الآية

قال تعالى:

بسم الله الرحمن الرحيم

(اقرا باسم ربك الذي خلق (1) خلق الانسان من علق (2) اقرا وربك الاكرم(3) الذي علم بالقلم (4) علم الانسان ما لم يعلم(5)

صدق الله العظيم

سورة العلق الآيات (1-5)

Dedication

I dedicate this thesis

To my parents

To My large family

To the people whom I love

To my friends

All my colleges

Acknowledgements

I would like to send out my greatest thanks to Dr. Ahmed Mostafa Abukonnafor kindly supervising this study and for his patience through all the month's that makes this work possible.

My thanks also extend to my friends for their generous help and support.

Abstract

This was a descriptive study designed to cross secttion discription pulmonary embolism patients in the sudanese population using MDCT the study was carried out and the data will be collected from Ribat University Hospital in Khartoum state with a suspicion of pulmonary embolism in the during the period from Feb 2017 to Jun 2017.The study sample size ware 78patients (33 male and 45 female), the average age of the male 57 years and the female 42 years. Pulmonary embolism is a common and potentially fatal disorder although CT pulmonary angiography is best and easiest method widely used to evaluation pulmonary embolism segmental and peripheral (subsegmental) embolisms, so the researcher try to find the pulmonary embolism feature or study in the Sudanese population using MDCT. To characterize the common gender who have a pulmonary embolism**,** To characterize the common age group that have a highly incidents rate by a pulmonary embolism, To evaluate the recurrent probability in the patient who have a previous history of pulmonary embolism, To discover the risk of pulmonary embolism in the postoperative patients, To determine the common location of pulmonary emboli. Patient's laboratory result of the renal function tests most be in the normal , all patients were asked to continue adequate simple fluid intake up to 3 hours prior to examination to ensure adequate hydration, patients were taught how to hold breath during examination when requested, to ensure their cooperation and then underwent CT pulmonary angiography with a multi-detector row CT scanner.

The age group have probability of pulmonary embolism was 61-70 year old, the probability of pulmonary embolism incidence increased by a previous patients family history, the postoperative and prolong bed rest patients is one of patients whom at ricky of pulmonary embolism, the common side of pulmonary embolism is in the right pulmonary artery, bilateral and in the left pulmonary artery respectively, the study shows the common location of pulmonary embolism, was in

the periphery of the pulmonary vessels and less prevalence in the large central vessels patients.A large sample size is needed for further study of the pulmonary embolism patients, pulmonary CTA is a good stander modality in detection of pulmonary embolism but still need another investigation to support the diagnosis. Using a modified technique in pulmonary CTA by adding a delayed run to fill the small peripheral vassals to exclude subsegmental embolism and be shore your patients will understanding your breathe hold instruction to avoid motion artifact which degraded the image quality false +ve result.

الخلاصة

وهي دراسة وصفية بأثر رجعي تهدف إلى توصف مرضى الانسداد الرئوي في المجتع السوداني باستخدام جهاز الأشعة الطبقي متعدد الكواشف ، وسيتم جمع البيانات من أقسام الإشعة المقطعية لكل مرضىإشتباه بالإنصمام الرئوي في السودان ولاية الخرطوم خلال الفترة من فبراير 2017 إلى يونيو 2017 وكان حجم عينة الدراسة 78 مريضا (33 ذكور و 45 أنثى)، ومتوسط عمر الذكور 57 عاما" والإناث 42 عاما". وكانت الفئة العمرية التي لديها احتمال الأنسداد الرئوي من عمر 61 الى 70 سنة. وزادت احتمالة الإصابة بالإنصمام الرئوي لدى المرضى الذين لهم تاريخ مرضي سابق فيالأسرة ، وبعد العملية الجراحية ومرضى الراحة لسريرية المطولة وهم من المرضى الذين يكونونعرضة"للإنسداد الرئوي. وتظهر الدراسة المكان الشائع للإنسداد الرئوي هو في الشريان الرئوي الأيمن ,الشريانين معا" والشريان الرئوي الأيسر على التوالي، وأظهرت الدراسة الدراسة أيضا"أن للإنسداد الرئوي يظهر غالبا" في الأوعية الدموية الطرفية الصغيرة للرئتين أكثرمن الأوعية الدموية المركزية الكبيرة. وكان من توصيات الباحث أن هناك حوجة إلى حجم عينة كبيرة للحصول على مزيد من توصيف مرضى الانسداد الرئوي، تصويرالأوعية الدموية الرئوي بواسطة جهاز الأشعة الطبقي متعدد الكواشف هوأفضل وسيلة للكشف عن الإنسداد الرئوي ولكن لا تزال هنالك حوجةلعمل فحوصات ملحقةلتحقيق دعم آخر للتشخيص.

باستخدام تقنية معدلة في تصويرالأوعية الدموية الرئوي بواسطة جهاز الأشعة الطبقي متعدد الكواشف بإضافة مرحلة تصوير متأخرلتيح ملء الأوعية الطرفية الصغيرة لأستبعاد الإنسداد على الشخص الذي يقوم بعمل الفحص ا لتاكد بان المريض قد فهم تعليمات التنفس الخاص بالفحص لتجنب الحركة مما قد يسبب تشويشا"في ا لصورة الذي بدورة يؤدي لتدهور جودة الصورة مما قد يعطي نتيجة خاطئة.

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List of abbreviations

PE	Pulmonary embolism
MPA	Main pulmonary artery
LPA	Left pulmonary artery
RPA	Right pulmonary artery
VTE	Venous thromboembolism
ROI	Region Of Interest
CTA	Computed tomography angiography
RFT	Renal Function Test
HU	House field unit
IR	Image Receptor
PA	Postero-anterior
AP	Antro-posterior
CR	Center Ray
LAT	lateral
IV	Intra-venous
KVP	Kilo Volt Pick
MAS	Miliampere Second
FOV	Field Of View
CM	Contrast Media
SOB	Short Of Breath
NM	Nuclear medicine

Chapter one

Introduction

1.1 Introduction:

British engineer Godfrey Hounsfield came up with an improvement on the 70-year-old technology its combined x-ray images with a computer; if you took many x-rays of the same area at slightly different angles, a computer could put the information from the x-rays together to create a cross-sectional image, Hounsfield called this technology a CT (computerized tomography) scan, also called a CAT scan (computerized axial tomography), Hounsfield was knighted and won the 1979 Nobel Prize (Baghaie, 2009). Its less-invasive modern technologies have largely replaced invasive procedures such as angiography for imaging of the pulmonary arteries; these techniques have the advantage of short exposure times and the ability to create three-dimensional (3D) data sets that have greater diagnostic possibilities than do standard projection angiographic images, contrast material–enhanced spiral computed tomography (CT) provides these advantages (Baghaiel, 2009).

Pulmonary artery is one of the two vessels which are formed as terminal branches of the pulmonary trunk and convey un-aerated blood to the lungs; the two pulmonary arteries differ in length and anatomy, and the right pulmonary artery is the longer of the two it passes transversely across the midline in the upper chest and passes below the aortic arch to enter the helium of the right lung as part of its root, the left pulmonary artery is the shorter of the two terminal branches of the pulmonary trunk, it pierces the pericardium (the sac around the heart) and enters the helium of the left lung (Baghaie, 2009).

CT pulmonary angiography (CTPA) is a medical diagnostic test that employs computed tomography to obtain an image of the pulmonary arteries it was

introduced in the 1990s as an alternative to ventilation/perfusion scanning, which relies on radionuclide imaging of the blood vessels of the lung, because of its minimally invasive nature and high sensitivity and specificity, CTPA has evolved into the first line imaging study for the evaluation of suspected pulmonary embolism, images are acquired using a breath hold technique during the pulmonary arterial enhancement phase following intravenous contrast material injection, with pulmonary embolism appearing as a filling defect in the otherwise densely opacified pulmonary artery (Tardivon, 1999).

Pulmonary embolism (PE) is a blockage of the main artery of the lung or one of its branches by a substance that has travelled from elsewhere in the body through the bloodstream (embolism) (Tardivon, 1999).

PE most commonly results from deep vein thrombosis (a blood clot in the deep veins of the legs or pelvis) that breaks off and migrates to the lung, a process termed venous thromboembolism (VTE), small proportion of cases are caused by the embolization of air, fat, or talc in drugs of intravenous drug abusers or amniotic fluid. The obstruction of the blood flow through the lungs and the resultant pressure on the right ventricle of the heart lead to the symptoms and signs of PE. The risk of PE is increased in various situations, such as cancer or prolonged bed rest due to orthopedic surgery or Caesarean section.

