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Prospesctive Analysis of Pulmonary Embolism Detection via CTPA

Santosh Kumar[1], Piyush Kant[2], Zubair Ul Islam[3], Nandini B[4], Shakir Nisar Bhat[5], Dr. Kulsoom Zahra[6], Wajihus Shams[7], Junaid Ul Islam[8]

[1,2]Assistant Professor, Department of Vocational Studies & Skill Development (School of Science), Maulana Azad National Urdu University, Gachibowli, Hyderabad (0009-0004-5664-470X) & Assistant Professor, Department of Radio-Imaging Technology, Faculty of Allied Health Sciences, SGT University, Gurugram, Haryana (0000-0002-2092-5313)
[3,4,5,6,7,8]Assistant Professor, Department of Vocational Studies & Skill Development (School of Science), Maulana Azad National Urdu University, Gachibowli, Hyderabad

Abstract
Background: Evaluation of Pulmonary Embolism with Computed Tomography Pulmonary Angiography.
Methods: CT scan study of pulmonary artery was done on 50 patients from 24 April (2024) to 24 October (2024) over a period of the 6 months. All patients will undergo CT study of the CT Pulmonary Angiography. This scan was acquired on a Philips 128 slices CT scan machine in the caudocranial direction but we studied in different articles about the direction of scan is craniocaudal. All the cases will be evaluated by conventional CT technique with contrast using a 128 slice multidetector CT (Philips).
Result: In a study of 160 patients, 50 were diagnosed with pulmonary embolism (PE), predominantly males (74%) with a mean age of 44.76 years. Among these, 28% had chronic PE, while 72% had acute PE. Blood clots were the most common cause (32%), followed by air bubbles (24%), fat emboli (16%), and DVT (28%). PE locations varied, with segmental arteries and pulmonary arteries being the most affected. Accurate diagnosis of the PE cause and location is crucial for effective treatment and improving outcomes.
Conclusion: In summary, by studying the nature, causes, and sites of pulmonary embolisms, this study highlights their complexity. The increased prevalence in middle-aged and older adults—especially in men—highlights the significance of taking demographics into account. The requirement for accurate, customized treatment approaches to maximize patient outcomes is highlighted by the differences between acute and chronic PE, as well as the variety of embolism causes and sites.

Keywords: Pulmonary Embolism, Acute PE, Chronic PE, Embolus, Thrombus

INTRODUCTION:

Pulmonary embolism is a clinically defined blockage of pulmonary arteries by blood clots that travel through the blood stream into the lungs. It is a type of venous thromboembolism, which includes DVT. It is the third most common cause of cardiovascular death after heart attack and stroke (1). A blockage in the lung's blood vessels caused by an embolus usually comes from a blood clot in a vein in the legs. Clotting factors work in a series of steps to form a blood clot. This process can be triggered by damage to blood

