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**Original article:**

# Spectrum of Computed Tomography Pulmonary Angiography (CTPA) findings in clinically suspected cases of pulmonary thromboembolism

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**Abstract**

**Introduction:** Pulmonary thromboembolism is the third most common acute cardiovascular disease, after myocardial infarction and stroke. CT pulmonary angiography has become one of the standard investigation in recent times for clinically suspected cases of pulmonary thromboembolism.

**Aims:** To determine the presence of pulmonary thromboembolism as well as other positive findings and hence to establish the role of CTPA in clinically suspected cases of thromboembolism.

**Material and Methods:** 100 consecutive patients with clinical suspicion of pulmonary embolism underwent MDCT pulmonary angiography at Terna Speciality Hospital and Research centre, Nerul, Navi Mumbai, Maharashtra, India.

**Results:** Out of 100 patients, 19 patients showed presence of thromboembolism. Other than thromboembolism, other findings like pneumonia (consolidations), pleural effusion, pericardial effusion etc were seen with consolidations being the most common diagnosis.

**Conclusion:** CTPA has become an important tool in ruling out the presence of pulmonary thromboembolism in clinically suspected cases as a majority of cardio-pulmonary diseases present with almost similar clinical manifestations.

**Keywords:** Pulmonary thromboembolism, CT pulmonary angiography, consolidations.

## INTRODUCTION:

Pulmonary thromboembolism is the third most common acute cardiovascular disease, after myocardial infarction and stroke, and is a major public health problem [1]. CT pulmonary angiography has become one of the standard investigations in recent times for clinically suspected cases of pulmonary thromboembolism. Whether the process is acute or chronic, CT pulmonary angiography helps in diagnosing thromboembolism along with associated findings in the lung parenchyma like infarction, abscess or hypo-perfusion. Further, involvement of segmental and lobar branches is also well delineated.Women are affected slightly more frequently, and patients with underlying malignant, cardiovascular, or pulmonary disease are at increased risk of developing this condition. Other reported risk factors include splenectomy, ventriculo-atrial shunts, chronic inflammatory disorders, and myelo-proliferative syndromes. Ethnic differences in the clinical characteristics of chronic thromboembolic pulmonary hypertension



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(e.g., it is more prevalent in Asian patients after an acute episode of pulmonary thromboembolism) are suggestive of the involvement of a genetic factor in the etiology or pathogenesis of the condition [2]. Computed tomographic (CT) pulmonary angiography has been evaluated with meta-analysis and has demonstrated sensitivities of around 53%–almost 100% and specificities of 83%–100%, wide ranges that are explained in part by technologic improvements over time. Pulmonary angiography, the diagnostic standard of reference for confirming or refuting a diagnosis of pulmonary embolism, remains underused [3]. Further, the lung is unusual because it is supplied by two distinct vascular systems—the pulmonary and bronchial arteries. The main function of the pulmonary artery is gas exchange, whereas the bronchial artery provides nutrition to the bronchial structures, pulmonary vessels, parenchyma, lymph nodes, and pleura [4].

Clinical signs and symptoms in patients with pulmonary thromboembolism are non-specific [5]. The ECG may show an S1Q3T3 pattern. Patients may have deep vein thrombosis (usually from the lower limbs) which are the most common source of the PE. Massive PE is suggested if the patient is hypotensive (<90 mmHg), bradycardiac (<40 bpm), or pulseless [6]. The patient may be at risk for circulatory collapse secondary to right-sided heart failure, and resultant embolism may be a cause of mortality.

**AIMS AND OBJECTIVES**

1) To determine the cases, positive for pulmonary thromboembolism based on clinical suspicion.
2) To determine findings, apart from thromboembolism in clinically suspected cases of thromboembolism.

**MATERIAL AND METHODS**

**STUDY DESIGN:** This study is a retrospective observational study.

Hundred patients with suspected pulmonary embolism at our institution underwent MDCT pulmonary with retrospective review of clinical histories to determine the principal reason that the patient underwent MDCT pulmonary angiography, history of present illness and medical history.

**PLACE OF STUDY:** Tertiary care centre: Terna Speciality Hospital and Research centre, Nerul, Navi Mumbai, Maharashtra, India.

**STUDY DURATION:** 2015 – 2018

**SAMPLING SIZE:** 100 patients fulfilling the inclusion and exclusion criteria were included in the study.

**EXCLUSION CRITERIA:** Raised Sr. Creatinine levels > 2.00 mg/dl, Known allergy to iodinated contrast, Hemodynamic instability, Patient's refusal for procedure.