Symptoms of pulmonary embolism include difficulty breathing, chest pain on inspiration, and palpitations and the clinical signs include low blood oxygen saturation and cyanosis, rapid breathing, and a rapid heart rate, severe cases of PE can lead to collapse, abnormally low blood pressure, and sudden death (Tardivon, 1999).

Diagnosis is based on these clinical findings in combination with laboratory tests (such as the D-dimer test) and imaging studies, usually CT pulmonary angiography, Pulmonary embolism can be diagnosed through the patient's history,

a physical exam, and diagnostic tests including chest x ray, lung scan, pulmonary angiography, electrocardiography, arterial blood gas measurements, and leg vein ultrasonography or venography (Tardivon, 1999).

1.2 Research problem:

Pulmonary embolism is a common and potentially fatal disorder although CT pulmonary angiography is best and easiest method widely used to evaluation pulmonary embolism segmental and peripheral (subsegmental) embolisms, so the researcher try to find the pulmonary embolism feature or characters in the Sudanese population using MDCT.

1.3 Objectives:

1.3.1 General Objective:

To study the pulmonary embolism using Multi Detectors Computraized Tomography (MDCT) in Khartoum state.

1.3.2 Specific Objective

To characterize the common gender who have a pulmonary embolism**,** To characterize the common age group that have a highly incidents rate by a pulmonary embolism, To evaluate the recurrent probability in the patient who have a previous history of pulmonary embolism, To discover the risk of pulmonary embolism in the postoperative patients, To determine the common location of pulmonary emboli.

1.4 Overview of the study:

The study consists of five chapters:

Chapter one will include briefly introduction about the study, research problem, general and specific objectives and overview of the study. Chapter two is

containing literature review (anatomy, physiology, pathology, previous studies in the role of MDCT in diagnosis of CTPE. Chapter three will describe the methodology (material, method) will be use in this study. Chapter four will include result and presentation of final finding of study.Chapter five will include discussion, conclusion and recommendation for future scope in addition to references and appendices.

Chapter Two

Theoretical background and Literature review

2.1 Pulmonary blood supply (pulmonary circulation)

Is a portion of the cardiovascular system which carries deoxygenated blood away from the heart, to the lungs, and returns oxygenated blood back to the heart (Costello, 2000).

2.1.1Pulmonary trunk

The pulmonary trunk is a large artery superior to the right ventricle of the heart and anterior to the aorta .it is widest where it divides into the pulmonary arteries measuring about 1 inch (2.5) in diameter .The pulmonary valve and extends superiorly, posteriorly and slightly to the left .At its superior end it divides into the left pulmonary artery and the right pulmonary artery, which continue toward the left and right lungs respectively (Costello et.al, 2000).

The walls of pulmonary trunk are extremely thick to withstand the high pressure exerted by blood as it exit the heart .The inner most layer of the arterial wall is the tunica intimae , which forms the internal lining of the vessel and is mad of endothelium (Costello, 2000).

Endothelium is a layer of simple squamous epithelium that prevents blood cells from sticking to the blood vessel surrounding the tunica intimae is the thick tunica media that contains smooth muscle and elastic tissue. smooth muscle and elastic tissue .smooth in the tunica media contrast to resist the pressure of blood pushing on the arterial walls while elastic tissue give the arterial wall the ability to stretch under pressure and return to its original size between heart beats .finally the tunica externa forms the outer most layer of pulmonary trunk (Costello, 2000).

2.1.2 Right and left pulmonary artery

It divides into the left pulmonary artery (LPA) and right pulmonary artery (RPA) at the level of the fifth thoracic vertebra. The RPA is longer than the LPA and crosses the mediastinum, sloping slightly inferiorly to the right lung hilus.The LPA represents the continuation of the MPA.

Segmental and sub segmental pulmonary arteries generally parallel segmental and sub segmental bronchi and run alongside them .The is in contrast to the course of most pulmonary veins which run independently of bronchi within interlobular septa (Costello et.al, 2000).

The segmental arteries are named according to the bronchopulmonary segments that feed and we follow the Jackson and Huber classification in this description however, the proximal portion of the arteries to the lingular posterior sub segment of the left upper lobe and lingular arteries can run independently of the their respective bronch for short segment (Costello, 2000).

Also there are frequently accessory arteries from neighboring segments particularly in the right upper lobe Segmental and sub segmental pulmonary arteries very considerably in the location of their origins I whether they arise as common trunk with other arteries or as separate arteries and in their number (Costello et.al, 2000).

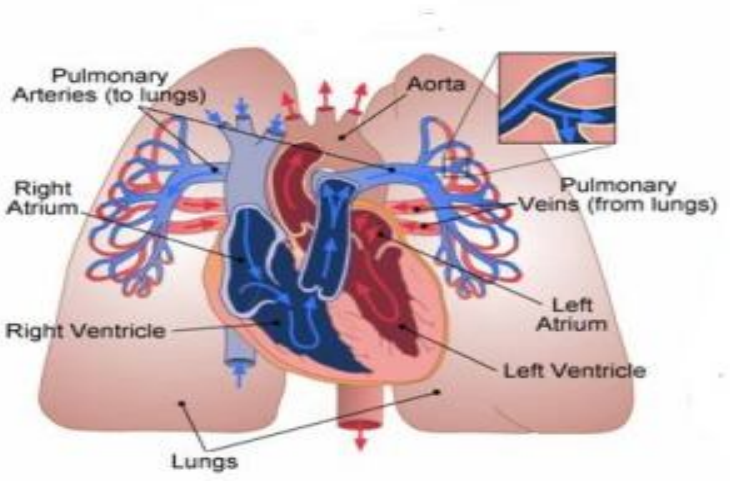

Fig 2.1.2 shows the pulmonary circulation (Costello, 2000).

2.1.3 Pulmonary vein:

Pulmonary veins are large blood vessels that receive oxygenated blood from the lungs and drain to the left atrium of the heart. (Costello P, 2000)

There are four pulmonary veins, two from each lung, the pulmonary veins are among the few veins that carry the oxygenated blood, two pulmonary veins emerge from each lung helium, receiving blood from three or four bronchial veins apiece and draining into the left atrium, an inferior and superior vein drains each lung, so there are four veins in total. The veins are fixed to the pericardium, the pulmonary veins travel alongside the pulmonary arteries. (Costello P, 2000)

At the root of the lung, the right superior pulmonary vein lies in the front and a little below the pulmonary artery, the inferior is situated at the lowest part of the lung helium, behind the pulmonary artery is the bronchus, the right pulmonary veins pass behind the right atrium and superior venacava, the left in front of the descending thoracic aorta (Costello et.al, 2000).

2.2 Pulmonary Physiology

Is a branch of human physiology focusing upon respiration, inhalation (breathing in) is an active movement, the contraction of the diaphragm muscles cause a pressure variation, which is equal to pressure caused by elastic, resistive and internal components of the respiratory system. Expiration (breathing out) is usually a passive process. (Costello P, 2000).

2.2.1 Pulmonary circulation

Isa portion of the cardiovascular system which carries deoxygenated blood away from the heart, to the lungs, and returns oxygenated blood back to the heart, the term pulmonary circulation is readily paired and contrasted with the systemic circulation (Baghaiee, 1998).

2.2.2 Gas exchange

In the lungs, oxygen and carbon dioxide are exchanged in the tiny air sacs (alveoli) at the end of the bronchial tubes. The alveoli are surrounded by capillaries .When a person inhales oxygen moves from the alveoli to the surrounding capillaries and into the blood stream, gases are constantly consumed and produced by cellular and metabolic reactions in most living things, so an efficient system for their exchange is required (Baghaiee.1998).

