in the right lung than left lung as shown in the figure 2 below. The Figure 2 also shown that the segmental arteries were more affected followed by lobar arteries.

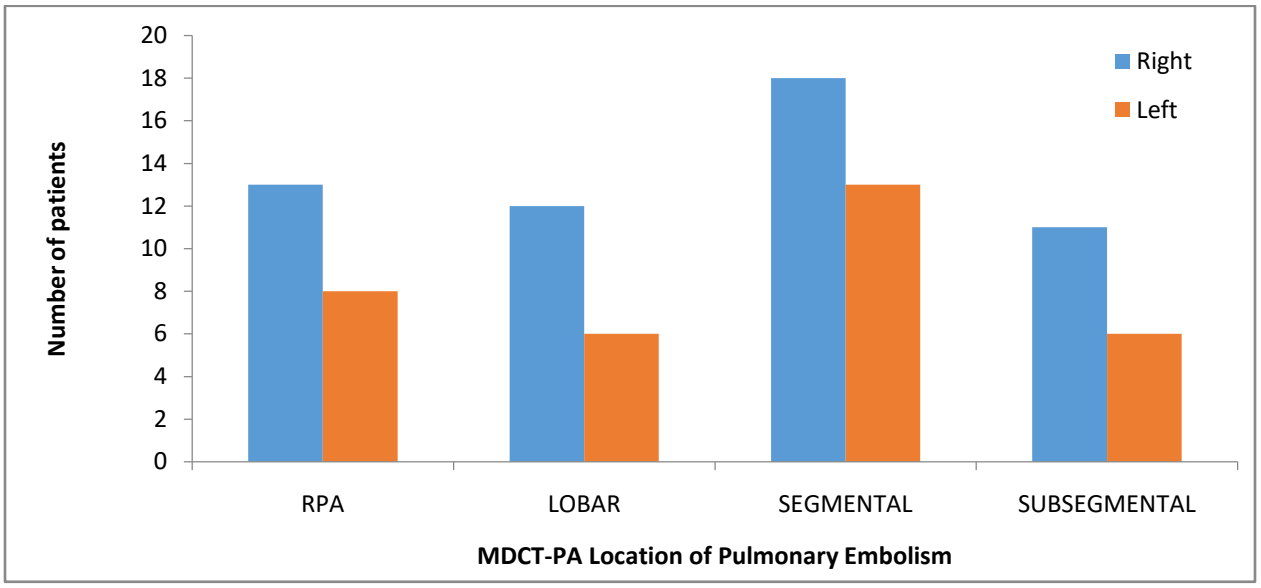


Figure 2: The distribution of MDCT PA location among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2018. N=74

The results shown that, the MPA/AO diameter ratio of >1, wassignificantly related with pulmonary embolism 23(92%, P=0.0001) as shown in the Table 13 below.

Table 5: The MPA/AO diameter with PE among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2018. N=74

		Pulmonary Embolism			X^2 (P value)
		Yes (%)	**No (%)**	**Total (%)**	
Ratio MPA/AO	0-1	2 (8.0)	48 (98.0)	50 (67.6)	**61.1(0.0001)**
	>1	23 (92.0)	1 (2.0)	24 (32.4)	
	Total (%)	**25 (100)**	**49 (100)**	**74 (100)**	

It is also found that the Right/Left ventricular diameter ratio of >1, was strong significantly related with pulmonary embolism 20(80%, P=0.0001) as described in the Table 14 below.

Table 6: The Right/Left ventricular diameter ratio with PE among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2017. N=74

		Pulmonary Embolism			X^2 (P value)
		Yes (%)	**No (%)**	**Total (%)**	
Right/Left ventricular diameter	0-1	5 (20.0)	39 (79.6)	44 (59.5)	**24.4(0.0001)**
	>1	20 (80.0)	10 (20.4)	30 (40.5)	
	Total	**25 (100)**	**49 (100)**	**74 (100)**	

3. Determination of clinical presentations of PE among patients attending MNH from August to March 2018

The results shown that hemoptysis was among clinical presentations highly related with PE13(52%, P = 0.0001**).** Although dyspnea was not statistically significant, shows high magnitude to those patients found with PE, 25 (100%) of which all patients who were diagnosed to have PE, presented with dyspnea. As shown in the Table 7 below.

Table 7: The clinical presentation with PE among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2018. N=74

Clinical presentations		Pulmonary Embolism			X^2 (P value)
		Yes (%)	No (%)	Total (%)	
Dyspnea	Yes	25 (35.2)	46 (64.8.6)	57 (100)	1.6(0.546)
	No	0 (0.0)	3 (100.0)	17 (100)	
	Total	25 (33.8)	**49 (66.2)**	**74 (100)**	
Chest Pain	Yes	23 (40.4)	34 (59.6)	57 (100)	**4.8(0.029)**
	No	2 (11.8)	15 (88.2)	17 (100)	
	Total	25 (33.8)	**49 (66.2)**	**74 (100)**	
Cough	Yes	24 (33.8)	47 (66.2)	71 (100)	0.001(0.987)
	No	1 (33.3)	2 (66.7)	3 (100)	
	Total	25 (33.8)	**49 (66.2)**	**74 (100)**	
Hemoptysis	Yes	12 (85.7)	2 (14.3)	14 (100.0)	**20.8(0.0001)**
	No	13(48)	47 (78.3)	60 (100.0)	
	Total	25(33.8)	**49(66.2)**	**74(100)**	

4. Determination of the associated risk factors for PE among patients attending MNH from August to March 2018

Although risk factors show no statistical significance in this study, immobilization was higher in the pulmonary embolism patients followed by pregnancy and deep venous thrombosis as shown in the Table 8, and Figure 7 below.