**MACHINE:** Siemens – Somatom Sensation 64 Slice Multidetector Computed Tomography Machine (MDCT).

**CONTRAST USED:** Iohexol, Non ionic water soluble contrast medium, with Iodine content of 370 mg/ml. Bolus triggered post contrast sequence after injecting around approximately 80 ml or 1 ml/kg non-ionic iodinated contrast with auto trigger at HU + 60.

**OBSERVATION AND RESULTS**

100 patients were selected for the study with clinical suspicion of pulmonary thromboembolism. Dyspnoea, chest pain, and hemoptysis were the most common complains. Other complains were breathlessness and tachypnea.



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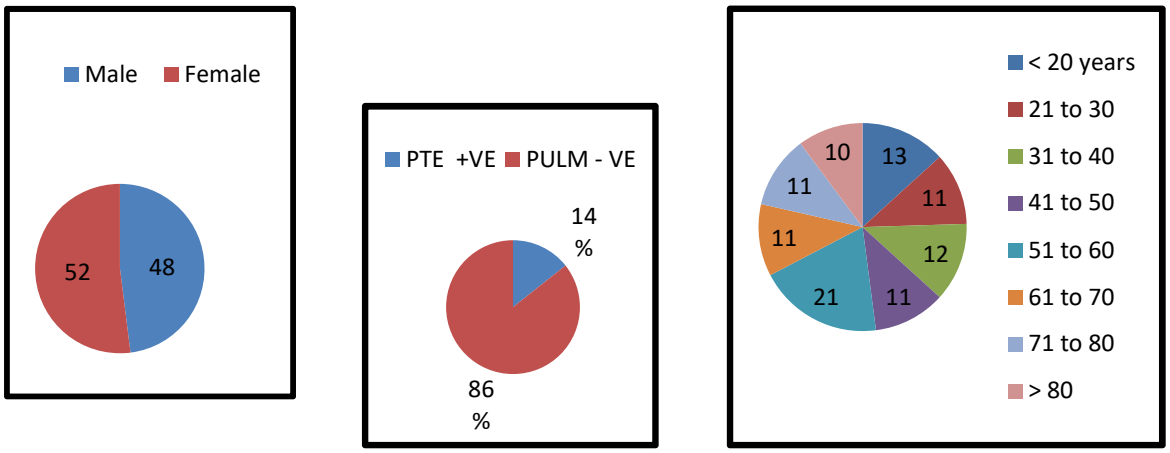
Out of hundreds, 52 were female patients and 48 were male patients. Out of 100 patients, 19 patients showed presence of thromboembolism. Other than thromboembolism, other findings like pneumonia (consolidations), pleural effusion, pericardial effusion etc were seen. Out of 19 positive patients, 11 were female and 8 were male patients.

Consolidations suggesting pneumonia was the most common diagnosis, which was seen in around 22 patients (22 % cases). It was followed by large pleural effusion which was seen in 11 patients (11% cases). Pulmonary edema was seen in 7 patients, heart failure was seen in 9 patients, whereas 1 patient shows a heterogeneous lesion along bronchus suggesting bronchogenic carcinoma. Two patients were diagnosed with abdominal pathology, Cholelithiasis in one patient while gastritis in other.

Out of the 19 cases which showed thromboembolism, 3 patients shows saddle thrombus, 4 patients show thrombus involving left lobar branches, 4 patients had thrombus involving right lobar branches, 1 patient had right pulmonary artery thrombus extending into main pulmonary trunk, 5 patients had bilateral thromboembolism involving segmental branches and remaining 2 patients had unilateral segmental branch thrombosis.

One of the patient with thromboembolism showed wedge shaped infarct which is also a common complication.

On 2D ECHO, 15 patients had dilated RA and RV. Majority of suspected cases were in age group of 51 to 60 yrs.