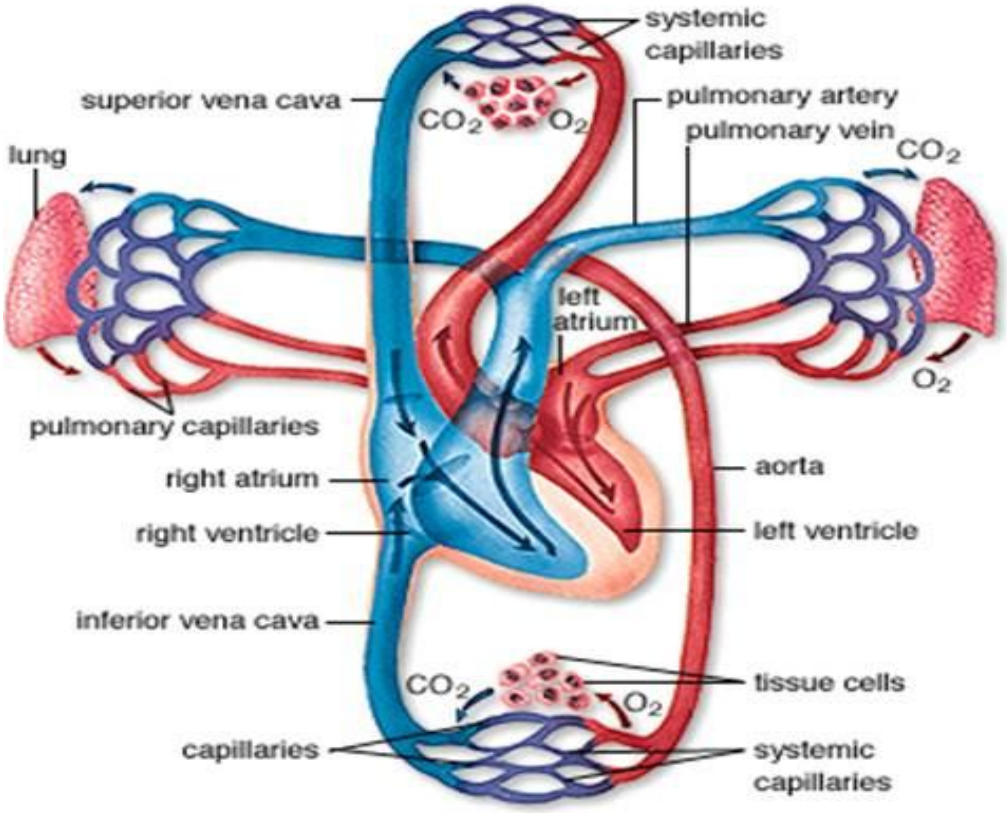

Fig2.2.2a diagram shows the gas exchange process (Baghaiee.1998).

2.4 Vascular disease in pulmonary circulation

Pulmonary embolism can cause cardiac arrest and sudden death, shock, abnormal heart rhythms, death of part of the lungs, called pulmonary infarction.

2.4.1 Acquired pulmonary vessels disease

2.4.1.1 Pulmonary embolism

Is a blockage of an artery in the lungs by a substance that has traveled from elsewhere in the body through the blood stream, symptoms of PE may include one or many of the following: dyspnea (shortness of breath), tachypnea (rapid breathing), chest pain of a "pleuritic" nature (worsened by breathing), cough and hemoptysis (coughing up blood). More severe cases can include signs such as cyanosis (blue discoloration, usually of the lips and fingers), collapse, and circulatory instability because of decreased blood flow through the lungs and into the left side of the heart. About 15% of all cases of sudden death are attributable to PE (Baghaiee, 1998).

On physical examination, the lungs are usually normal; occasionally a pleural friction rub may be audible over the affected area of the lung (mostly in PE with infarct). A pleural effusion is sometimes present that is exudation, detectable by decreased percussion note, audible breath sounds and vocal resonance. Strain on the right ventricle may be detected as a left parasternal heave, a loud pulmonary component of the second heart sound, and/or raised jugular venous pressure. A low-grade fever may be present, particularly if there is associated pulmonary hemorrhage or infarction (Baghaiee, 1998).

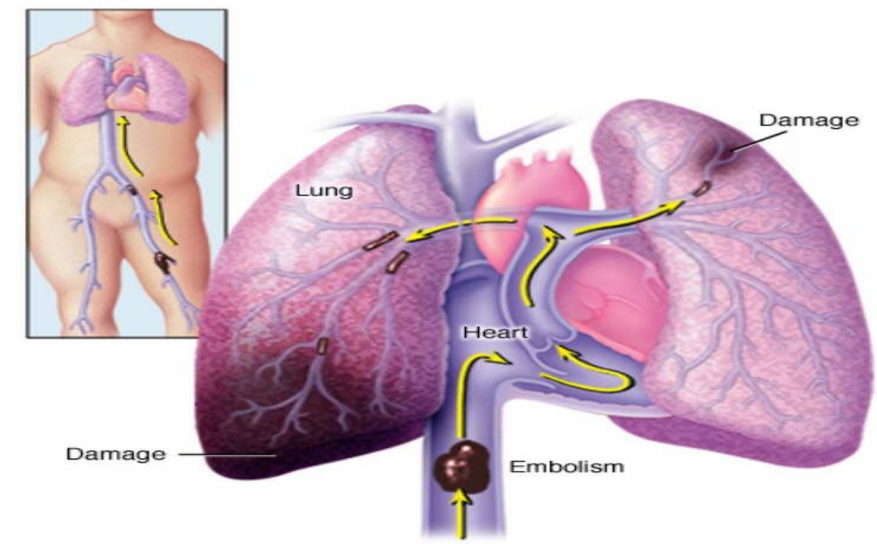

Fig 2.4.1.1 a diagram shows the mechanism of initiation of pulmonary emboli (Baghaiee, 1998).

2.4.1.2 Thrombotic PE

Acute pulmonary embolism is a form of venous thromboembolism (VTE) the clinical presentation of PE is variable and often nonspecific making the diagnosis challenging.

Chronic pulmonary embolism is mainly a consequence of incomplete resolution of pulmonary thromboembolism (Nina, 2014).

2.4.1.1 .1 b. Non Thrombotic PE

Symptoms of a blood clot in the leg may also present such as a red, warm, swollen, and painful leg, signs of PE include low blood oxygen levels , rapid breathing , rapid heart rate , and sometimes a mild fever. Sever cases can lead to passing out, abnormally low blood pressure, and sudden death (Baghaiee, 1998).

The risk factor of the blood clots is increased by cancer, prolonged bed rest, smoking, certain genetic conditions, estrogen-based medication, pregnancy, obesity, and after some types of surgery, a small proportion of cases are due to the

embolization of air, fat, or amniotic fluid, diagnosis is based on signs and symptoms in combination with test results. If the risk is low a blood test known as a D-dimer will rule out the condition. Otherwise a CTA, lung ventilation\perfusion scan, or ultrasound of the legs may confirm the diagnosis; efforts to prevent PE include beginning to move as soon as possible after surgery, lower leg exercises, and use of blood thinners after some types of surgery (Nina, 2014).

Treatment is typically with blood thinners such as heparin or warfarin, sever cases may require thrombolysis using medications or may require surgery (pulmonary thromboectomy) or using venacava filter; pulmonary emboli affect about 430,000 people each year in Europe, in the United States between 300,000 and 600,000 cases occur each year. Rates are similar in males and females they become more common as people get older (Nina. 2014).

2.4.1.2 Pulmonary hypertension:

It is defined as a mean pulmonary artery pressure greater than 25mm Hg during rest (normal level, 10 mm Hg) or greater than 30 mm Hg during exercise (normal 15 mm Hg)(Nina, 2014).

2.4.1.3 Pulmonary Aneurism

An aneurism Focal dilatation of blood vessel involving 3 layers of the vessel wall (Nina, 2014).

2.4.1.4 Intravascular Pulmonary Metastases

Intra vascular pulmonary metastases are commonly seen at autopsy, particularly in patients with carcinoma of the breast, stomach, liver, kidney, or lung. The majorities of the tumor emboli are microscopic and involve sub segmental arteries and arterioles (Nina, 2014).

2.4.2 Congenital

2.4.2.1 Pulmonary atresia

Is a congenital malformation of the pulmonary valve in which the valve orifice fails to develop. The valve is completely closed thereby. It is present from birth. In pulmonary atresia, a solid sheet of tissue forms where the valve opening should be, and the valve stay closed. Because of the defect, blood from the right side of the heart cannot go to the lungs to pick up oxygen (Nina, 2014).

2.5 Investigation for PE

2.5.1 Plain Chest X-ray

Provide images of structures in and around the thorax and are most useful for identifying abnormalities in the heart, lung parenchyma, pleura, chest wall, diaphragm, mediastinum and helium. They are usually done evaluate the lungs. The standard chest x-ray is taken from back to front (posterior anterior view) to minimize x-ray scatter that could artifictually enlarge the cardiac silhouette and from the side of thorax (lateral view) lordatic or oblique views can be obtained to evaluate pulmonary nodules or clarify abnormalities that maybe due to superimposed Structures although chest CT provides more information has largely superseded these views. Lateral decubitus views may be used to distinguish free-flowing from lobulated pleural effusion, but CT or ultrasonography can provide more information. End-expiratory views can be used to detect small pneumothoraxes (Nina, 2014).