Table 8: The PE risk factors among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2018. N=74

risk factors		Pulmonary Embolism			X^2 (P value)
		Yes (%)	**No (%)**	**Total (%)**	
Deep Venous Thrombosis	Yes	1 (33.3)	2 (66.7)	3 (100)	0(0.987)
	No	24 (33.8)	47 (66.2)	71 (100)	
	Total	**25 (33.8)**	**49 (66.2)**	**74 (100)**	
Surgery	Yes	1 (50.0)	1 (50.0)	2 (100)	0.2(0.623)
	No	24 (33.3)	48 (66.7)	72 (100)	
	Total	**25 (33.8)**	**49 (66.2)**	**74 (100)**	
Immobilization	Yes	24 (33.8)	47 (66.2)	71 (100)	0(0.987)
	No	1 (33.3)	2 (66.7)	3 (100)	
	Total	**25 (33.8)**	**49 (66.2)**	**74 (100)**	
Malignancy	Yes	1 (100)	0 (0.0)	1 (100)	2(0.159)
	No	24 (32.9)	49 (67.1)	73 (100)	
	Total	**25 (33.8)**	**49 (66.2)**	**74 (100)**	
Pregnancy	Yes	1 (33.3)	2 (66.7)	3 (100)	0(0.987)
	No	24 (33.8)	47 (66.2)	71 (100)	
	Total	**25 (33.8)**	**49 (66.2)**	**74 (100)**	

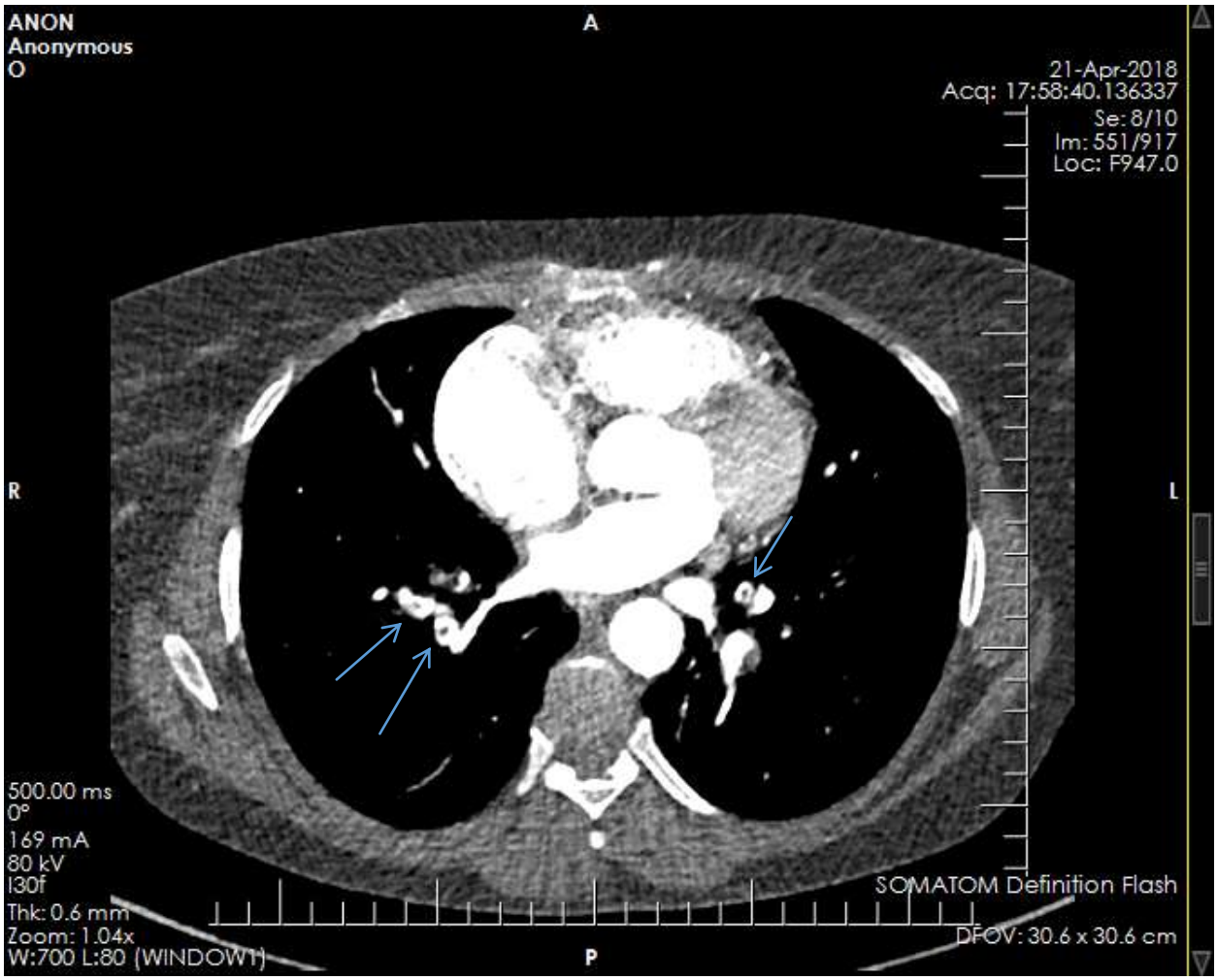
It was seen that, infarct was strong significantly related with PE patients 5(100%, P=0.003) and atelectasis had significantly negative relation with PE as shown in the Table 10.

