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ROLE OF CT PULMONARY ANGIOGRAPHY IN DIAGNOSIS OF ACUTE PULMONARY THROMBOEMBOLISM

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INTRODUCTION

Since its introduction in 1992, computed tomography angiography (CTA) of the pulmonary arteries has become the main diagnostic test for the evaluation of pulmonary embolism (PE). With the advent of multi detector scanning, CTA has gained substantially in image acquisition speed and spatial resolution, which changed its diagnostic yield in many respects. Pulmonary embolism is the third most common acute cardiovascular disease after myocardial infarction and stroke and results in thousands of deaths each year because it often goes undetected.[1,2] Diagnostic tests for thromboembolic disease include (a) the D-dimer assay, which has a high sensitivity but poor specificity in this setting[3], (b) ventilation-perfusion scintigraphy, which has a high sensitivity but very poor specificity[4] and (c) lower limb ultrasonography, which has a high specificity but low sensitivity.[5] Computed tomographic (CT) pulmonary angiography has been evaluated has demonstrated sensitivities of 53%–100% and specificities of 83%–100% in wide ranges.[6]

Pulmonary angiography, the diagnostic standard of reference for confirming or refuting a diagnosis of pulmonary embolism, remains underused.[7,8] For each lung the main, lobar, segmental and subsegmental arteries are examined for pulmonary embolism. Acute pulmonary embolism cause intraluminal filling defects that should have a sharp interface with the intravascular contrast material. The vessels are seen as either normal, containing acute pulmonary embolism, or indeterminate. The reason for indeterminacy is reported, along with the extent of normalcy. For example, vessels may appear normal to the level of the segmental arteries; however, the presence of pulmonary embolism in sub-segmental arteries may remain indeterminate depending on the quality of the study.

The diagnostic criteria for acute pulmonary embolism include the following: 1. Arterial occlusion with failure to enhance the entire lumen due to a large filling defect; the artery may be enlarged compared with adjacent patent vessels, 2. A partial filling defect surrounded by contrast material, producing the “polo mint” sign on images acquired perpendicular to the long axis of a vessel and the “railway track” sign on longitudinal images of the vessel, 3. A peripheral intraluminal filling defect that forms acute angles with the arterial wall.

Clinical comparison will be done with Wells criteria.[11] Criteria includes multiple parameters like deep vein thrombosis, tachycardia, haemoptysis, history of surgery and malignancy.

AIMS AND OBJECTIVES

- To diagnose pulmonary thromboembolism on CT pulmonary angiography.
- To compare the CT pulmonary angiography study results with
- Clinical status - Wells criteria.
- Biochemical marker – D-dimer status.

MATERIALS AND METHODS

After obtaining permission from hospital ethics committee, this prospective study was carried out at Sasson Hospital, Pune in the department of Radiodiagnosis from March 2012 to March 2014.

4.1 Study population

A total of 80 subjects were included irrespective of their age and sex with following inclusion and exclusion criteria.

4.2 Inclusion criteria

Patients referred for CT pulmonary angiography those who were clinically suspected to have acute pulmonary thromboembolism irrespective of biochemical (D-dimer) status.

4.3 Exclusion criteria

Patients with contrast allergy.
Pregnancy

4.4 Equipment used

CT Machine: 64 slice siemens scanner.

4.5 Method
Complete history was taken and thorough physical examination was done in all recruited patients. D-dimer values were noted. Other haematological tests were observed.

Images of pulmonary vasculature were obtained in axial planes by bolus tracking and maximum intensity projection. Reformatting in axial, coronal and sagittal planes was done using software provided.

4.7 Technical parameters are as follows
Field of view - 300 mm, Length- 240 mm.
Detector configuration (in mm) – 16 x 1.5 mm
Pitch factor - 0.938
Gantry rotation time – 0.5 sec
Reconstructed slice thickness – 2.0 mm
Increment- 1.5 mm
Tube current (in eff. mAs) - 200, kV- 120
Contrast material: Volume – 2 ml/kg
- Concentration– 300 mg /ml
- Injection rate – 5 ml/s

OBSERVATIONS AND RESULTS
The present study was carried out at SGH Hospital, PUNE in the department of Radio diagnosis from May 2012 To May 2014. Total 80 patients of varied age groups with suspected acute pulmonary thrombo-embolism were scanned by multidetector spiral CT.

Table 3: Age distribution.

Age group	Number of patients	Percentage (%)
21 - 30	14	17.5
31 - 40	8	10.0
41 - 50	14	17.5
51 - 60	13	16.3
61 - 70	17	21.3
71 - 80	14	17.5
Total	80	100.0

From the table of age distribution it is seen that maximum numbers of patients were in age group of 61 to 70 years and followed by 71 to 80 years and 41 to 50 years. Males outnumbered females in most of the age group.