2.5.1.1 Patient position (PA):

Patient erect feet spread slightly, Wight equally distributed on both feet, Chin raised, resting against IR,Hands on lower hips, palms out and elbows partially flexed, Shoulders rotated forward against IR to allow scapulae to move laterally clear of lungs field. Also depress shoulders downward to move clavicles below the

apices. Align midsagittal plane to CR and to midline of IR with equal margins between lateral thorax and sides of IR. (Adrian D. Moore, et al, 2012).

Central Ray:

Perpendicular to IR and centered to midsagittal plane at level of T7, Cassette centered to CR, SIO of 72 inches (180 cm). (Adrian D. Moore, et al, 2012).

2.5.1.2 Patient position (AP):

Patient is supine on cart; if possible, the head end of the cart or bed should be raised into a semi erect position, roll patient shoulders forward by rotating arms medially or internally. (Adrian D. Moore, et al, 2012).

Central Ray:

CR angled caudad to be perpendicular to long axis of sternum, CR level of T7, 3 to 4 inches or 8 to 10 cm below jugular notch, Minimum SID of 40 inches (100 cm) for supine. (Adrian D. Moore, et al, 2012).

2.5.2 Computed Tomography:

CT defines intrathoracic structures and abnormalities more clearly than does a chest x-ray. Disadvantages are motion artifacts and limited detail from volume average of tissue within each 10-mm slice. (Adrian D. Moore, et al, 2012).

Technique used:

Axial images, Patient supine, Feet first, arms raised, Scan from above lung apices to below diaphragm routinely – 3mm cuts. Contrast used may be IV (Highlights blood vessels) (Drucker et al, 1998).

Fig 2.5.1.2 shows patient positioning in CT scanner (Adrian D. Moore, etal, 2012).

2.5.3Computed Tomography Pulmonary angiography (CTPA):

Medical diagnostic test that employs computed tomography to obtain an image of the pulmonary arteries. Its main use is to diagnose pulmonary embolism (PE) . It is a preferred choice of imaging in the diagnosis of PE due to its minimally invasive nature for the patient, whose only requirement for the scan is an intravenous line.

Modern MDCT (multi –detector CT) scanners are able to deliver images of sufficient resolution within a short time period, such that CTPA has now supplanted previous methods of testing, such as direct pulmonary angiography, as the gold standard for diagnosis of PE (Drucker et al, 1998).

2.5.3.1 Indications:

CTPA is only requested if pulmonary embolism is suspected clinically. If the probability of PE is considered low, a blood test called D-dimer may be requested (Drucker et al, 1998).

2.5.3.2 Contraindications:

CTPA is less desirable in pregnancy due to the amount of ionizing radiation required, which may damage the breasts, which are sensitive during pregnancy and the effects of iodine on the fetus (Drucker et al, 1998).

2.5.3.3Advantages:

Readily available, Fast, Minimally invasive, Can provide prognostic information by assessing the size of the right ventricle, Can detect alternative diagnoses (Drucker et al, 1998).

2.5.3.4Disadvantages of CTPA:

Expensive, Radiation dose, Contraindicated in those with renal failure, contrast allergies and pregnant women (Drucker et al, 1998).

2.5.3.4 Feature of PE in CT scan:

CT pulmonary angiography (CTPA) will show filling defects within the pulmonary vasculature with pulmonary emboli. When observed in the axial plane this has been described The central filling defect from the thrombus is surrounded by a thin rim of contrast, appearing like the popular sweet, Emboli may be occlusive or non-occlusive, the latter as seen with a thin stream of contrast adjacent to the embolus. Typically the embolus makes an acute angle with the vessel, in contrast to chronic emboli. The affected vessel may also enlarge. Acute pulmonary thromboemboli can occasionally be detected on non-contrast chest CT as intraluminal hyperdensities. In contrast to acute pulmonary embolism, chronic thromboemboli are often complete occlusions or non-occlusive filling defects in the periphery of the affected vessel which forms obtuse angles with the vessel wall. The thrombus may be calcified. Features noted with chronic include: webs or bands, intimal irregularities abrupt narrowing or complete obstruction of the pulmonary arteries, pouching defects which are defined as chronic thromboembolism organized in a concave shape that, points toward the vessel lumen mosaic perfusion, vascular calcification, bronchial or systemic collateralization. (Wersley DF, Alavi A, et al, 2009).

2.6 previous studies:

(Jitphapa, et al,2008) studied all AIS patients admitted to participating institutions in the Registry of the Canadian Stroke Network. Clinically PE was documented by a physician and confirmed by computed tomography pulmonary angiography within 30 days of the stroke case index. The primary outcome was death or disability at discharge. Secondary outcomes included disposition, length of hospital stay, and mortality at 3 months and 1 year. Among 11 287 patients with AIS, PE was found in 89 (0.78%).

History of cancer, deep vein thrombosis (DVT)/PE, and DVT during the hospitalization were associated with PE. PE was associated with higher risk of death at 30 days (25.8% versus 13.6%; P<0.001), at 1 year (47.2% versus 24.6%; P<0.001), and disability at discharge (85.4% versus 63.6%; P<0.001). Mean length of stay was longer in stroke patients with PE (36 versus 16 days; P=0.001). After adjusting for age, sex, and stroke severity, PE remained associated with lower survival at 30 days and 1 year, and death or disability at discharge (OR 3.02; 95% CI 1.56 to 5.83) (Jitphapa, etal. 2008).

(Robert, etal, 2010) studied the differences in clinical presentation of pulmonary embolism in women and men, the analyzed data concluding that from a total of 3414 outpatients with suspected PE. The study population comprised 1940 women (57%; mean age 60 ± 17) and 1474 men (43%; mean age 60 ± 20). The diagnosis of PE was confirmed in 773 patients (22.6%): 432 out of 1940 women and 341 out of 1474 men (22.3% vs. 23.1%; P = 0.55). Thromboembolic risk factors, symptoms and clinical signs according to gender are presented personal or family history of venous thromboembolism, or varicose veins was more commonly found in women. Among PE diagnosed by CT, the most proximal level was troncular in 29%, lobar in 37%, segmental in 30% and multiple sub segmental in 4%, without

any significant difference between genders. However, the proportion of PE-associated proximal DVT was higher in men than in women: 43% of men compared with 33% of women had an associated proximal DVT (P = 0.009).

(M.T, etal, 2014) studied 313 PE patients; 56% were women and the median age was 70 years (interquartile range 53-78 years). Central PE accounted for 68% of cases; segmental and subsegmental PE, for 25% and 7%. Patients with sub segmental PE was younger had lower comorbidity and none of them presented proximal DVT (Table 1). Patients in the subsegmental PE group included 10 (45%) with single PE and 12 (55%) with multiple PE.

Prevalence of sub segmental PE was 7%, similar to that reported by other authors.5 No significant gender difference was found in terms of the extent of the disease; however, the proportion of women is slightly higher in our sample. The age of patients with sub segmental PE was lower than that of patients with central and segmental PE. The difference could be related to hyper coagulation and the changes in vascular endothelium that come with aging19: these could facilitate the extent of thrombi in older patients, especially considering that no age difference was found in the prevalence of risk factors for PE.

(Han Jo Kim,et al,2010) studied that surgery was associated with a significant risk of postoperative pulmonary embolism (PE) and/or deep vein thrombosis (DVT). This study was performed to compare the clinical presentations of a suspected versus a documented PE/DVT and to determine the actual incidence of PE/DVT in the post-operative orthopedic patient in whom CT was ordered. All 695 patients at our institution who had a postoperative spiral CT to rule out PE/DVT from March 2004 to February 2006 were evaluated and information regarding their surgical procedure, risk factors, presenting symptoms, location of PE/DVT, and anticoagulation were assessed. Statistical analysis was performed using an independent samples *t* test with a two-tailed *p* value to examine significant

associations between the patient variables and CT scans positive for PE. Logistic regression models were used to determine which variables appeared to be significant predictors of a positive chest CT. Of 32,854 patients admitted for same day surgery across all services, 695 (2.1%) had a postoperative spiral CT based on specific clinical guidelines. The incidence of a positive scan was 27.8% (193/695). Of these, 155 (22.3%) scans were positive for PE only, 24 (3.5%) for PE and DVT, and 14 (2.0%) for DVT only. The most common presenting symptoms were tachycardia (56%, 393/695), low oxygen saturation (48%, 336/695), and shortness of breath (19.6%, 136/695). Symptoms significantly associated with DVT were syncope and chest pain. A past medical history of PE/DVT was the only significant predictor of a positive scan. Patients who have a history of thromboembolic disease should be carefully monitored in the postoperative setting.(Han Jo Kim,et al,2010).