Table 9: The other identified findings to patients with PE among patients clinically suspected of PE attending CT UNIT at MNH Tanzania from August to March 2018. N=74

Other findings		Pulmonary Embolism			OR (P value)
		Yes (%)	No (%)	Total (%)	
Pleural effusion	Yes	2 (20.0)	8 (80.0)	10 (100)	1(0.322)
	No	23 (35.9)	41 (64.1)	64 (100)	
	Total	**25 (33.8)**	**49 (66.2)**	**74 (100)**	
Atelectasis	Yes	1 (8.3)	11 (91.7)	12 (100)	**4.1(0.042)**
	No	24 (38.7)	38 (61.3)	62 (100)	
	Total	**25 (33.8)**	**49 (66.2)**	**74 (100)**	
Consolidation	Yes	7 (36.8)	12 (63.2)	19 (100)	0.1(0.744)
	No	18 (32.7)	37 (67.3)	55 (100)	
	Total	**25 (33.8)**	**49 (66.2)**	**74 (100)**	
Infarct	Yes	5 (100)	0 (0.0)	5 (100)	**10.5(0.003)**
	No	20 (29.0)	49 (71.0)	69 (100)	
	Total	**25 (33.8)**	**49 (66.2)**	**74 (100)**	

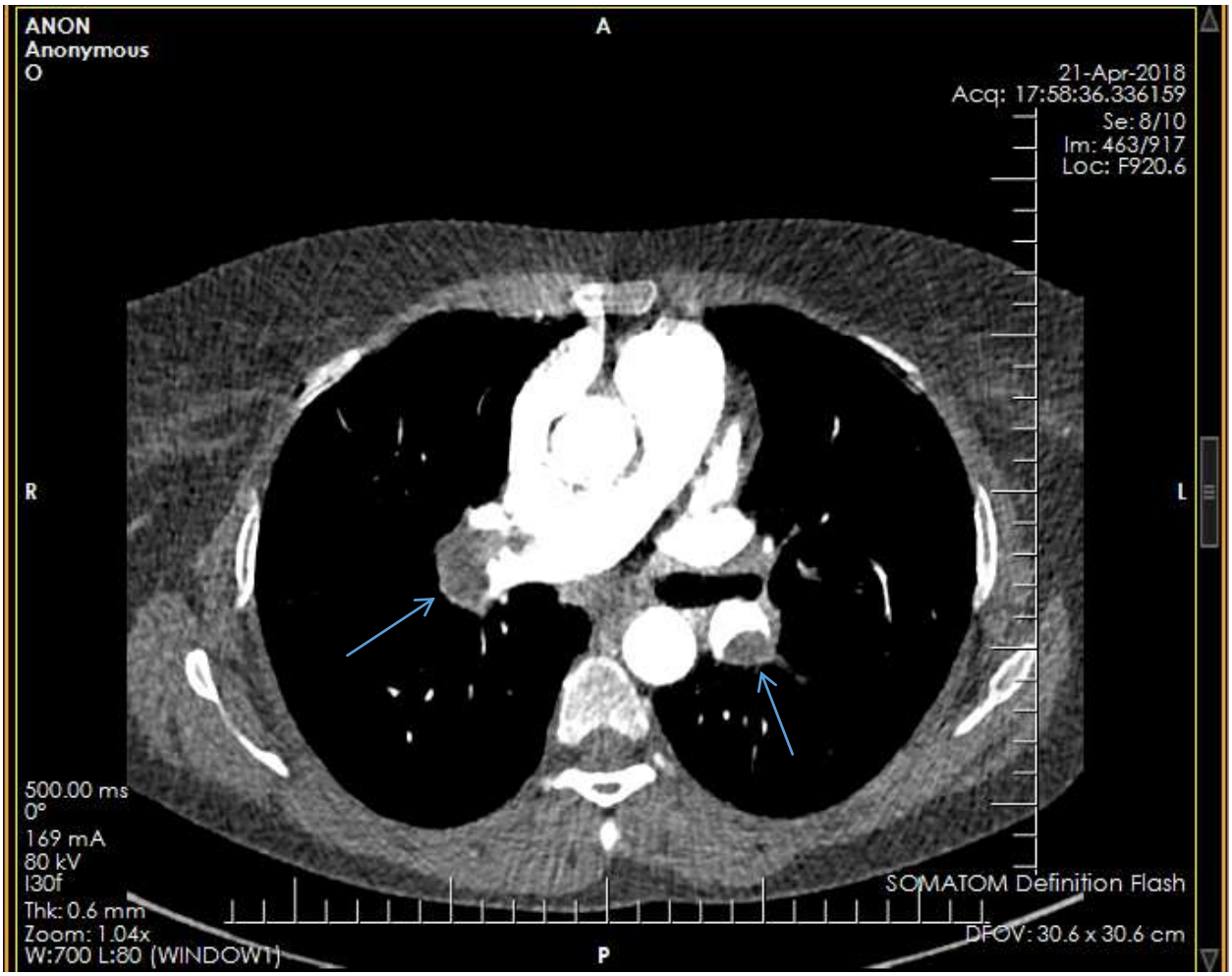
3.1 ILLUSTRATIONS:

Patient no 1:




ANON
Anonymous
O
A
21-Apr-2018
Acq: 17:58:35.623564
Se: 8/10
Im: 447/917
Loc: F915.8
R
L
500.00 ms
0°
169 mA
80 kV
I30f
Thk: 0.6 mm
Zoom: 1.04x
W:700 L:80 (WINDOW1)
SOMATOM Definition Flash
DFOV: 30.6 x 30.6 cm
P


ANON
Anonymous
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DFOV: 30.6 x 30.6 cm
P



A 31 years old female patient with history of dyspnea, and chest pain. Images shows bilateral extensive central filling defects, acute angle peripheral intraluminal filing defect in right and left lobar pulmonary arteries, central filling defects in the right middle segmental branches (polo-mint sign) as seen in the images above. She also had central filling defects in right upper segmental, right lower segmental, left upper, lingulaand lower segmental braches. She also had areas of peripheral opacifications in keeping with infarcts.

. The MPA – 37.2mm, AA – 24.8mm, with MPA: AA ratio of 1.5.

RV – 57.6 mm. LV – 25.2 mm with RV: LV ratio of 2.2.

