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Original article:

Study of radiological findings on MDCT-PA in clinically suspected cases of pulmonary thromboembolism

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Abstract:

Introduction: Pulmonary embolism (PE) is a common condition with considerable morbidity and mortality. Prompt and accurate diagnosis is important because the mortality of untreated PE is high and complications can occur with its treatment of long-term anticoagulation. As there are no specific signs or symptoms of this condition, the diagnosis relies heavily on imaging tests. Since the introduction of Multi-Detector Computed Tomography (MDCT) technology with high spatial and temporal resolution, Multi-Detector Computed Tomographic Pulmonary Angiography (MDCT-PA) has become the current imaging method of choice for imaging pulmonary vessels when PE is suspected.

Material and methods: This descriptive study was carried out on 93 patients in the Department of Radio-diagnosis, Rural medical college (RMC), Pravara institute of medical sciences (D.U), Loni for a duration of 2 years (2018-2020). The study population included 93 consecutive patients referred by clinicians with clinically suspected PE for MDCT-PA. The ethical clearance was obtained from the Ethics Committee, Rural Medical College and Hospital, Loni.

All the patients fulfilling the selection criteria were explained about the purpose of study and a written informed consent was obtained to participate in the study before enrolment.

Results: In our study out of 93 patients, there was radiological evidence of PE in 33 patients (35.5%). There was no evidence of PE in 60 patients (64.5%). Anatomically PE was found more commonly in the segmental arteries followed by sub-segmental, lobar, right and left pulmonary arteries and main pulmonary artery (MPA). Additional diagnosis was found in 19 out of 33 patients with PE (57.6%) whereas alternative diagnosis was made in 26 out of 60 patients (43.33%) found to have no evidence of PE.

Conclusion: MDCT-PA was found to be a useful diagnostic tool in the work-up of patients suspected of having PE. In patients without a contraindication for iodinated intravenous contrast medium, this readily available, rapid and minimally invasive study is well tolerated. It allows direct demonstration of endoluminal clots in the thorax and also reveals significant additional diagnosis which is imperative for appropriate patient management.

Keywords: MDCT-PA , Pulmonary embolism

Introduction:

MDCT-PA has been established as the first imaging test due to its high negative predictive value for clinically relevant PE. Despite the direct visualization of clot material, depiction of cardiac and pulmonary function in combination with the quantification of pulmonary obstruction helps to grade the severity of PE for further risk stratification.Additionalandalternativediagnosesaddtotheusefulnessofthismethod[1].Also, MDCT-PA has been recommended as a first line test by most of the international guidelines [2].In particular, MDCT equipment with 16–64 detector rows or more with the use of intravenous contrast can properly display pulmonary arteries down to the sub-segmental level, quickly providing images with voxel isotropy and maximizing the efficiency of the intravenous bolus of iodinated contrast medium [3].

PE whether acute or chronic form, causes either partial or complete intraluminal filling defects, which should have a sharp interface with intravascular contrast material. In acute PE that manifests as complete arterial occlusion, the affected artery may be enlarged. In acute PE, partial filling defect forms acute angles with respect to the vessel wall when seen on angiography or MDCT. Chronic PE can manifest as complete occlusivediseaseinvesselsthataresmallerthanadjacentpatentvessels.Otherfindings are evidence of recanalization, webs or flaps, and partial filling defects that form obtuse angles with the vessel wall [4]. Intimal irregularities are broad-based, smooth, margined abnormalities that create obtuse angles with the vessel wall. They may be unilateral or bilateral. Pulmonary artery intimal irregularities can also be due to plaques secondary to pulmonary hypertension [5]. Despite the fact that CTPA has been found to be cost effective and widely available some of the limitations include the use of ionizing radiation with a relatively high radiation dose and is also contraindicated in patients with allergy to iodinated contrast media and reduced renal function. There is also evidence for the development of contrast induced nephropathy which may lead to renal failure [6,7].