vessel walls, an increased tendency to clot, or changes in blood flow. Small emboli usually block the smaller arteries in the extremities; at the same time, larger ones can get stuck where the main arteries divide; this can cause "saddle embolism." (2). CTPA is the best diagnostic imaging technique to detect a suspicious Pulmonary embolism (PE). It is widely available to observe the patients (3). The symptoms of PE are indeterminate, and clinical algorithms for bedside exclusion of PE are based on the negative results of the D-dimer test (4). Contrast agents used in CT of the Pulmonary artery are considered highly sensitive and specific for evaluating acute PE, so both helical CT and electron beam CT have been suggested for this purpose (5). PE reduces morbidity and mortality. It is a quick and potentially diagnostic approach. Computed tomography pulmonary angiography (CTPA) is the best test available to detect PE because of its high sensitivity and specificity. CTPA is the primary imaging technique to detect PE to help the high-patient reduce the mortality rate (6). Different abnormalities are found in the thoracic vasculature, mainly the aorta, pulmonary arteries, and central veins, and are also caused by trauma, blood clots, or other mechanisms (7). In CTPA, testing of D-dimer and intermediates has a low clinical probability. This high number of potential outcomes includes contrast nephropathy, allergic reactions, radiation exposure, and a higher financial burden for healthcare facilities (8). The main way to classify massive acute PE is in the presence of low blood pressure. That is why massive PE is uncommon, so no doctor or hospital can decide the best treatment based on their own experience (9). Also, sudden central PE causes more severe changes in blood flow and blood pressure. Patients with this type of PE have a high risk of death as compared to those who have distal PE or chronic PE. Acting in time is very important for a successful treatment outcome. Radiologists can diagnose PE accurately by using MDCT information, which can be very useful when a CTPA is not possible or not available (10). A lung-supplying artery blockage results in serious harm, disrupts the lungs' normal function, and, depending on how significant the blockage is, may even be directly fatal. The blood clot is the most frequent type of emboli that results in pulmonary embolism. Other scenarios, however, include amniotic emboli from childbirth, scatter tumor emboli from cancerous diseases, or even traumatic fat emboli from the bone or bone marrow in patients who have had many fractures and physical trauma (11). Cardiovascular disease events caused by PE, such as myocardial infarction and stroke, have a higher prevalence than stroke and myocardial infarction. PE linked to cancer increases mortality rates, hospital stays, and recurrent venous thromboembolism risk. Additional tests like D-dimer and echocardiography are needed (12). Cardiac arrest caused by a pulmonary embolism (PE) happens because a blood clot blocks the main lung arteries and releases chemicals that narrow blood vessels. This increases the pressure on the right side of the heart chambers, making it harder for the heart to pump blood, which can lead to cardiac arrest (13). Most people who experience shortness of breath during physical activity are usually diagnosed with one of four conditions: asthma, chronic obstructive pulmonary disease (COPD), interstitial lung disease, or heart failure. However, when this shortness of breath happens after a pulmonary embolism, it can be more difficult to determine if the problem is due to the PE or one of these other conditions (14).

Material and methods

- **Study duration**: Period to observe and collect data, in department of Radiology department of Medicover Hospital Hi-tech city Hyderabad, 500032. Patients with suspected Pulmonary Embolism, this study was undergoing a special CT scan (CT pulmonary angiography) on a advanced Philips 128-slice CT scan machine to help diagnose and locate the issue.
- **Study design: -** Prospective Cross Sectional Analytical Study.
- **Study area: -** Medicover Hospital, Hi-tech city, Hyderabad.

- **Sampling Procedure: -**All patients referred to the department Radiology at Medicover Hospital with Pulmonary embolism will be subjected for the study.
- **Sample size:** 50
- **Protocol:** All patients will undergo CT study of the angiogram and CT Pulmonary Angiography. All the cases will be evaluated by conventional CT technique with contrast using a 128 slice multidetector CT (Philips). Serum creatinine will be done prior to scan (Serum creatinine: 0.7 to 1.3 mg/dL for men and 0.6 to 1.1 mg/dL for women.

For CT Procedure through the step

- Non contrast imaging
- Contras through the Bolus Technique
- Contrast Volume 80-120 (According to Body weight)
- Contrast Follow rate 4-5 ml/Sec.

Inclusion Criteria

- Patients with age more than 20 Years.
- Confirmed diagnosis of acute pulmonary embolism, typically through imaging studies such as CT pulmonary angiography (CTPA), ventilation- perfusion (V/Q) scan, or pulmonary angiography.

Exclusion Criteria:

- Patient with age of less than 20years.
- Iodine Based Contrast Allergic

Technique:

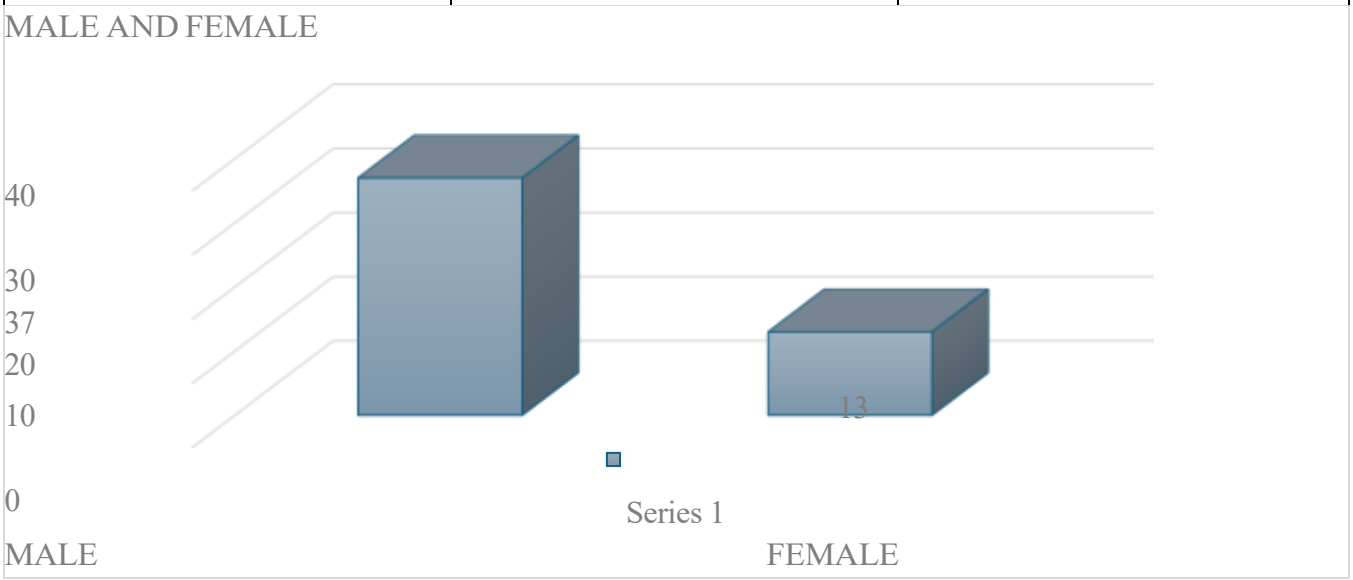
This scan was acquired on a Philips 128 slices CT scan machine in the caudocranial direction but we studied in different articles about the direction of scan is craniocaudal, during this scan positioning of the patients is head first supine with arm, elevated above this level of head. Mode of scanning is helical with single breath hold. Before the scan we should instruct the patient above breathing that patient needs to hold their breath for 10-15 sec during scan. In this hospital automated dose control software are using with 120 kVp and 195 mAs. Pulmonary Angiography was performed via arm or neck vein. In this procedure 80-120 ml of low osmolar contrast medium (350 Omnipaque GE health care) was injected through an 18- gauge cannula sited in the antecubital fossa at the flow of rate 4-5 ml/sec, followed by a 40-ml saline bolus chaser injected 4ml/s. Optimal scan acquisition time was determine using bolus tracking technique with an ROI placed in the right atrium. When the density of the contrast material in the right atrium reaches 120 HU. Contrast enhanced helical CT was then performed with 5mm collimation and a 5mm/s table speed (pitch of 1) scanning began at the domes of the diaphragm and end location is 2cm above the aortic arch. After scanning slice thickness in reconstruction is thinnest available in scanner (0.5-1mm) and slice interval is 0.25-0.5mm.

RESULT

Gender Distribution:- In this study involving 160 patients, 50 were diagnosed with pulmonary embolism (PE), comprising 37 males and 13 females. The age distribution of these patients was 21–86 years old, with a 44.76-year mean, a 62-year mode, and a 51% median age. There was a 37:13 ratio in the gender distribution, with 74% of men and 26% of women. The breakdown is depicted in the figure, which also

shows the range of ages of PE patients and the greater proportion of males than females.