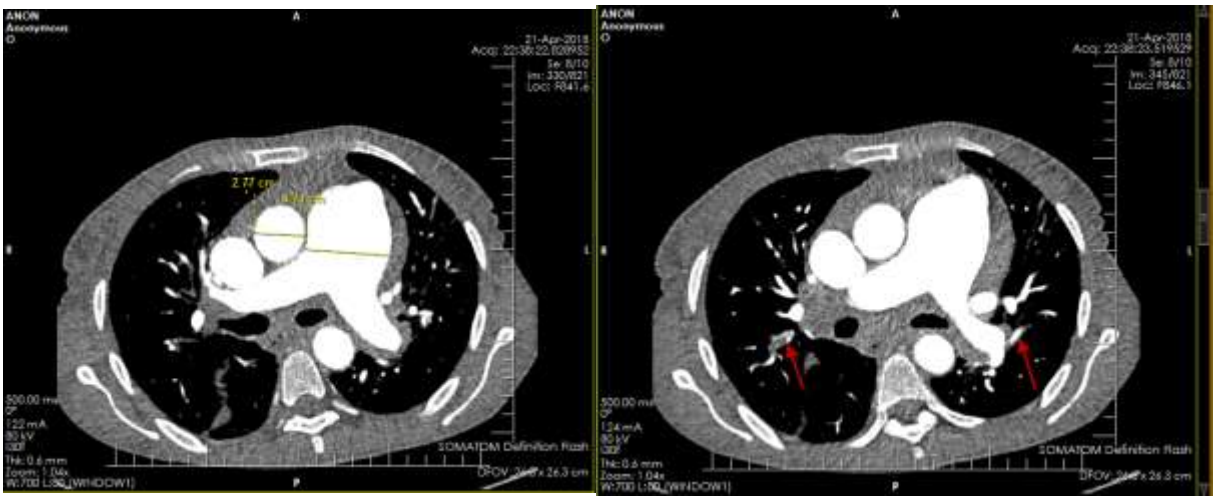
Features are consistent with – Bilateral extensive pulmonary embolism

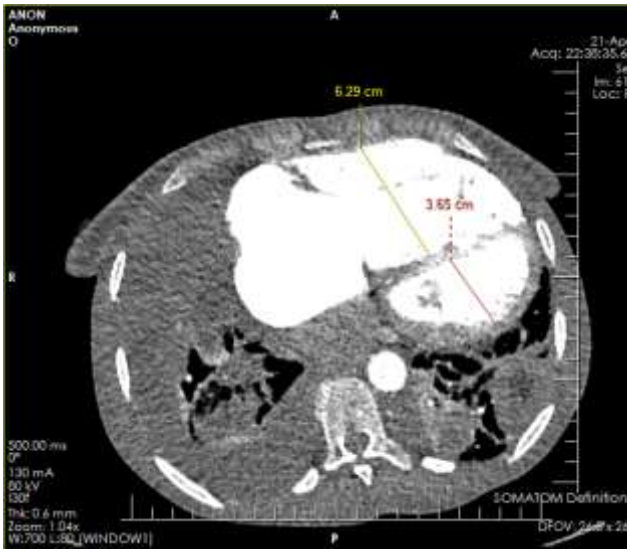
Patient no 2



49 years old patient with history of dyspnea and chest pain, CTPA revealed central filling defects, and acute angle peripheral intraluminal filling defects seen in right and left lobar pulmonary arteries respectively, consistent with bilateral acute PE.

Patient no 3:







43 years old Patient with history of difficulty in breathing, hemoptysis and chest pain

Web like filling defect on right side, eccentric filling defect on the left side, MPA diameter of 4.71 cm, and AA diameter of 2.77 cm with MPA: AA of 1.7. RV diameter of 6.29 cm and LV 3.65 cm, RV: LV of 1.7, enlarged right atrium, and reflux contrast flow into IVC (contrast back flow), consistent with - Bilateral chronic PE with right chambers enlargement (Right sided heart failure)

CHAPTER FOUR

4.0 DISCUSSION

The study involved a total of 74 patients, of which 27(36.5%) were male and 47(63.5%) female. Among 74 patients, 25 (33.8%) had PE, of which 7(9.5%) had acute PE, and 18(24.3%) had chronic PE. The patients' mean (SD) age was 51.2(±15.8) years old. Ranges from 15-80 years old. Majority of the patients were aged 61 years old and above 25(33.8%). This is similar in mean age to a study done in Kenyatta hospital by Nduta WA. where the mean age was 52.6 years, ranges from 36 – 70 years .(26)

This is contrary to mean age found in East Africa tertiary hospital in Kenya study done by Ogeng JA which reported the younger mean age than most of reported ones in literature, mean age of 40.8 years. (20)

The older mean age reported is from Australia by Bin S Ong et al, which was 66.4 years old. (36) Mean age of PE differs among literatures.

The prevalence found in this study is 33.8% (25), similar to study done in Sub-Saharan by Tambe J et al, which revealed a prevalence of 32.4% (12 of 37 patients), (21)

In South Africa study done by Ramlakhan R et al, the prevalence revealed was 26%. (18)

In Kenyatta National hospital study done by Ogeng JA prevalence revealed was 27.3%. The approximate prevalence from other literatures is between 25% - 35% prevalence of PE in clinically suspected patients.(20)

Results show that there is gender predilection with more female patients found to have PE, comprising of 17 (23.0%) out of 25 patients. This is in keeping with study done in Kenyatta National hospital and MP Shah Hospital in Kenya by Nduta WA which also revealed more female patients found to have PE, comprised of 20 (66%) while male was 10 (33.3%), and in Australia study done by Ong BS et al, women contributed 61% of all 130 patients participated in the study (26)(36)

Study done in East Africa tertiary hospital in Kenya by Ogeng JA et al also show female predomination of F:M ratio of 1.13:1. (20)

There are other studies which show PE prevalence being more male patients in comparison to female patients. Study done in Tunisia by Maha S. et al and in Nigeria by A. Awotedu et al showed male predomination over female patients (25)(37)

In UK study done by Gillian Ritchie et al revealed male patients predomination by 59% in comparison to female who had 41%. (38)

The effect of gender in PE shown conflicting results, there for studies concerning gender in PE has not been confirmed so far (39)

Results revealed that PE is the disease of old age, that most of PE patients fall in the age 51- 60+ years old, where among 25 patients found with PE, 14 patients were found in age groups from 51–60+. This is in keeping with other previous literatures, done by Tambe J. et al, Maha S. et al, and Ong BS et al. (21)(25)(36).