Material and methods:

The present descriptive study was carried out on 93 patients in the department of Radio-diagnosis, RMC, PIMS (D.U), Loni from September 2018 to September 2020. The study was carried out on 93 patients referred by clinicians with a clinical suspicion of PE for MDCT-PA to the department of Radio-diagnosis, RMC, PIMS (D.U), Loni from September 2018 to September 2020.MDCT-PA was performed on ―SIEMENS-Multislice SOMATOM Perspective‖ 64 rows 128 slice MACHINE.

INCLUSION CRITERIA:

1. Patients/ Guardian who were ready to give written informedconsent,
2. Patients with suspected PE referred by clinicians to department of Radio- diagnosis with requisition form for MDCT-PA within the studyperiod,
3. No history of allergy to Iodinated contrast media.

EXCLUSION CRITERIA:

1. Non-consentingpatients.

Results

In present study, 93 patients clinically suspected of having pulmonary embolism were evaluated using MDCT-PA for confirmed findings of PE.

TABLE 1: MDCT-PA findings of PE in clinically suspected pulmonary embolism patients (n=93)

In clinically suspected pulmonary thromboembolism (n=93)	
MDCT-PA +ve	**MDCT-PA -ve**
33(35.5%)	60(64.5%)

In clinically suspected pulmonary embolism patients, the MDCT-PA confirmed findings of pulmonary embolism (PE) in 33(35.5%), while 60(64.5%) had no PE as shown in Table 1

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TABLE 2: MDCT-PA findings in clinically suspected pulmonary embolism patients. (n= 93)

Findings	**Frequency**	**Percent**
• Pulmonary Embolism	33	35.5
• No Pulmonary Embolism	60	64.5
• Right sided PE	33	35.5
• Both sided PE (Left and Right)	27	29.0
• Additional diagnosis to PE(n=33)	19	57.6
• Alternate diagnosis to PE(n=60)	26	43.33
• Other findings:		
Pleural Effusion	33	35.5
Consolidation	20	21.5
Infarct	15	16.1
Atelectasis	4	4.3

As shown in Table 2; out of 93 clinically suspected patients, PE was confirmed on MDCT-PA in 35.5% i.e., in 33 patients. While 64.5 %, i.e., in 60 patients did not have PE. Out of 93 clinically suspected patients, all cases with positive imaging on MDCT-PA had right sided involvement of PE i.e., in 33 (35.5%) patients while bilateral involvement of PE (right as well as left) in 27 (29%) patients. Out of total 33 PE patients, additional diagnosis to PE was noted in 19(57.6%) patients. Out of 60 clinically suspected patients with no PE, 26(43.33%) had an alternate diagnosis to PE on MDCT-PA.

Other findings on MDCT-PA were pleural effusion in 33(35.5%), consolidation in 20(21.5%), infarct in 15(16.1%) and 4(4.3%) having atelectasis.

TABLE 3: Pulmonary embolism v/s other pleural and parenchymal findings on MDCT-PA (n=93)

Other Findings	Pulmonary Embolism on MDCT-PA			
	Present No's (%) n=33	Absent No's (%) n=60	Odd ratio (95% CI)	p value
Pleural Effusion	15(45.5%)	18(30%)	0.7(0.4-1.1)	0.136
Consolidation	6(18.2%)	14(23.3%)	1.2(0.6 -2.6)	0.563
Infarct	14(42.4%)	1(1.7%)	0.3(0.2-0.4)	0.001
Atelectasis	1(3%)	3(5%)	1.4(0.3-8.0)	0.654

As shown in Table 3; in clinically suspected patients with PE on MDCT-PA, 15(45.5%) had pleural effusion, while out of those with negative PE on MDCT PA only 18(30%) had pleural effusion. Though there was pleural effusion predominance in PE patients than non PE confirmed patients, there was statistically no significant ($p>0.05$) difference in association of pleural effusion with confirmed PE on MDCT-PA in suspected PE patients.

Out of 33 PE patients on MDCT-PA, consolidation was present in 6(18.2%) and 14(23.3%) in those without PE. There was statistically no significant ($p>0.05$) difference and association of consolidation with confirmed PE on MDCT-PA in suspected PE patients.