Table 4: Gender distribution.

Gender	Number of patients	Percentage (%)
Male	47	58.8
Female	33	41.3
Total	80	100.0

Table 5: **Pulmonary thrombo-embolism on CTPA.**

CT pulmonary angiography for pulmonary thromboembolism	Number of patients	Percentage (%)
Present	44	55.0
Absent	36	45.0
Total	80	100.0

On CTPA, 55% of patients were PE positive.

Table 6: Lung vasculature involvement on CTPA
Above table shows there is unilateral thromboembolism in 52.27% of patients and bilateral involvement in 47.73% of patients.

Most of the emboli were seen at segmental (53.75%) and lobar (30.0%) levels, followed by at subsegmental level (18.75%).

(Note: In some cases, there were multiple pulmonary artery segments involvement in single patient).

By using latex agglutination assay, 92.5% patients were positive for D-dimer and only 7.5% had showed negative results.

In present study pulmonary thrombo-embolism were seen in 44 (55%) patients. In 36 (45%) patients non-embolic pathologies were demonstrated including interstitial lung disease (n=7), pneumonia(n=6), congestive cardiac disease (n=4), COPD (n=4) and pleural effusion in 1 patient. Search of origin of emboli was made. Deep vein thrombosis was seen in 24 patients, 5 patients shown IVC thrombosis on colour doppler while 2 patients were of right ventricular thrombus on ECHO. In remaining 13 patients cause of pulmonary

thrombo-embolism was inconclusive. After 1 month follow up, out of 44 patients diagnosed and treated for pulmonary thromboembolism, 5 patients died in 2 to 8 days period after diagnosis.

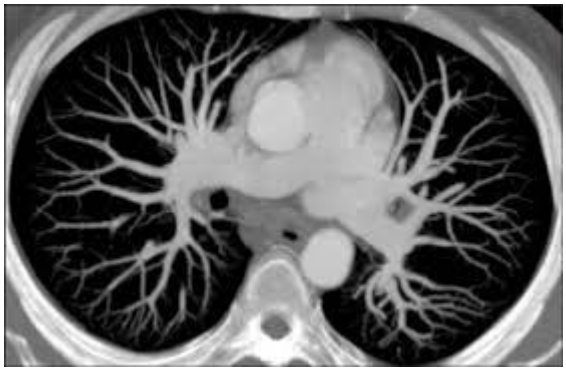

FIG. 1 Normal appearance of pulmonary angiography.

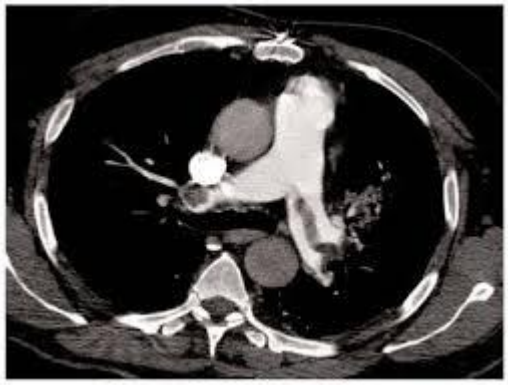

FIG.2 Filling defects in bilateral distal main pulmonary representing thrombus.

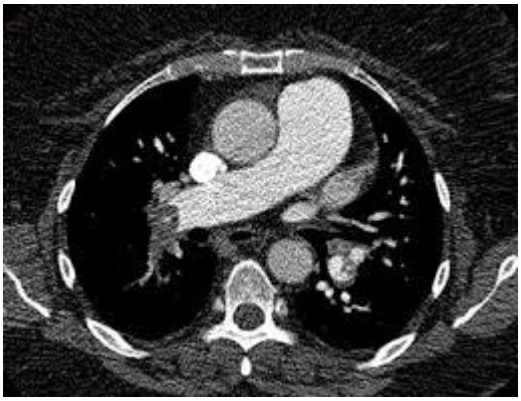

Fig. 3 Filling defects in right distal main pulmonary representing thrombus.

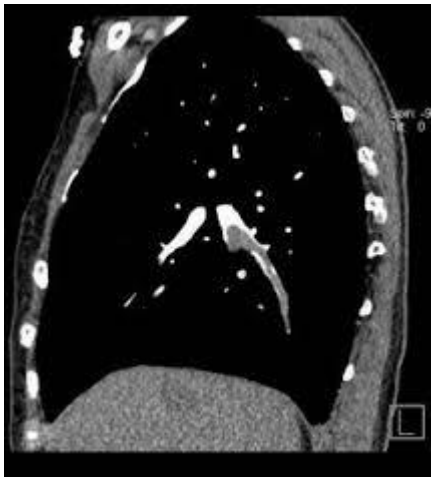

Fig 4. Sagittal image showing thrombus in left lower lobe segmental artery.