The MDCT-PA radiological findings found in acute PE patients was strongly significantly found with central filling defect with P value 0.0001, acute angle intraluminal filling defect with P value 0.0001, and complete occlusion P value 0.001. And there was strong significance relationship between chronic pulmonary embolism with linear filling defect value of 0.001, and eccentric filling defect P value of 0.0001, This result is similar to literatures and studies done on radiological presentation of acute and chronic PE on MDCT – PA (1)(5)(21)(22)(26)(33).

This is to say that CTPA is accurate in diagnosing PE both acute and chronic PE.(26)(10)

The results found that PE was mostly located in segmental arteries, followed by sub-segmental and lobar arteries, RPA and LPA. There was no patient found with PE on MPA. This result differs from a study done in Kenyatta hospital which revealed commonly anatomical distribution within the sub-segmental, followed by segmental, lobar, RPA, LPA, and the MPA. (20)

Results also revealed PE was more prominent on the right lung than left lung. This is in keeping with the study done by Nduta WA which show 30 (100%) patients had PE on the right lung compared to left lung 21 (79%) (26).

The results show that there is strong significance in relationship between MPA/AO ratio of >1 with PE patients 23 (92%, P=0.0001), And Right / Left ventricular diameter ratio of >1, 20 (80.0%, P= 0.0001).

There for a ratio of >1, in both MPA/AA, and RV/LV, is significant in diagnosing PE. This is in keeping with previous studies done by Kim K et al, and Reid JH et al. (40)(41)

Although dyspnea was not statistically significance, this parameter shows high magnitude to those patients found with pulmonary embolism, 25 (100%) of which all patients who were diagnosed to have PE presented with dyspnea.

However, the study revealed a significance relationship between hemoptysis and chest pain with PE which differs from previous study done by Nduta WA. noted PE has nonspecific clinical symptoms (26)

The results show the other clinical features were not significantly associated with PE, similar to other literatures which reported by Ramlakhan R et al and Nduta WA. (18)(26)

Although PE risk factors were not statistically significance due to few number of patients found, immobilization 24 (33.8%, P=0.987) was higher in the pulmonary embolism patients compared to patients without PE, followed by deep venous thrombosis 1 (33.3%, P=0.987), and pregnancy 1 (33.3%, P=0.987).

The most common secondary diagnosis depicted was mosaic perfusion pattern, 16 (64.0%) among 25 patients found to have PE, 9 patients had no mosaic pattern, similar to study done by Fedullo PF et al. (10)

Among other findings seen in patients with PE, results show infarct (wedge shape opacity) is strong significantly related with pulmonary embolism patients 5(100%, P=0.003) This finding correlate with previous studies, done by Nduta WA, and Coche E et al (26)(42)

All these keeps on emphasizing that CTPA is excellent in diagnosing PE and hence contribute in early diagnosis, and accurate management of patients.

4.1 LIMITATIONS

1. The study only included patients from Muhimbili National Hospital and so results may differ from other settings as it is known that variability in Radiology use exists amongst clinicians and this can potentially impact diagnostic rates.
2. The sample number of patients was not met due to the fact that many patients were not be able to afford CTPA costs, majority of patients were not medically insured.
3. The local prevalence rate was unknown especially in Tanzania, no major comprehensive study has been undertaken locally on PE, and the prevalence of PE is still challenging in Africa. So the prevalence used might be not truly representative of PE in Tanzania. (More studies should be follow after my study with my prevalence as to have enough information concerning PE)
4. There was no information of the exact number of patients who presented to clinicians suspected with PE but never presented for CTPA, for reasons explained. Because this study was limited to patients who were sent by clinicians to Radiology department for CTPA.
5. Time limit was a big challenge, if time could have been enough the results could have been more than this, since flow of patient sent by clinicians was challenging, sometimes only 1 patient per week or in two weeks.
6. Follow up of patients was difficult and challenging, which would have contributed something to prognosis of patients with PE.

CHAPTER FIVE

5.0 Conclusion

Computed tomography pulmonary angiography (CTPA) revealed significant radiological findings in both acute and chronic pulmonary embolisms, including the ratio of >1 of both the MPA/AO and right/left ventricle diameters. It therefore ensures a proper diagnosis and appropriate management to patients, thus saving many patients lives. PE is the disease of old age, that most of PE patients fall in the age group, 51- 60+, as revealed in this study, so it is therefore important to know the diagnostic value of risk factors, symptoms, and clinical signs of PE, especially in elderly.Immobilization was found to have a high magnitude among PE risk factors.
The results of this study add evidence on CTPA as a gold standard of care for evaluation of patients with suspected pulmonary embolism, hence requests should be done to all patients suspected with PE, as CTPA significantly shows radiological finding in acute and chronic PE.

5:1 Recommendations.

1. More researches are needed regarding MDCT-PA in Tanzania to include bigger sample size and collaborations between different departments and multicenter study to establish risk factors and clinical presentation.
2. The study was not the representation to all population; it only included patients from Muhimbili National Hospital and so community based study should be conducted.
3. Since there are limited documentations about CTPA in diagnosing PE in developing countries including Tanzania, it is therefore vital to utilize findings of this study in the management of patients with suspected PE, as untreated patients are associated with high mortality.
4. CTPA is the gold standard of care for evaluation of patients with suspected pulmonary embolism, requests should be done to all patients suspected with PE, as CTPA significantly shows radiological finding in acute and chronic PE.
5. Old age should also be considered as among the risk factors associated with PE.
6. Let the finding from this research provides baseline database for Researchers wishing to conduct a similar study in developing countries, particularly sub-Saharan Africa
7. Our government should ensure CT scan services are available in all of zonal referral hospitals and tertiary specialized hospitals within the country

6.0.REFERENCES:

1. DOUMA R.A. Pulmonary embolism: Advance in diagnosis and prognosis. University of Amsterdam; 2017.
2. Kruip MJHA. Improving the diagnostic strategy of pulmonary embolism. Rotterdam; 2006.
3. Kamphuisen PW, Kramer MHH. The Natural Course of Hemodynamically Stable Pulmonary Embolism * Clinical Outcome and Risk Factors in a Large. chestjournal. 2007;131(2):517–23.
4. Douketis JD, Kearon C, Bates S, Duku EK, Ginsberg JS. Risk of Fatal Pulmonary Embolism in Patients With Treated Venous Thromboembolism. JAMA. 1998;279(6):458–62.
5. Wittram C, Maher CMM, Yoo AJ, Kalra MK, Shepard JO, Mcloud TC. CT Angiography of Pul- monary Embolism : Diagnostic Criteria and Causes of Misdiagnosis 1 OBJECTIVES. RG. 2004;24(5):1219–38.
6. Mediratta A, Addetia K, Medvedofsky D, Gomberg-maitland M, Mor-avi V, Ph D, et al. Echocardiographic Diagnosis of Acute Pulmonary Embolism in Patients with McConnell ' s Sign. CME. 2015;696–702.
7. Vazquez FJ, Posadas-martinez ML, Bioetti B, Giunta D, Gandara E. Prevalence of Deep Vein Thrombosis in Hospitalized Patients With Suspected Pulmonary Embolism Ruled Out by Multislice CT Angiography. Clin Appl Thromb. 2017;1–4.
8. Apfaltrer P, Hanna EL, Henzler T, Fink C, Schoepf UJ. CT Imaging of Pulmonary Embolism : Current Status. Springer Sci + Bus Media. 2011;4:476–84.
9. Fedullo PF, Tapson VF. The Evaluation of Suspected Pulmonary Embolism. new Engl J o f Med. 2003;349(13):1247–56.
10. Sharma S, Lucas CD. Increasing use of CTPA for the investigation of suspected pulmonary embolism. Postgrad Med [Internet]. 2017;00(00):1–5. Available from: http://dx.doi.org/10.1080/00325481.2017.1281084
11. Tkacz JN. The MD-CTPA ; Technique , Diagnosis and Pitfalls. Boston; 2002.
12. Howell M, Medical H. Current Approach to Radiologic Evaluation of Suspected Pulmonary Embolism. 2010.

13. Reiman RE, Yoshizumi TT, Goodman PC, Toncheva G. Radiation Dose from Contemporary Cardiothoracic Multidetector CT Protocols with an Anthropomorphic Female Phantom : Implications for Cancer Purpose : Methods : Results : Conclusion : Radiology. 2007;245(3):142–750.
14. Therapy T. Thrombolytic Therapy. 2015;157.
15. Article Clinical Impact of Bleeding in Patients Taking Oral Anticoagulant Therapy for Venous Thromboembolism. 2003;(C):893–901.
16. Ashrani AA, Silverstein MD, Rooke TW, Lahr BD, Petterson TM, Bailey KR, et al. Impact of venous thromboembolism , venous stasis syndrome , venous outflow obstruction and venous valvular incompetence on quality of life and activities of daily living : A nested case-control study. Vasc Med. 2010;15(5):387–97.
17. Australian R, Zealand N. Education Modules for Appropriate Imaging Referrals SUSPECTED PULMONARY. R Aust NEW Zeal Coll Radiol 2015. 2015;1–40.
18. Ramlakhan R, Andronikou S, Rajkumar A. Cardiovascular Topics The prevalence and radiological findings of pulmonary embolism in HIV-positive patients referred for computed tomography pulmonary angiography in the Western Cape of South Africa. Cardiovasc J Afr. 2017;(February):1–8.
19. Park TY, Jung J, Choi JC, Shin JW, Kim JY, Choi BW. Epidemiological trend of pulmonary thromboembolism at a tertiary hospital in Korea. 2017;
20. Ogeng JA. Pulmonary thromboembolism in an East African tertiary referral hospital. 2011;32:386–91.
21. Tambe J, Moifo B, Fongang E, Guegang E, Juimo AG. Acute pulmonary embolism in the era of multi- detector CT : a reality in sub-Saharan Africa. BMC Med Imaging [Internet]. 2012;12(1):1. Available from: BMC Medical Imaging
22. Progress M, Tapson VF. Acute Pulmonary Embolism. new Engl J o f Med. 2008;358(10):1037–52.
23. Heit JA, Spencer FA, White RH. The epidemiology of venous thromboembolism. J Thromb Thrombolysis. 2016;41(1):3–14.
24. Heit JA, Spencer FA, White RH. The epidemiology of venous thromboembolism. Cross Mark. 2016;41(January):3–14.

25. Maha S, Mohamed A, Habib BA, Bilel Z, Fatma G, Mahdi BK, et al. la mort subite secondaire à une embolie pulmonaire au nord de la tunisie : a propos de 37 cas . 2014;92(1):610–4.
26. Nduta WA. The pattern of findings on multidetector computed tomographic pulmonary angiography for suspected pulmonary embolism in nairobi . A descriptive cross-sectional study carried out at kenyatta national hospital and m . P shah hospital . A dissertation submit. 2013.
27. Society T, Republic C. Pulmonary embolism , part I : Epidemiology , risk factors and risk stratification , pathophysiology , pulmonary embolism. Clin Cardiol Rev. 2013;18(2):129–38.
28. Lieberman G. Imaging Pulmonary Embolism. New ways to look a diagnostic dilema. 2001;(May).
29. Pe Web Page Privalence Nigeria 2. Canada;
30. Parcice B-B. Pulmonary Embolism. 2016.
31. Mohammad MM, Adimi P, Seyedi SR, Sharif-kashani B. Assessment of Wells Criteria in Patients with Pulmonary Embolism. 2008;7:50–3.
32. Wells Score : Clinical probability of Deep Vein Thrombosis Wells Score : Clinical probability of Pulmonary Embolism. :4.
33. Wittram C. How I Do It : CT Pulmonary. Chest Imaging Perpective. 2007;188(May):1255–61.
34. Characteristics P, Bhargavan M, Sunshine JH, Lewis RS, Jha S, Owen JB, et al. Frequency of Use of Imaging Tests in the Diagnosis of Pulmonary Embolism : Effects of Physician and Region. Heal Care Policy Qual. 2010;194(April):1018–26.
35. Mcfarlane MJ, Imperiale TF. Use of the Alveolar-Arterial Oxygen Gradient in the Diagnosis of Pulmonary Embolism. Am J Med. 1994;96:57–62.
36. Ong BS, Karr M a, Chan DKY, Frankel A, Shen Q, Medical T. Management of pulmonary embolism in the home. Med J Aust [Internet]. 2005;183(5):239–42. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16138796
37. Awotedu AA, Igbokwe EO, Akang EE, Aghadiuno PO. Pulmonary embolism in Ibadan, Nigeria: five years autopsy report. Cent Afr J Med. 1992;38(11):432–5.
38. Ritchie G, McGurk S, McCreath C, Graham C, Murchison JT. Prospective evaluation of