**Charts for Male: Female ratio, Patients Positive for PTE and Age distribution from left to right.**



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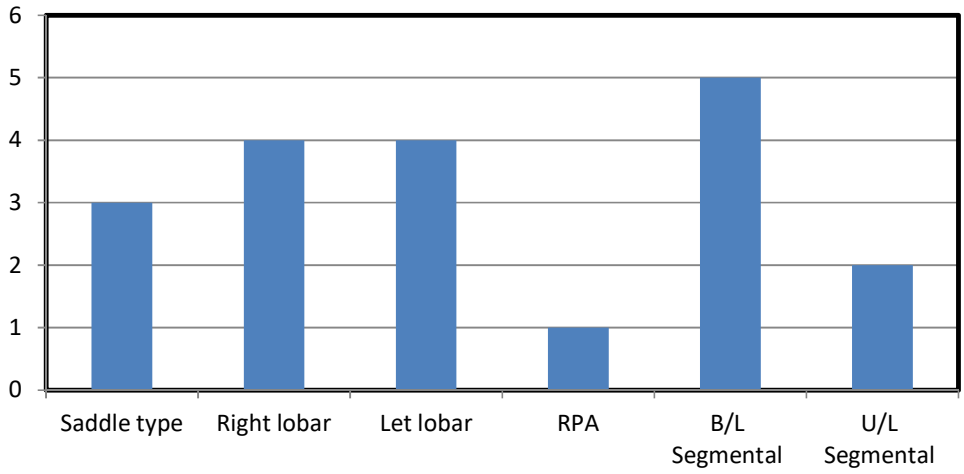


**Graph 1: Type of Pulmonary Thrombo-embolism.**

**DISCUSSION:**

The main pulmonary artery (MPA) is intrapericardial and courses posteriorly and superiorly from the pulmonic valve. 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 hilum. The LPA represents the continuation of the MPA.

Segmental and subsegmental pulmonary arteries generally parallel segmental and subsegmental bronchi and run alongside them. This is in contrast to the course of most pulmonary veins, which run independently of bronchi within interlobular septa. The segmental arteries are named according to the broncho-pulmonary segments that they feed, and we follow the Jackson and Huber classification in this description. However, the proximal portions of the arteries to the posterior sub-segment of the left upper lobe and the lingular arteries can run independently of their respective bronchi for short segments. Also, there are frequently accessory arteries from neighboring segments, particularly in the right upper lobe. Segmental and subsegmental pulmonary arteries vary considerably in the location of their origins, in whether they arise as common. trunks with other arteries or as separate arteries, and in their number.

Computed tomographic (CT) pulmonary angiography is becoming the standard of care at many institutions for the evaluation of patients with suspected pulmonary embolism. Pulmonary thromboembolism can be acute or chronic. The diagnostic criteria for acute pulmonary embolism are arterial occlusion with large filling defects; the artery may be enlarged compared with adjacent patent, partial filling defect, and CT signs like “polo mint” sign on images perpendicular to the long axis of a vessel and the “railway track” sign on images parallel to the vessel. Peripheral intraluminal filling defect forms acute angles with the arterial walls [7-9].



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The diagnostic criteria for chronic pulmonary embolism include complete occlusion of a vessel that is smaller than adjacent patent vessels, peripheral, crescent-shaped intraluminal defect that forms obtuse angles with the vessel wall, re-canalized smaller arteries, a web or flap within a contrast filled artery and secondary signs, including extensive bronchial or other systemic collateral vessels, mosaic perfusion pattern or calcification within eccentric vessel thickening [7-9].

Acute pulmonary embolism does not appear to cause bronchial dilatation. Dilatation of bronchial arteries is seen in 50% of the group of patients with chronic or recurrent pulmonary embolism. [10]. It is vital to differentiate patients with chronic or recurrent pulmonary embolism from those with acute pulmonary embolism because patients with chronic pulmonary embolism might benefit from pulmonary thrombo-endarterectomy and patients with recurrent pulmonary embolism might be candidates for the insertion of an inferior vena caval filter [11].

Pulmonary CTA has been shown to be highly sensitive and specific when pretest clinical diagnostic tools are used [12] but surprisingly inaccurate in patients with low pretest probability, with false-positive rates as high as 42% [13]. Nonetheless, many clinicians will initiate anticoagulation therapy on the basis of a positive result, regardless of pretest probability [14].

Assessing the accuracy of CT pulmonary angiography is hindered by the rapid changes in the number of rows of detectors available in Multi-detector CT (MDCT) machines [15] According to one cohort study, single-slice spiral CT may help to diagnose detection among people with suspected pulmonary embolism. In this study, the sensitivity was 69% and specificity was 84%. In this study which had a prevalence of detection was 32%, the positive predictive value of 67.0% and negative predictive value of 85.2%. However, this study's results may be biased due to possible incorporation bias, since the CT scan was the final diagnostic tool in people with pulmonary embolism. The authors noted that a negative single slice CT scan is insufficient to rule out pulmonary embolism on its own [16]. A separate study with a mixture of 4 slice and 16 slice scanners reported a sensitivity of 83% and a specificity of 96%, which means that it is a good test for ruling out a pulmonary embolism if it is not seen on imaging and that it is very good at confirming a pulmonary embolism is present if it is seen. This study noted that additional testing is necessary when the clinical probability is inconsistent with the imaging results.[13]