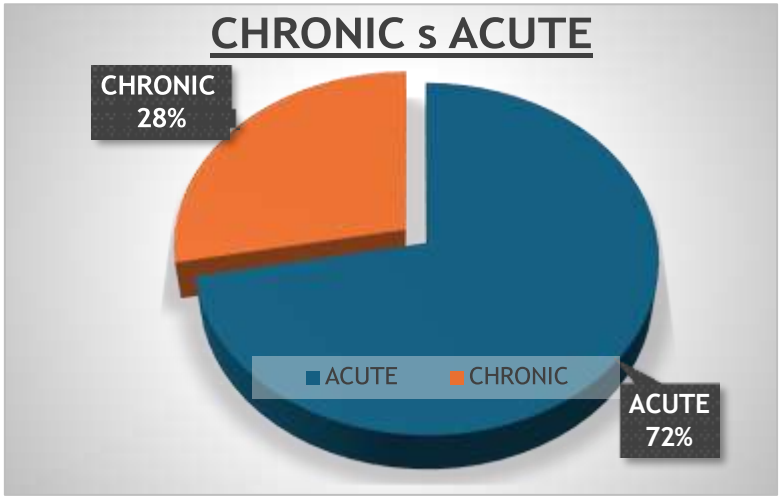
Age	No. of patients	Percentage%
20-30	12	24
30-40	6	12
40-50	4	8
50-60	15	30
60-70	7	14
70-80	3	6
80-90	3	6
Total	50	100



Nature of Pulmonary embolism

Examining fifty patients, it was determined that fourteen had a chronic pulmonary embolism and thirty-six had an acute embolism. It can be observed that 28% of the patients had the chronic type while the majority, or 72%, had the acute form. Different treatment strategies may be required depending on whether a patient has an acute or chronic pulmonary embolism.

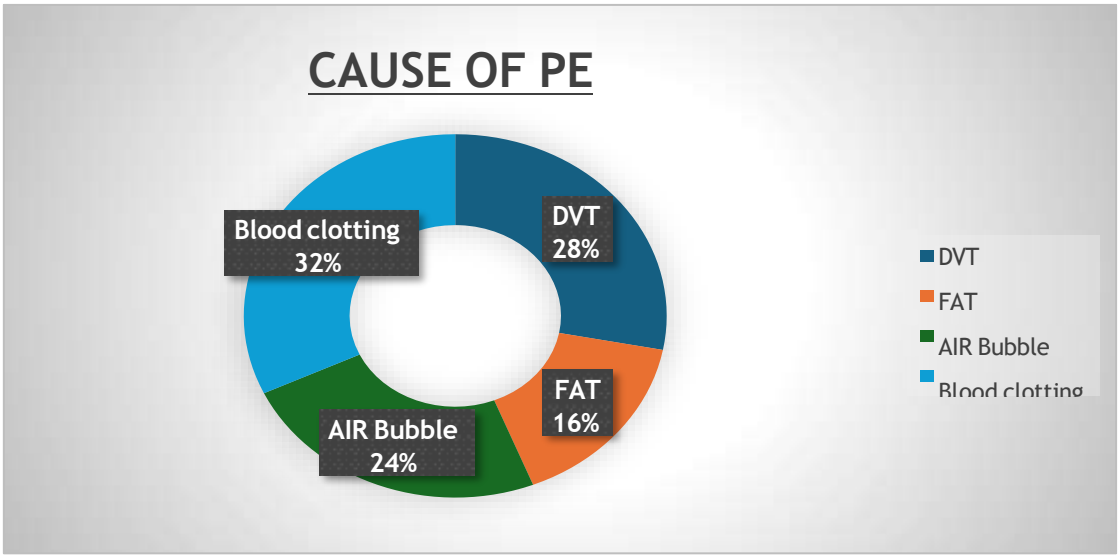
Nature of PE	No. of cases	Percentage
Acute	36	28%
Chronic	14	72%
Total	50	100%