unsuspected pulmonary embolism on contrast enhanced multidetector CT (MDCT) scanning. Thorax. 2007;62(6):536–40.

39. Park TY, Jung JW, Choi JC, Shin JW, Kim JY, Choi BW, et al. Epidemiological trend of pulmonary thromboembolism at a tertiary hospital in Korea. Korean J Intern Med. 2017;32(6):1037–44.
40. Kim K, Mu NL, Mayo JR. Pulmonary Embolism : Utility of Spiral CT 1. 1999;693–7.
41. Reid JH, Murchison JT. Acute right ventricular dilatation: a new helical CT sign of massive pulmonary embolism. Clin Radiol. 1998;53(9):694–8.
42. Coche E, Wiggs R, Mayo R. Thoracic Ancillary Embolism : at Spiral.

7.0 APPENDICES:

APPENDIX I: Wells score: Clinical probability of PE.

CRITERION	POINTS	SCORE
Clinical signs and symptoms of DVT	+3	
Alternative DX less probable than DVT	+3	
Heart rate > 100 bpm	+1.5	
Immobilization for at least 3 days or major surgery past 4 weeks	+ 1.5	
Previous DVT or PE	+ 1.5	
Hemoptysis	+ 1	
Malignancy (on treatment, treated in the last 6 month or palliative)		
Total score		

Clinical probability simplified score: PE likely: more than 4 points

PE unlikely: 4 points or less. (31)

APPENDIX II: Well score: Clinical probability of DVT.

CRITERION	POINTS	SCORE
Active cancer	+ 1	
Paralysis, paresis, or recent plaster immobilization	+ 1	
Recently bedridden (> 3 days) or major surgery past 4 weeks	+ 1	
Localized tenderness along DVT	+ 1	
Entire limb swollen	+ 1	
Calf swelling by more than 3cm compared to asymptomatic legs	+ 1	
Previous documented DVT	+ 1	
Pitting edema – greater in the symptomatic leg	+ 1	
Dilated collateral superficial veins (non – varicose)	+ 1	
Alternative diagnosis likely or more possible that DVT	-2	
Total scow:		

Clinical probability simplified score: DVT likely: 2 points or more

DVT unlikely: 1 point or less(32)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

SCHOOL OF MEDICINE - DEPARTMENT OF RADIOLOGY

P.O.BOX 65001 MUHIMBILI

DAR ES SALAAM, TANZANIA

APPENDIX III: **QUESTIONNAIRE:**

1. PATIENT'S BIODATA

SERIAL NO…… CTPA NO…… AGE…….

GENDER MALE…… FEMALE……

RACE AFRICAN……CAUCASIAN…….. ASIAN…….

2. CLINICAL HISTORY (Tick where applicable and specify)

A. DYSPNEA YES ☐ NO ☐

B. CHEST PAIN YES ☐ NO ☐

C. COUGH YES ☐ NO ☐

D. HEMOPTYSIS YES ☐ NO ☐

E. OTHERS (SPECIFY) YES ☐ NO ☐

F. NONE YES ☐ NO ☐

3. RISK FACTORS (Tick where applicable and specify)

A. DEEP VENOUS THROMBOSIS YES ☐ NO ☐

B. PREVIOUS VENOUS THROMBOEMBOLISM YES ☐ NO ☐

C. SURGERY YES ☐ NO ☐

D. TRAUMA YES ☐ NO ☐

E. IMMOBILIZATION > 3 CONSECUTIVE DAYS YES ☐ NO ☐

F. MALIGNANCY YES ☐ NO ☐

G. PREGNANCY YES ☐ NO ☐

H. COAGULATION DISORDERS YES ☐ NO ☐

I. CONTRACEPTION. YES ☐ NO ☐

J. OTHER (S) YES ☐ NO ☐

K. NONE YES ☐ NO ☐

4 OTHER INVESTIGATIONS DONE (Tick and specify where applicable)

A. CHEST RADIOGRAPH YES ☐ NO ☐

B. D-DIMERS YES ☐ NO ☐

C. DOPPLER ULTRASONOGRAPHY YES ☐ NO ☐

D. RADIONUCLIDE V/QSCANNING YES ☐ NO ☐

E. CT VENOGRAPHY (LOWER LIMBS YES ☐ NO ☐

F. CONVENTIONAL PULLMONARY ANGIOGRAPHY YES ☐ NO ☐

G. OTHER (S) YES ☐ NO ☐

IF YES MENTION……
……

H. NONE YES ☐ NO ☐

5 MDCT – PA FINDINGS (Tick and specify)

A. NORMAL YES ☐ NO ☐

B. ABNOMALITY YES ☐ NO ☐

C. NO PULMONARY EMBOLISM YES ☐ NO ☐

D. PULMONARY EMBOLISM YES ☐ NO ☐

E. ACUTE PULMONARY EMBOLISM YES ☐ NO ☐

i Complete occlusion; failure to enhance the entire lumen due to large filling defect, the artery may be enlarged compared with adjacent patient vessels YES ☐ NO ☐