Most cardiopulmonary diseases share at least one symptom with pulmonary embolism (PE). In one study [17] PE occurred in less than 4% of patients with cardiopulmonary symptoms. Acute heart failure, pneumonia and chronic obstructive pulmonary disease exacerbation were the most likely diagnoses in patients with dyspnea. Acute myocardial infarction was present in roughly 10% of patients with chest pain. Atrial fibrillation was the prevalent diagnosis in patients with palpitations.

In a retrospective study performed by Perelas et al, 18% of 641 patients who underwent CTA for the possibility of PE were instead found to have other conditions requiring treatment. These included pneumonia, pulmonary edema, malignancy, large pleural or pericardial effusion, heart failure and acute abdominal pathology [18].

In another study, the prevalence of PE among the 1,025 patients studied was 10% [19]. The most common findings included infiltrate or consolidation suggesting pneumonia (81%), aortic aneurysm or dissection (7%), and mass suggesting undiagnosed malignancy (7%).

Another study was performed by Ferreira, Eleci Vaz et all [20] on 191 patients. In their study, on the basis of the CTA findings, PTE was diagnosed in 47 cases (24.6%). Among the 144 patients not diagnosed with PTE via CTA, the findings were abnormal in 120 (83.3%). Such findings were consistent with an alternative diagnosis that explained the symptoms in 75 patients (39.3%). Among those 75 cases, there were only 39 (20.4%) in which the same alterations had not been previously detected on chest X-rays. The most common alternative diagnosis, made solely on the basis of the CTA findings, was pneumonia (identified in 20 cases).

Study performed on 203 patients by J van Es, RA Douma et al, sixty-one of the 203 patients (30%) had no abnormality on CTPA. Thirty-nine patients (19%) were given a diagnosis of PE [21].

In our study, 19% of the cases were positive for thrombo-embolism. 22% cases were consolidations and 11% showed pleural effusion. Findings in our study were also more or less similar to above studies.

**CONCLUSION:**

CTPA has become an important tool in ruling out the presence of pulmonary thromboembolism in clinically suspected cases. As majority of cardio-pulmonary diseases present with almost similar clinical manifestations, it is important to rule out PE. CTPA should principally be used to confirm or exclude PE in high-probability cases.

In patients undergoing CTPA for suspected PE, findings supporting an alternative diagnosis like pneumonia, large pleural effusion, pulmonary edema, heart failure, findings of tuberculosis, malignancy, abdominal pathology, etc. should also be mentioned.

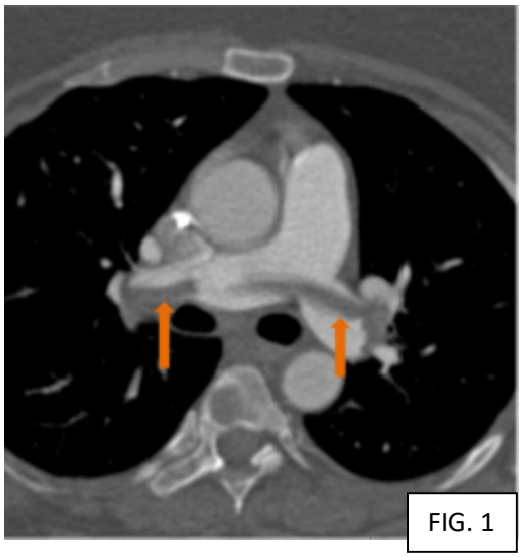


Figure 1: Saddle thrombus extending into both pulmonary arteries.

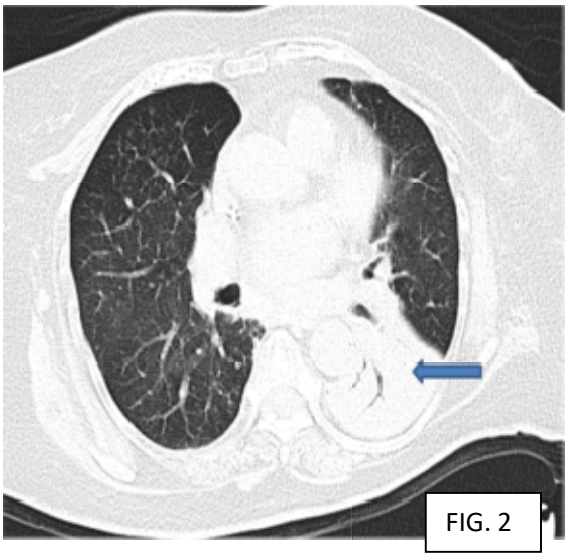


Figure 2: Consolidation with air bronchogram.