Infarct was predominantly present in 14(42.4%) PE positive patients on MDCT-PA, while it was present only in 1(1.7%) in PE negative patients. There was statistically significant ($p=0.001$) association of presence of infract with PE on MDCT-PA in clinically suspected PE patients.

Out of 33 PE patients on MDCT-PA, atelectasis was present in 1(3%) and 3(5%) in those without PE. There was statistically no significant ($p>0.05$) difference in association of atelectasis with confirmed PE on MDCT-PA in suspected PE patients.

TABLE 4: Anatomical distribution of the location of pulmonary embolus on MDCT-PA (n=33)

Findings	Frequency	Percent
Main Pulmonary Artery (MPA)	2	6.1
Right Pulmonary Artery (RPA)	14	42.4
Left Pulmonary Artery (LPA)	9	27.3
Lobar Artery	27	81.8
Segmental Artery	30	90.9
Sub-segmental Artery	29	87.9

As shown in Table 4; anatomically, PE on MDCT-PA had common involvement of segmental arteries i.e 90.9%, followed by sub-segmental arteries i.e 87.9% , lobar arteries in 81.8% .There was involvement of right pulmonary artery in 42.4%, left pulmonary artery in 27.3% patients and main pulmonary artery in only 6.1% of the patients.

TABLE 5: Anatomical distribution of the location of pulmonary embolus on MDCT-PA (n=33)

Findings	Frequency	Percent
Right Lung involvement	33	100
Both Lung involvement	27	81.8
Main Pulmonary Artery (MPA)	2	6.1
Right Pulmonary Artery (RPA)	14	42.4
Left Pulmonary Artery (LPA)	9	27.3
Right Lobar Artery	18	54.5
Left Lobar Artery	21	63.6
Right Segmental Artery	30	90.9
Left Segmental Artery	20	60.6
Right Sub-segmental Artery	26	78.8
Left Sub-segmental Artery	20	60.6

As shown in Table 5; anatomically, PE on MDCT-PA was found to be in all 33 patients within right lung i.e, in 100% while in 27 patients within both right and left lung i.e., in 81.8%. PE had common involvement of segmental arteries with more in right with 90.9% and 60.6% in left, followed by sub-segmental arteries (right 78.8% vs. left 60.6%) , lobar (right 54.5% vs. left 63.6%) .There was involvement of right pulmonary artery in 42.4% and left pulmonary artery in 27.3% patients and main pulmonary artery in only 6.1% of the patients.

Representative cases:

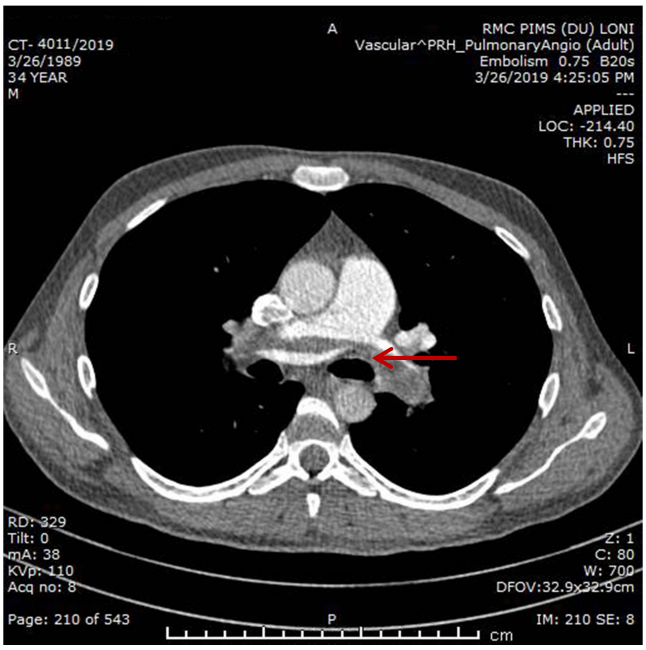

Figure1 : MDCT-PA axial pulmonary embolism specific window showing – non enhancing 'saddle' thrombus in main pulmonary artery extending into right and left pulmonary arteries (red arrow).