Chapter Three

Materials and Methods

3.1 Materials:

3.1.1 Subjects:

It was a descriptive retrospective study designed to studing pulmonary embolism patients in the sundaes population using MDCT, the study was carried out during the period from Feb 2017 to Jun 2017.78patients (33 male and 45 female) who were referred to the Radiology department in Khartoum state hospitals and diagnostic centers with a suspicion of pulmonary embolism with the common complaining chest pain, low blood oxygen saturation and, abnormally low blood pressure. Their age ranged 30-70 years. Child and patients below 30 year old and pregnant females were excluded.

3.1.2 Machine used:

All of the CT imaging was performed with a 16-slice MDCT(Light Speed and Bright Speed, Siemens).Before dynamic CT was performed, high resolution CT (HRCT) images were obtained. One –mm- thick imaged were taken at 10-mm spacing from lung apexes to lung bases, with the patient breathing out fully for each image. with power automatic injector medrad (stellant) imaging system interface module.

3.2 Methods :

3.2.1Technique used:

Patient’s laboratory result of the renal function tests most be in the normal , all patients were asked to continue adequate simple fluid intake up to 3 hours prior to examination to ensure adequate hydration, patients were taught how to hold breath during examination when requested, to ensure their cooperation and then underwent CT pulmonary angiography with a multi-detector row CT scanner the

patients were positioned supine on the CT table in the “foot first” position with an 18-20 gauge canula placed into a superficial vein within the antecubital fossa, a two scouts were acquired, anteroposterior and lateral, the examination was planned on these scouts from the level of mid of the neck till the upper abdomen and the patients were requested to hold their breath during the first 20 seconds of the acquisition.

The technical parameters will be sassed (kV, mAs tube rotation/s), the acquisition timing for optimum opacity is achieved by using automatic bolus tracking in region of interest placed on an artery the ROI is placed on the pulmonary artery just below the tracheal carina , the trigger level is set at 80 Hounsfield units.

This study will evaluate the variation of contrast media used volume of low osmolar non-ionic contrast medium (Omnipaque 300mg I/ml GE Healthcare, Milwaukee).

Before dynamic CT was performed, high resolution CT (HRCT) images were obtained. One –mm- thick imaged were taken at 10-mm spacing from lung apexes to lung bases, with the patient breathing out fully for each image. Then 100 ml of iodinated contrast medium (Omnipaque 300 mg/ml) was intravenously injected with a power injector at rate 6 ml/sec. The scanning was then performed from the lung apexes to the middle pole of the kidneys. Smart preparation technique-scanning delay was automatically determined with bolus tracking in the pulmonary trunk , and only after the contrast medium injection and subsequent waiting for density of in the pulmonary trunk to be over 80 Hu was the starting scan used. The region of interest (ROI) was placed in the in the pulmonary trunk. The scanning parameters were a collimation of 1.25 mm, a table speed of 34.375 mm/sec and a pitch of 1.375. Axial slices were reconstructed with a slice width of mm and a slice interval of 5.0 mm. Then, the 0.625 mm reconstructed raw data of the dynamic CT images were sent to the CT workstation (Advantage Window 4.4). Experience

radiologists in chest CT independently reviewed the nearly-isotropic data set consisting of 300-400 reconstructed CT images at the workstation techniques and unaware of the final diagnosis of each lung lesion.

3.2.2 Data collection and Analysis:

The data of patients were obtained by a data collect sheet used to collect a various information and these variables were age, gender, Family History, postoperative, location of pulmonary embolism, characterize of the emboli location is it central or peripheral. The obtained data were then analyzed using SPSS software program.

3.2.3 Image interpretation:

CT angiography was interpreted and the arterial tree was always studied part by part, from the pulmonary trunk to the last peripheral arterioles, the degree of contrast enhancement in the pulmonary artery was also evaluated , also the mean Hounsfield units will be measured at the level of pulmonary arteries bifurcation.

Several tools were used at the workstation to display data, and most often, MPR and MIP were used in our study. Rotations around and along any axis in real time were also used. The observers assessed the relationship of the lung lesions and adjacent pulmonary artery with multiple windows and levels simultaneously at CT workstations and recorded the relationships as encasement, penetration, in the margin, and disconnection. The definition of encasement is a mass enveloping a pulmonary artery while decreasing the size of a pulmonary artery`s caliber. Displacement indicates a mass is causing deviation of a pulmonary artery away from the normal vascular course without a notch in the pulmonary artery penetration is when a pulmonary artery passes through the lesion without changing the vascular course or caliber of the pulmonary artery.

Chapter 4

Results

4.1Results

In this chapter the researcher will present the general results dealing with study the pulmonary embolism patients using MDCT in Khartoum state hospital and diagnostical centers, the parameters will be considered age, gender, Family History, postoperativepatients, location of pulmonary emboli, characterize of the emboli location (central or peripheral).

Table 4.1 Shows Frequency distribution of gender

Genders	Frequency	percent
Male	33	42.3 %
Female	45	57.7 %
Total	78	100.0 %

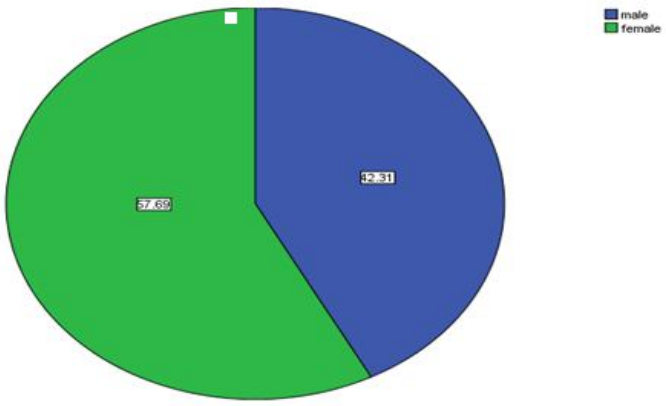

Figure 4.1 shows Frequency distribution of gender.

Table 4.2 shows Frequency distribution of age groups:

Age group	frequency	percent
21-30	3	3.8%
31-40	6	7.7%
41-50	15	19.2%
51-60	21	26.9%
61-70	9	11.5%
71>	24	30.8%
total	78	100.0%

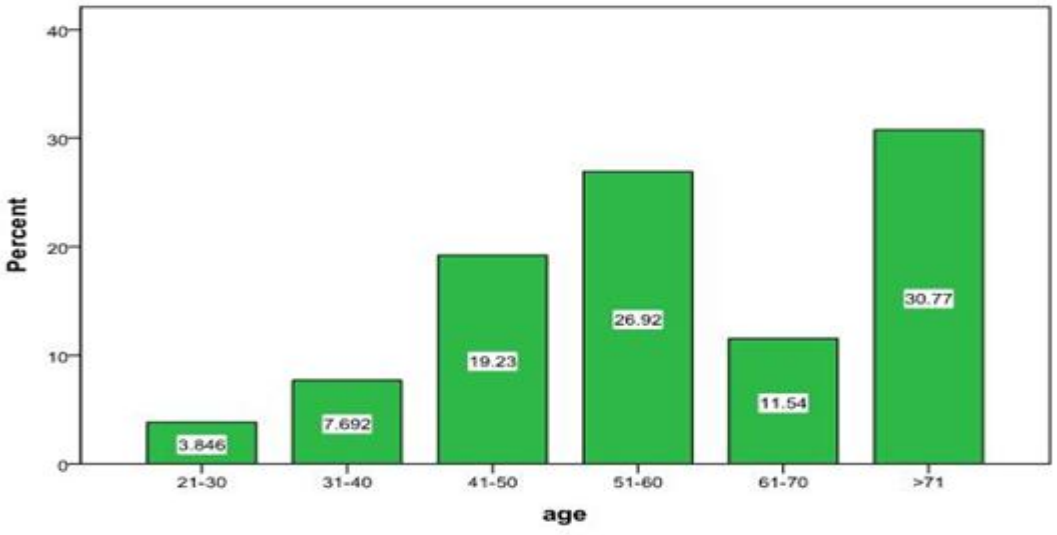

Fig 4.2 shows Frequency distribution of age.