Cause of Pulmonary Embolism

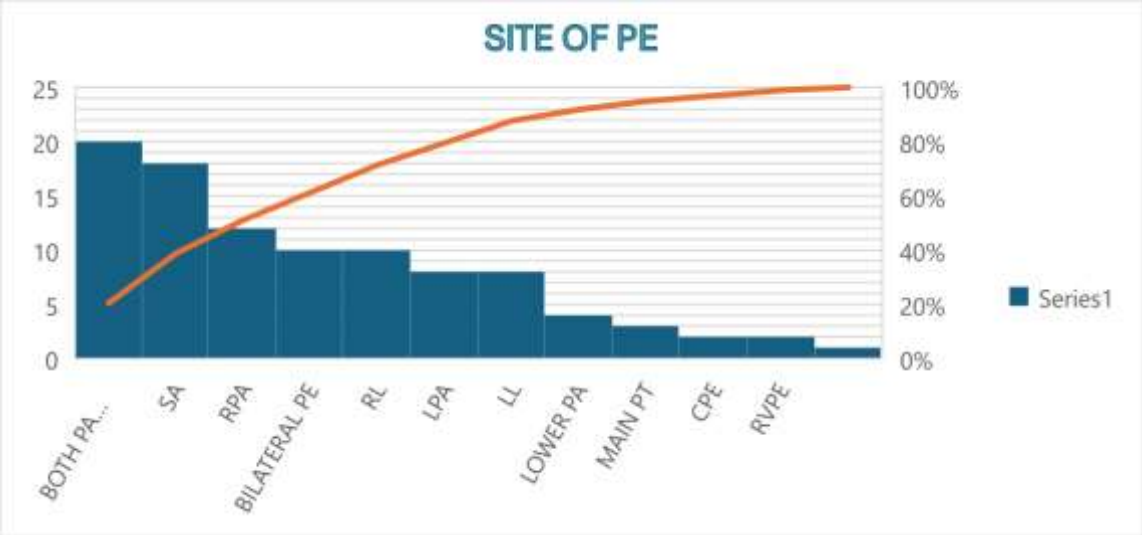
Pulmonary embolism can be caused by several factors, including deep vein thrombosis (DVT), blood clots, air bubbles, or fat. In this study of 50 patients, it was found that 16 (32%) had pulmonary embolism due to blood clots, making this the most common cause in the group. Air bubbles were the cause in 12 (24%) patients, while 8 (16%) patients had fat emboli. Additionally, 14 (28%) patients had pulmonary embolism linked to DVT. These results show that pulmonary embolism can arise from different causes, which highlights the importance of accurately diagnosing the specific cause in each patient. Proper diagnosis is crucial for choosing the right treatment and improving patient outcomes.

Cause of PE	**No. of patients**	**Percentage%**
Blood Clotting	16	32%
DVT	14	28%
FAT	16	16%
AIR Bubble	12	24%
Total	50	100%



Site of Pulmonary Embolism

In a study of 50 patients with pulmonary embolism, the embolisms were found in various locations, and some patients had embolisms in multiple sites. Among these patients, 18 had embolisms in the segmental arteries, while 20 had embolisms in both pulmonary arteries. Additionally, 12 patients had embolisms in the right pulmonary artery, and 10 patients had embolisms in bilateral locations. Embolisms in the right lobe were observed in 10 patients, whereas 8 patients had embolisms in the left pulmonary artery and 8 had embolisms in the left lobe. Furthermore, 4 patients were found to have embolisms in the lower pulmonary artery, and 3 patients had embolisms in the main pulmonary trunk. Central pulmonary embolism was identified in 2 patients, and another 2 patients had embolisms in the right ventricular pulmonary artery. These findings demonstrate the varied locations where pulmonary embolisms can occur, underlining the complexity of diagnosing and treating this condition. Recognizing the specific sites of embolism is crucial for tailoring treatment strategies to each patient, as the location of the embolism can significantly impact the management and outcomes of the condition. As shown in fig;



Cite of PE	No. of Location
Both PA	20
SA	18
RPA	12
Bilateral PA	10
RL	10
LPA	8
LL	8
Lower PA	8
CPE	2
Main PT	3

DISCUSSION:

In our study CTPA was performed in 50 patients of the Pulmonary Embolism. All imaging was done with the help of Philips 128 slices CT scan machine in the department of Radiodiagnosis of Medicover Hospital.