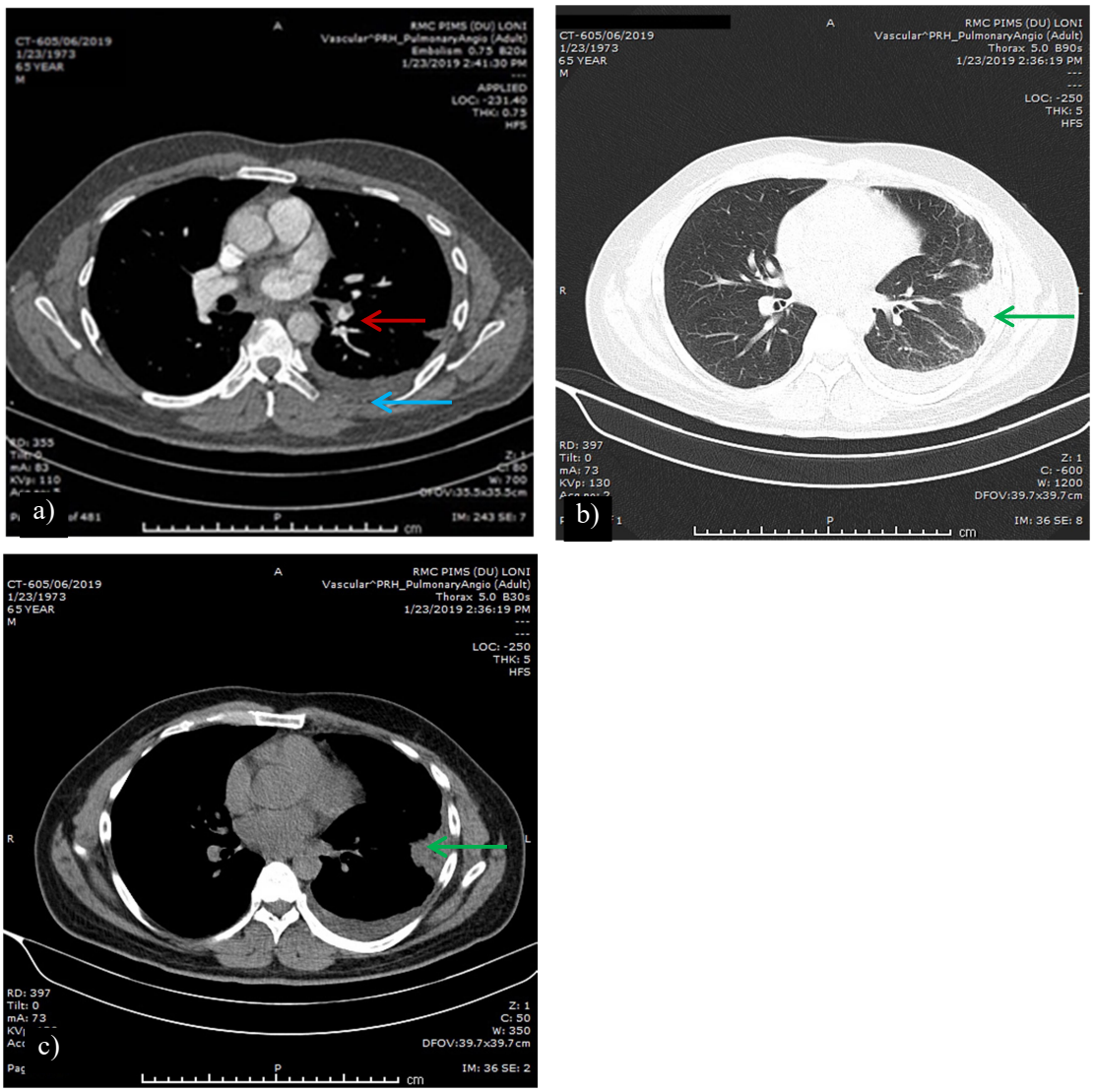

Figure 2: MDCT- PA (a) axial pulmonary embolism specific window showing- left superior segmental artery thrombus (red arrow) and minimal pleural effusion on left side (blue arrow),(b) axial lung window and (c) mediastinal window showing – 'Wedge' shaped area of consolidation in superior segment of left lower loberepresenting infarcted lung tissue (green arrow).