Table 4.3 show previous history of pulmonary embolism:

History of PE	frequency	Percent
Yes	48	61.5%
No	30	38.5%
Total	78	100 %

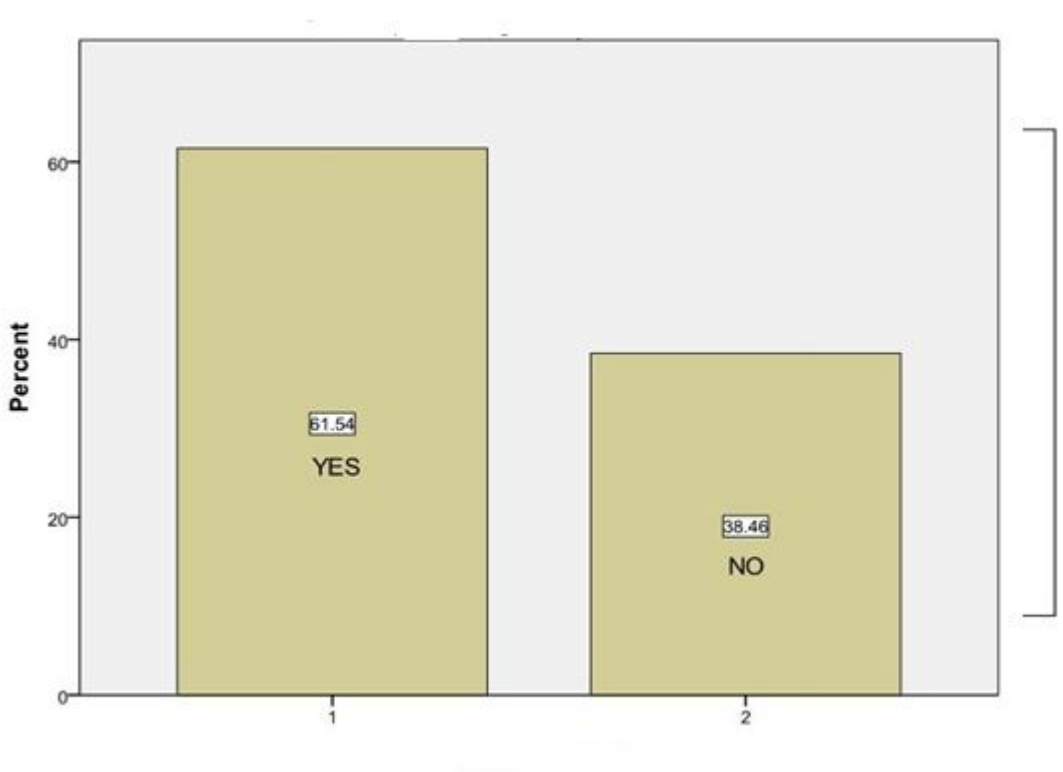

Fig 4.3 shows previous history of pulmonary embolism

Table 4.4 show clinical data for the postoperative patients:

postoperative	Frequency	Percent
Yes	54	69%
No	24	31%
Total	78	100.0 %

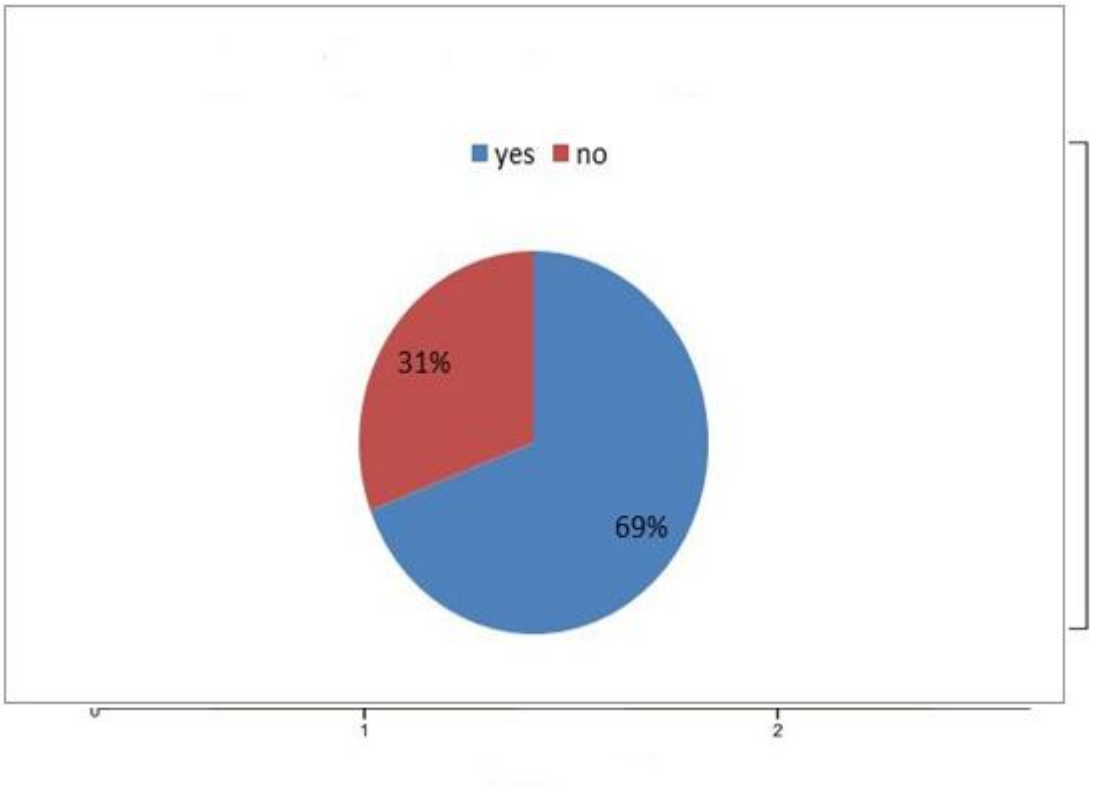

Fig 4.4 show clinical data for the postoperative patients

Table4.5 show side of pulmonary embolism

Site	Frequency	percent
Right	36	46.2%
Left	17	21.8%
Bilateral	25	32.1%
Total	78	100%

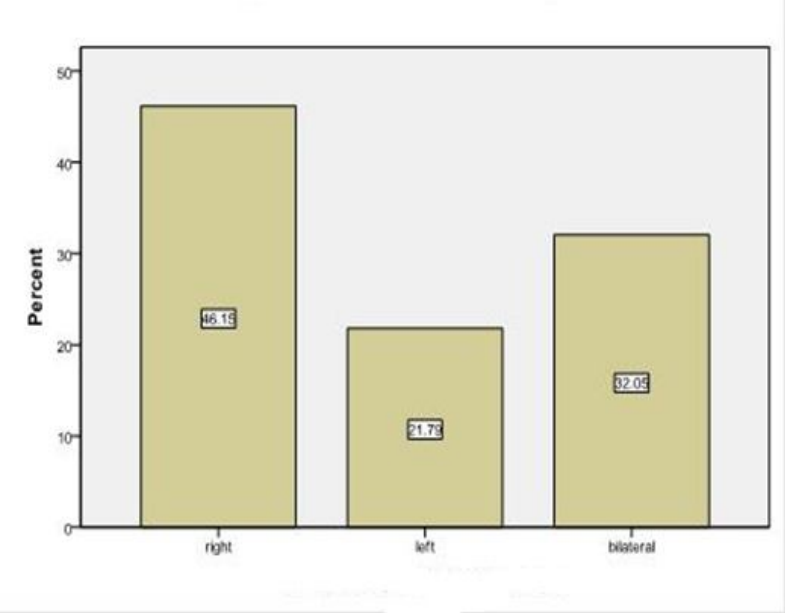

Fig 4.5 show side of pulmonary embolism

Table4.6 show the frequency of location of pulmonary embolism

location	Frequency	percent
Central	9	11.5%
peripheral	69	88.5%
Total	78	100%

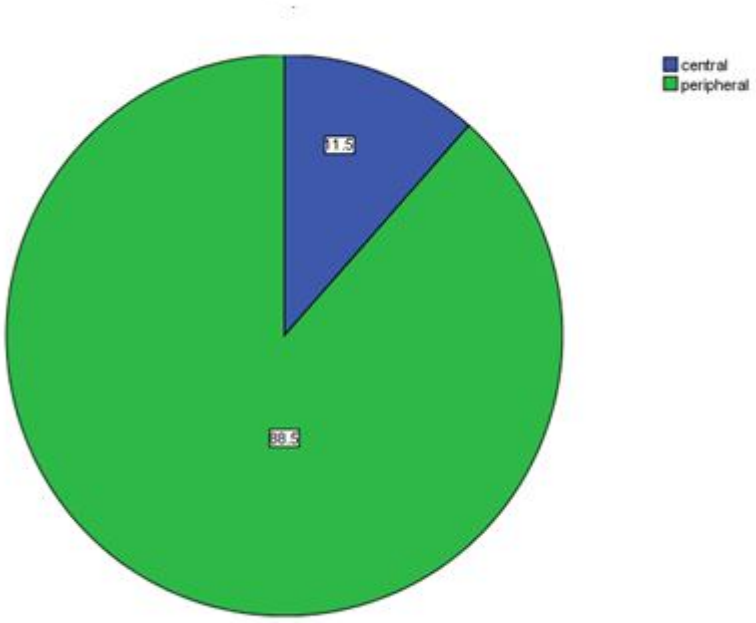

Fig4.6 show frequency distribution location of pulmonary embolism.