Gender Distribution: The observed gender distribution, with 74% of PE patients being male and 26% female, reveals a significant predominance of males in this group. This male-to- female ratio of 37:13 aligns with existing studies that indicate a higher occurrence of PE in males compared to females. Several factors may contribute to this difference, including variations in comorbidities, hormonal influences, and lifestyle factors that increase the likelihood of thromboembolic events in males.

Age Distribution: The age range of patients diagnosed with PE, ranging from 21 to 86 years, highlights the broad age spectrum of this condition. The mean age of 44.76 years and median age of 56.5 years indicate that PE occurs across various age groups but is more frequently observed in middle-aged and older adults. The mode age of 62 years points to a peak incidence in the older population, which corresponds with the well- documented link between advancing age and the risk of venous thromboembolism. This observation underscores the need for increased vigilance and appropriate screening strategies in older adults, who may be more prone to PE due to factors such as decreased mobility, existing comorbid conditions, and changes in blood clotting mechanisms.

Nature of PE: Thirteen patients in this sample of fifty were diagnosed with chronic pulmonary embolism, while thirty-six were found to have acute embolism. This shows that whereas 72% of the patients had the acute form, 28% of the patients had the chronic form. Acute and chronic pulmonary embolisms range significantly in prevalence, which emphasizes the necessity for unique treatment strategies catered to each disease. Comprehending the differences between acute and chronic emboli can be essential to improving patient care and results, since it can impact the treatment plan.

Causes of PE: A pulmonary embolism may be caused by fat, air bubbles, blood clots, or deep vein thrombosis (DVT). Blood clots accounted for 16 (32%) of the 50 patients in this study, making them the most common cause of the condition. Among the cases, 12 (24%) were caused by air bubbles, and 8 (16%) by fat emboli. In addition, 14 patients (28%) experienced a DVT-related pulmonary embolism. These results highlight the many possible causes of pulmonary embolism and highlight the importance of accurately diagnosing the underlying cause in each patient. To choose the best course of action and enhance patient outcomes, a proper diagnosis is crucial.

Location Of PE: Fifty people with pulmonary emboli were included in this study. The emboli were found in a variety of places, with some patients having emboli at more than one site. Particularly, 20 patients experienced embolisms in both pulmonary arteries, and 18 patients experienced embolisms in the segmental arteries. Furthermore, embolisms occurred in the right pulmonary artery in 12 individuals and in both lungs in 10 patients. Ten individuals were found to have embolisms in the right lobe, eight in the left pulmonary artery, and eight more in the left lobe. Additionally, embolisms occurred in the lower pulmonary artery in 4 patients and the main pulmonary trunk in 3 patients. Two patients had central pulmonary emboli, while two more patients had emboli in the right ventricular pulmonary artery. The various sites where pulmonary embolisms can occur are highlighted by these data, which emphasizes how difficult it is to diagnose and treat this illness. The precise site of the embolism must be considered because it might have a substantial impact on the patient's prognosis and the choice of treatment. As a result, pinpointing the embolism's location is crucial to creating tailored, efficient treatment plans that can enhance results.

CONCLUSION:

In conclusion, this study sheds valuable light on the multifaceted nature of pulmonary embolisms (PE) by examining their characteristics, causes, and the variety of locations where they occur. One of the notable findings is the increased prevalence of PE among middle-aged and older individuals, coupled with a higher incidence in males. These demographic patterns underscore the critical need to consider age and gender when diagnosing and treating PE. Tailoring medical approaches to these demographic factors can enhance the accuracy of diagnosis and the effectiveness of treatment. The study also highlights the importance of distinguishing between acute and chronic PE, as well as the diverse sources and sites of emboli. Acute PE, which typically requires immediate and aggressive intervention, contrasts with chronic PE, which may present more subtly and necessitate different management strategies. The variety in emboli sources ranging from deep vein thrombosis to fat or air emboli demands an exact understanding of each patient's unique situation.

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