ii Partial occlusion - Central filling defect surrounded by contrast 'Polo Mint sign', Railway track sign YES ☐ NO ☐

iii Acute angle peripheral intraluminal filling defect YES ☐ NO ☐

F. CHRONIC PILMONARY EMBOLISM YES ☐ NO ☐

i. Complete occlusion of vessels that is smaller than others of the same order of branching YES ☐ ☐

ii. Eccentric filling defects and luminal narrowing that form obtuse angle with the vessel's wall YES ☐ NO ☐

iii. Linear, web-like, or bands filling defects YES ☐O ☐

G. SECONDARY DIAGNOSIS YES ☐ NO ☐

i. Mosaic perfusion pattern YES ☐ NO ☐

ii. Bronchial or other systemic collaterals YES ☐ ☐

iii. Calcification within eccentric vessels thickening YES ☐NO ☐

H. ADDITIONAL DIAGNOSIS YES ☐ NO ☐

……

……

I. ALTERNATIVE DIAGNOSIS YES ☐ NO ☐

……

……

J. OTHER FINDINGS **YES** ☐ **NO** ☐

i. PLEURAL EFFUSION YES ☐ NO ☐

ii. ATELECTASIS YES ☐ NO ☐

iii. CONSOLIDATION YES ☐ NO ☐

iv. INFARCT (WEDGE SHAPE OPACITY). YES ☐ NO ☐

6 STATE DIAMETERS IN MILLIMITERS OF:

a. ASCENDING AORTA (AO)……..

b. MAIN PULMONARY ARTERY (MPA)……..

c. RIGHT VENTRICULAR CAVITY……..

d. LEFT VENTRICULAR CAVITY…….

7 RATIO.

a. MPA diameter /AO diameter.

b. RIGHT VENTRICULAR diameter/LEFT VENTRICULAR diameter

8 MDCT PA LOCATION OF THE PULMONARY EMBOLISM (Tick and specify)

RIGHTLUNG	RPA	LOBAR	SEGMENTAL	SUBSEGMENTAL
LEFT LUNG	LPA			
MPA				

KEY:

MPA – Main Pulmonary artery.

RPA – Right Pulmonary artery

LPA – Left Pulmonary artery.

7.2 APPENDIX IV: CONSENT FORM - ENGLISH

PATIENT'S CONSENT FORM:

My name is **DR SYLVIA BEDAS NSATO:**

I am pursuing my Masters of Medicine degree at MUHAS and pursuing my research study on matters related to imaging of Patients with suspected PE who have been referred for MDCT / CTPA to either confirm, or rule out PE in the department of Radiology at Muhimbili National Hospital.

I kindly requesting to use your data and findings so that the recommendations that I shall make may be used to improve management of Patients with similar problems.

You will not be required to write your name, and your information will be kept confidential.

Only the CTPA number will be used to your data. Your investigative imaging findings shall be utilized only for the purpose of research.

Please note that your participation is voluntary and you have the right to decline or withdraw from the study.

If you ever have questions about this study, you should contact the Principal Investigator,

DRSYLVIA BEDAS NSATO, Muhimbili University of Health and Allied Sciences, P. O. Box 65001, Dar es Salaam. **Tel. 0784474272**or in case you have questions about your rights of participation in this study you may contact;

DR JOYCE MASALU Chairperson of the Senate Research and Publications Committee, P. O. Box 65001 DSM. Telephone**: +255 022 2152489** or

DR. LULU FUNDIKIRA who is the supervisor of this study

Tel. +255 715 994 849

Patient's signature……

Date……..

I certify that the Patient has understood and consented to participate in this study.

DR SYLVIA BEDAS NSATO.

Signature…….

Date…….

f

APPENDIX V:CONSENT FORM – SWAHILI.

CHUO KIKUU CHA SAYANSI ZA AFYA MUHIMBILI

FOMU YA RIDHAA (RUHUSA) YA MGONJWA.

Jina langu naitwa Daktari **SYLVIA BEDAS NSATO.**

Nina soma shahada ya uzamili katika chuo cha MUHAS naninafanya utafiti katika eneo la tatizo la kuziba kwa mishipa ya damu ya mapafu,

Utafiti wangu utafanya uchunguzi kupitia upigaji picha kwa kutumia CTPA, na pamoja na kufanya utafiti katika shida ya kuziba mishipa hii ya damu, pia nitafanya utafiti kwa matatizo yanayoweza kuambatana. Utafiti huu utafanyika katika hospitali ya Taifa ya Muhimbili.

Ninaomba ridhaa / ruhusa yako, niweze kutumia taarifa zako katika utafiti wangu, ili maoni ya utafiti wangu yalete faida katika matibu ya magonjwa ya aina hii.

Hautatakiwakuandikajinalako, nataarifazakozitakuwasiri.

Namba yako ya hospitali iliyo kwenye fomu yako ya kipimo cha CTPA tu, ndio itatumika ili kukutambulisha. Matumizi ya majibu yako ya picha ni kwa ajili ya utafiti huu.

Tafadhali fahamu kuwa unayo haki ya kukubali au kukataa kushiriki au kujitoa katika zoezi zima bila kuathiri huduma nyinginezo zote zitolewazo hospitalini hapa.

Kama una maswali kuhusiana na utafiti huu, wasiliana na mtafiti mkuu -

DR SYLVIA BEDASNSATO, Chuo Kikuu cha Afya na Sayansi shirikishi Muhimbili, **S. L. P. 65001, Dar esSalaam.Simu 0784 474272,**

DR JOYCE MASALU Mwenyekiti wa kamati ya Utafiti na Uchapishaji, **S.L.P 65001, Dar es Salaam.Simu +255 022 2152489**au

Msimamizi wa utafiti huu **DR LULU FUNDIKIRA Simu 0715994849**

Sahihi ya Mgonjwa…….

Tarehe…….

Nathibitisha kwamba Mgonjwa muhusika ameelewa na ameridhika kushiriki katika utafiti huu.

Daktari **SYLVIA BEDAS NSATO.**

Sahihi……

Date ……..……