Chapter 5

Discussion, Conclusion and Recommendation

5.1 Discussion:

With advances in Multi Detector Computarize Tomography (MDCT) technology, evaluation of pulmonary thromboembolic disease can now be performed with combined CT pulmonary angiography and CT venography as a “one-stop-shopping” test. CT pulmonary angiography is cost-effective, is accurate, has high interobserver agreement, and has an added advantage of detecting other life-threatening diseases in the chest that mimic pulmonary embolism.

Table 4.1 and figure 4.1 shows the frequency distribution of patients under study according to gender, there was 33 males (42.3%) and 45 females (57.7%). Table 4.2 and figure4.2 shows the frequency distribution of patients under study according to age, the age from 21-30 there was 3 patients(3.8%)with pulmonary embolism, 31-40 there was 6 patients (7.7%)with pulmonary embolism, 41-50 there was 15 patients (19.2%)with pulmonary embolism, 51-60 there was 21 patients (19.2%)with pulmonary embolism, 61-70 there was 9 patients (11.5%) with pulmonary embolism, over-70 there was 24 patients(30.8%) with pulmonary embolism. Table 4.3and figure 4.3 shows the frequency distribution of patients under study according to family history, there were 48 patients (61.5%) with family history and 30 patients (38.5%)with no family history. Table 4.4 and figure 4.4show clinical data for the postoperative patients ware 54 patients 69% have pulmonary embolism after an operational intervention history and 24 patients (31%)have pulmonary embolism without a previous operational intervention. Table 4.5 and figure 4.5 shows the frequency distribution of patients under study according to side of pulmonary embolism, there were 36 (46.2%) in the right pulmonary artery, 17 (21.8%) left pulmonary artery and 25 (32.1%) bilateral in the

right and left pulmonary artery. Table 4.6and figure4.6shows the frequency of location of pulmonary embolism,there were 9 patients (11.5%) with pulmonary embolism located at the center of the pulmonary artery and 69 (88.5%) was peripherally.

Table 4.1 and figure 4.1 shows the frequency distribution of patients under study according to gender, there was 33 males (42.3%) and 45 females (57.7%). The ratio percent of males to female is similar and agree with the ratio percent in the study of (Robert Ebadi, etal. 2010) which shows the differences in clinical presentation of pulmonary embolism in women and men.

Table 4.2 and figure4.2 shows the frequency distribution of patients under study according to age, the age from 21-30 there was 3 patients(3.8%)with pulmonary embolism, 31-40 there was 6 patients (7.7%)with pulmonary embolism, 41-50 there was 15 patients (19.2%)with pulmonary embolism, 51-60 there was 21 patients (19.2%)with pulmonary embolism, 61-70 there was 9 patients (11.5%) with pulmonary embolism, over-70 there was 24 patients(30.8%) with pulmonary embolism and that was agree with the document of (M.T. García-Sanz etal.2014) revealing thatthe age of patients with subsegmental PE was lower than that of patients with central and segmental PE. The difference could be related to hyper coagulation and the changes in vascular endothelium that come with aging19, these could facilitate the extent of thrombi in older patients, especially considering that no age difference was found in the prevalence of risk factors for PE.

Table 4.3and figure 4.3 shows the frequency distribution of patients under study according to family history, there were 48 patients (61.5%) with family history and 30 patients (38.5%)with no family history as its shown in (M.T. García-Sanz etal.2014) study which discuss Personal details like age, gender, active smoking and obesity (body mass index >30) properly, the female have a higher awareness of VTE disease, family history of VTE, or varicose veins was more commonly

found in women, whereas cancer and chronic obstructive pulmonary disease (COPD) were more frequent in menand that agree with the research. (Robert EbadI etal.2010).

Table 4.4 and figure 4.4show clinical data for the postoperative patients ware 54 patients 69% have pulmonary embolism after an operational intervention history and 24 patients (31%)have pulmonary embolism without a previous operational intervention and that agree with (Han Jo Kim,et al,2010) studied that surgery was associated with a significant risk of postoperative pulmonary embolism (PE) and/or deep vein thrombosis (DVT). This study was performed to compare the clinical presentations of a suspected versus a documented PE/DVT and to determine the actual incidence of PE/DVT in the post-operative orthopedic patient in whom CT was ordered. All 695 patients at our institution who had a postoperative spiral CT to rule out PE/DVT from March 2004 to February 2006 were evaluated and information regarding their surgical procedure, risk factors, presenting symptoms, location of PE/DVT, and anticoagulation were assessed. Statistical analysis was performed using an independent samples *t* test with a two-tailed *p* value to examine significant associations between the patient variables and CT scans positive for PE. Logistic regression models were used to determine which variables appeared to be significant predictors of a positive chest CT. Of 32,854 patients admitted for same day surgery across all services, 695 (2.1%) had a postoperative spiral CT based on specific clinical guidelines. The incidence of a positive scan was 27.8% (193/695). Of these, 155 (22.3%) scans were positive for PE only, 24 (3.5%) for PE and DVT, and 14 (2.0%) for DVT only. The most common presenting symptoms were tachycardia (56%, 393/695), low oxygen saturation (48%, 336/695), and shortness of breath (19.6%, 136/695). Symptoms significantly associated with DVT were syncope and chest pain. A past medical history of PE/DVT was the only significant predictor of a positive scan. Patients

who have a history of thromboembolic disease should be carefully monitored in the postoperative setting.

Table 4.5 and figure 4.5 shows the frequency distribution of patients under study according to side of pulmonary embolism, there were 36 (46.2%) in the right pulmonary artery, 17 (21.8%) left pulmonary artery and 25 (32.1%) bilateral in the right and left pulmonary artery apperance of subsegmental PE group included 10 (45%) with single PE and12 (55%) with multiple PE.(García-Sanz, etal.2014) that was agree with the reseach results in muliple PE.

Table 4.6and figure4.6shows the frequency of location of pulmonary embolism,there were 9 patients (11.5%) with pulmonary embolism located at the center of the pulmonary artery and 69 (88.5%) was peripherally. and that was disagree with the study of (M.T,García-Sanz, etal.2014) properly duo to sample size variation, Study was included 313 PE patients; 56% were women and the median age was 70 years (interquartile range 53-78 years). Central PE accounted for 68% of cases; segmental and subsegmental PE, for 25% and 7%. Patients with subsegmental PE were younger, had lower comorbidity and none of them presented proximal DVT.

5.2 conclusions:

This study was done to study the pulmonary embolism patients using MDCT in Khartoum state hospital and diagnostical centers, and the researcher concluding that:

- The overall prevalence of PE in this study for both genders in females rather than males.
- The probability pulmonary embolism incidence increased by age increasing and the more appendance age group in the study was 61-70 year old.
- The study was represent according to family history the probabilityof pulmonary embolism incidence increased by a previous patients family history especially in family whom have an obesity (body mass index >30) or varicose veins.
- The postoperative and prolong bed rest patients is one of patients whom at risky to pulmonary embolism.
- The study was representing the common side of pulmonary embolism, in the right pulmonary artery, bilateral and in the left pulmonary artery respectively.
- The study shows the common location of pulmonary embolism, was in the periphery of the pulmonary vessels and less prevalence in the large central vessels patients.

5.3 Recommendations:

- A large sample size is needed for further studing of the pulmonary embolism patients.
- Pulmonary CTA is a good stander modality in detection of pulmonary embolism but still need another investigation to support the diagnosis.
- Using a modified technique in pulmonary CTA by adding a delayed run to fill the small peripheral vessels to exclude sup-segmental embolism.
- Be shore your patients will understanding your breathe hold instruction to avoid motion artifact which degradat the image quality false +ve result.
- Use automatic triggering for contrast media to reach the optimum vascular enhancement.
- Use saline flush pre and post contrast media admition to avoid upper chest stick artifact (miss diagnosis for the upper pulmonary branches vessels.
- Pulmonary embolism is a live treating case so the diagnostical departments shouldreduce the cost of pulmonary CTAexamination.