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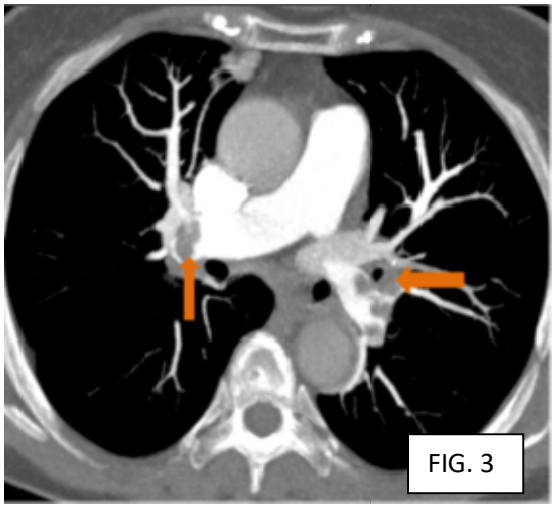


Figure 3: CTPA showing multiple
in right main pulmonary artery.
filling defects.

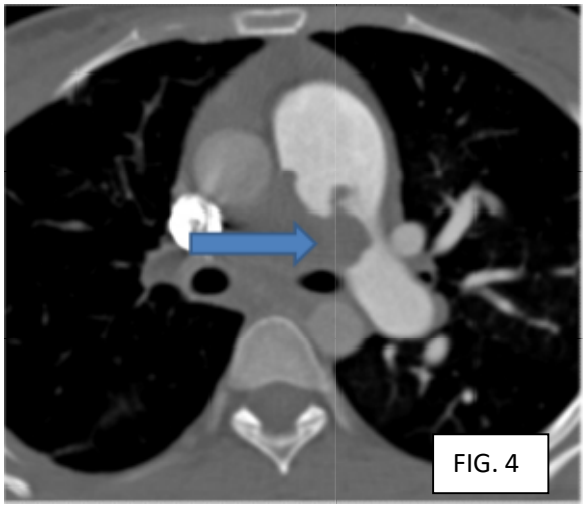


Figure 4: CTPA showing a large thrombus

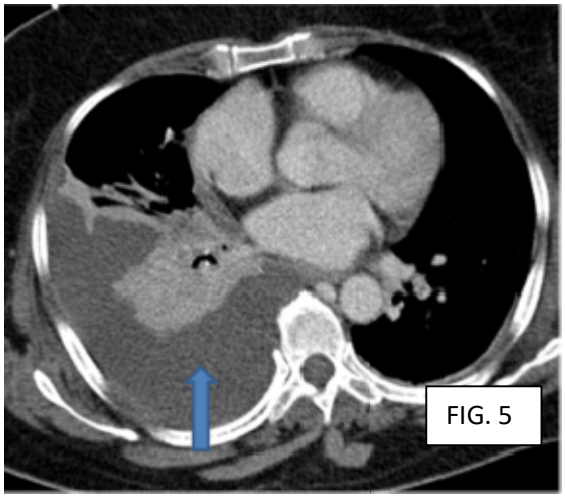


Figure 5: A large right sided pleural effusion.

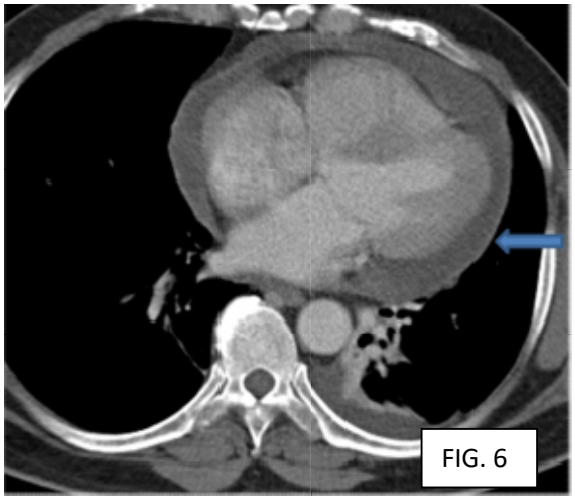


Figure 6: Pericardial effusion and mild left pleural effusion.



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