Discussion:

A total of 93 patients with clinically suspected pulmonary embolism were evaluated using MDCT-PA for confirmation of PE within the study period after having met the inclusion criteria. We found that the prevalence rate of pulmonary embolism was present in 33 patients (35.5%) out of clinically suspected patients, is comparable to other published studies which have reported approximately 25%-35 % prevalence of PE in clinically suspected cases [8, 9]. In our study, out of 93 suspected PE patients, 33 (35.5%) patients have an evidence of PE, while 60(64.5%) patients did not have an evidence of PE. 19 out of 33 patients (57.6 %) with PE had an additional diagnosis, while 26 out of 60 patients (43.3%) without PE had an alternative diagnosis. Our study results were similar and correlate with studies by Kim KI et al. and Lombard J et al.. These studies showed that, despite the presence or absence of PE, an alternate or additional diagnosis is commonly found on CTPA scans for suspected PE [10, 11].

In our study, PE was more commonly anatomically distributed within the segmental arteries i.e., right in 90.9% and left in 60.6%, followed by sub-segmental arteries (right 78.8% vs. left 60.6%), lobar (right 54.5% vs. left 63.6%). There was involvement of right pulmonary artery in 42.4% and left pulmonary artery in 27.3% patients and main pulmonary arteries in only 6.1%.

Our study results with maximum incidence of PE in segmental arteries were in correlation with the study of Yu S et al. which reported that there was proximal extension of embolus, maximum into segmental arteries (40%) followed by central (23.7%), lobar (23.4%) and sub segmental arteries (12.9%). [12]. Other pleural and parenchymal abnormalities were commonly reported among 72 patients (77.4%) with suspected PE. Pleural effusion was the commonest i.e., in 15 patients (45.5%) with PE and 18 (30%) without PE. This was followed by consolidation comprising 6 patients (18.2%) with PE and 14 (23.3%) without PE. However, this finding was not significantly associated with PE (p value >0.05) which were found to be non-specific for PE. Other undocumented co-existent cardiac, pulmonary, or other systemic diseases may have influenced the frequency of various parenchymal and pleural findings on CTPA. Only the presence of infarct (wedge shaped opacity) was found to be significantly associated with PE (p value 0.001). These findings were similar with earlier published studies [13].

Conclusion:

MDCT-PA was found to be readily available even during the off routine hours, fast, relatively affordable and minimally invasive imaging modality in clinically suspected PE patients for including and excluding PE.MDCT-PA reveals significant additional diagnoses which ensure appropriate patient management and is instituted without delay.Parenchymal abnormalities and pleural effusion are present in the majority of patients undergoing MDCT-PA for the clinical suspicion of PE, irrespective of the presence or absence of PE.Other than wedge-shaped opacities, parenchymal and pleural abnormalities on MDCT-PA do not correlate with the presence of PE in this study.MDCT-PA reduces mortality and improves cost- effectiveness in the diagnostic workup of suspected PE patients

Study limitations:

1. The study was limited to Pravara rural hospital (PRH), Loni, due to constraints of resources. Therefore the results may not be generalized to other radiology centers in or outsideLoni.

2. This study was not designed to compare the diagnostic accuracy of MDCT-PA as there was no comparison of findings to other imaging modalities due to limitation of resources.
3. No major comprehensive study has been undertaken locally on PE thus the local prevalence rate is unknown. Hence, the prevalence rate used here may not be truly representative of the actual localscenario.

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