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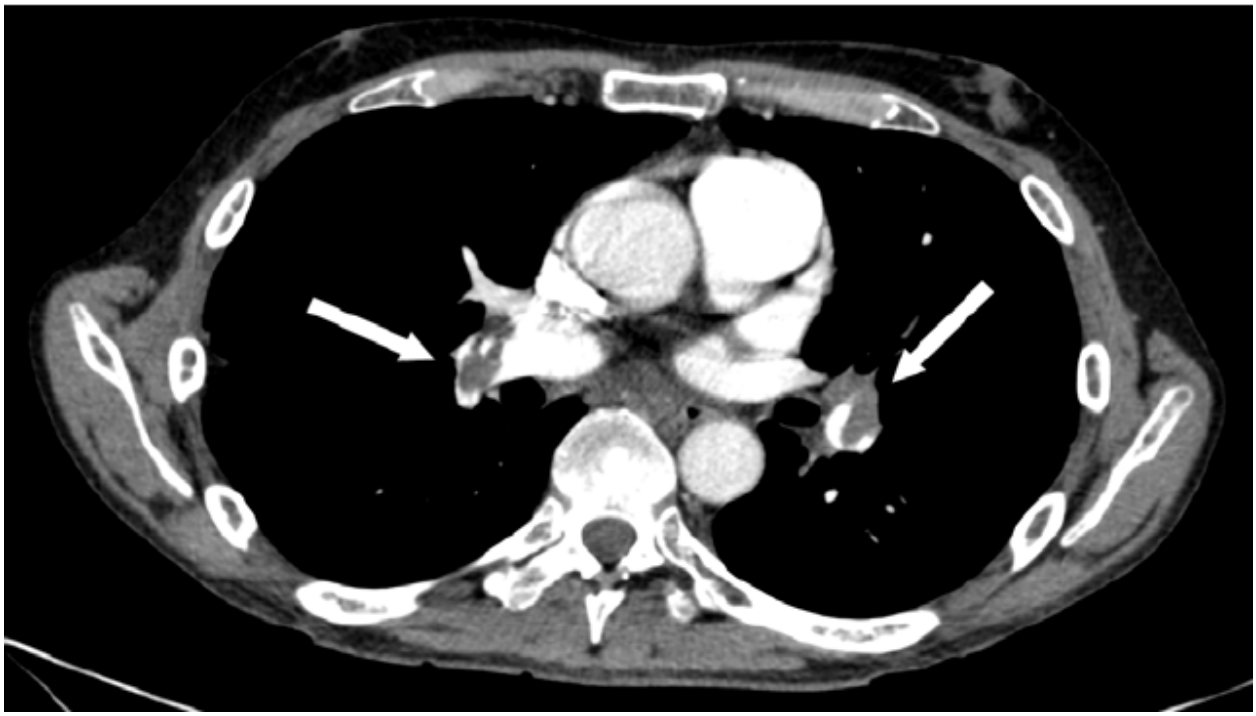
Appendix



Image(1) CTPA in the axial (transverse) plane demonstrating bilateral filling defects within the contrast opacified pulmonary arteries diagnostic of PE (arrows).

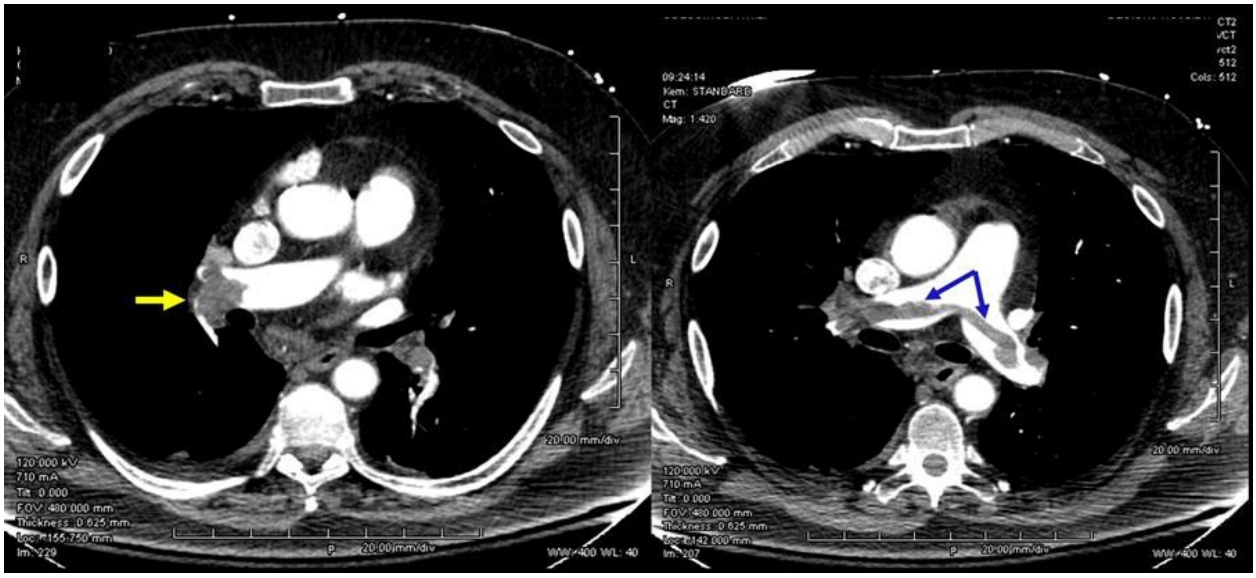


Image (2)These two axial CT images show profound pulmonary emboli. On the left the embolus almost completely blocks the right pulmonary artery (yellow arrow). Right image show an extensive saddle embolus forming in both pulmonary arteries and becoming extensive. Both of these types of pulmonary emboli are life threatening and require immediate medical attention.

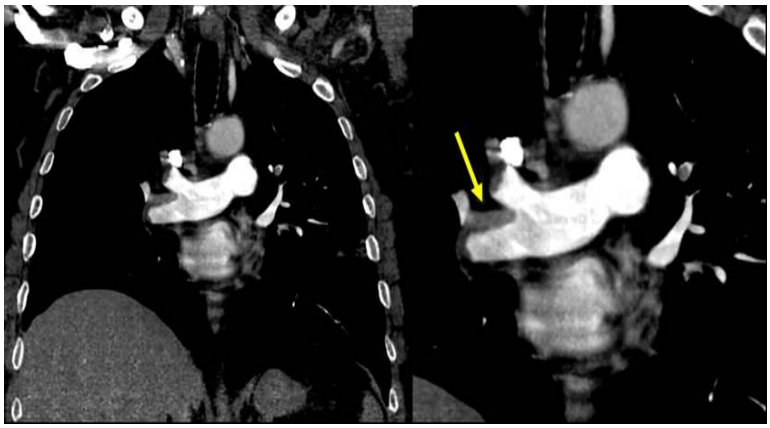


Image (3)this reformatted coronal image shows a large pulmonary embolus in the several segments of the right pulmonary artery. The pulmonary trunk and right pulmonary artery is magnified on the right to show a portion of the pulmonary embolus (yellow arrow). The superior segment of the right pulmonary artery also shows a blunting of its tip caused by pulmonary embolus. Coronal images give a better view of the whole vessel making smaller vessels easier to trace to their origin.

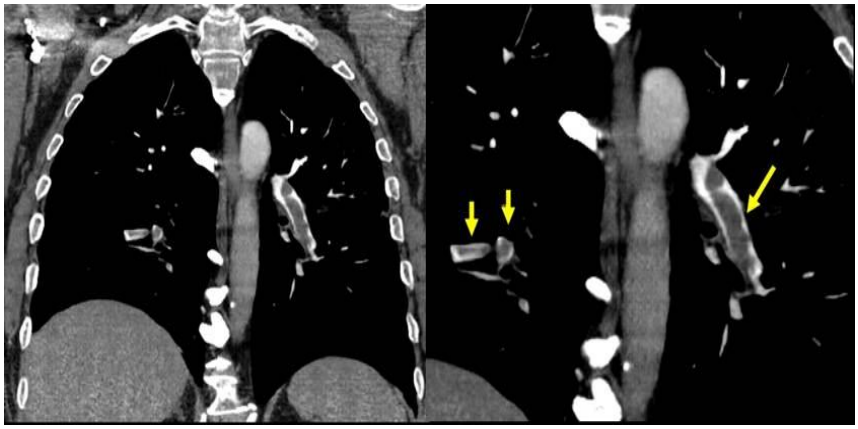


Image (4)this coronal image shows a large pulmonary embolus in a branch of the left pulmonary artery and scattered emboli in both lung fields. A magnified view of the chest is seen on the right with arrows pointing to several pulmonary emboli. Coronal images help show extensive emboli with present that can be correlated with axial images.