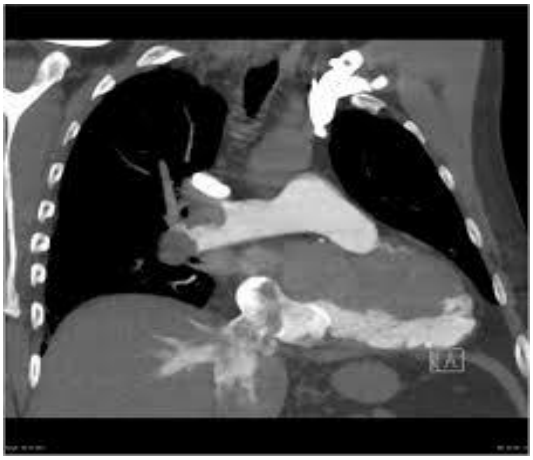

Fig. 5 Coronal image showing thrombus in right distal main pulmonary artery and upper lobar artery.

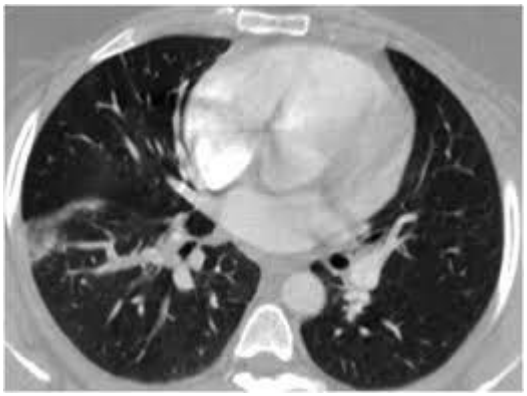

Fig 6. Subpleural ground glass densities in right lower lobe superior segment due to pulmonary infarct.

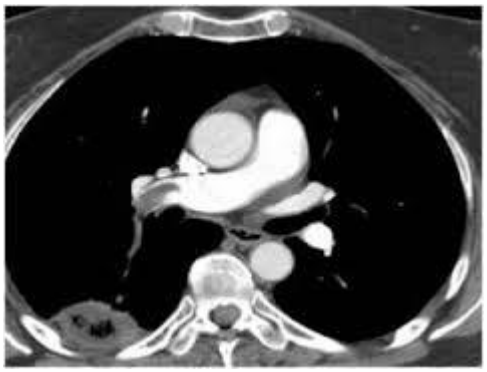

Fig 7 showing thrombus in right descending pulmonary trunk with subpleural cavitatory infarct in lower lobe.

DISCUSSION

This study of "Role of CT pulmonary angiography in diagnosis of clinically suspected acute pulmonary thromboembolism its comparison with clinical (Wells criteria) and biochemical (D-dimer) status" was done on 80 cases between time period March 2012 to March 2014.

The present study included 80 patients ranging from 20 to 80 years of age. 58.8% of the patients were males in the present study whereas only 41.3% of the patients were females. Quinn D et al[12] performed on 103 patients ranging from 16 to 87 years of age. 37% of the patients were males in the present study where as 63% of the patients were females.

The present study included 80 patients. 44 (55%) patients had PE detected on CTPA. 21 (47.72%) had bilateral PE and 23 had unilateral involvement. Out of which 55 patients (17%) had PE detected on CT. 39 (71%) had bilateral PE and 16 (29%) had unilateral involvement.

6.4 Distribution of thrombo-embolic materials

In present study, 44 out of 80 (55%) patients show pulmonary thromboembolism on CTPA. Out of 44 patients, single location thromboembolic material was found in 15 (34%) patients, double location in 14 (31.8%) patients and triple location in 12 (27.27%) patients while all segments were involved in 3 patients. Centrally (main and lobar branch) localized filling defects were visualized in 33(75%) patients. Segmental filling defects corresponding to thrombo-embolic material were demonstrated in 43 (97.72%) patients. In 15 (34.09%) patients, subsegmental filling defects were shown.

In present study of 80 patients by using latex agglutination assay and pulmonary arteriogram as a diagnostic criteria d-dimer show 97.73% of sensitivity, 13.89% of specificity and 83.33% of negative predictive value.

CONCLUSIONS

- Multidetector-row spiral CT technology has overcome past limitations of CT and is a preferred modality for imaging patients with suspected acute PE.
- In our study, out of total sample of 80 patients, 44 (55%) patients were showed pulmonary thromboembolism on CTPA.
- Bilateral distribution of emboli was seen in 21(47.73%) patients.
- Thrombo-embolic material was observed in more than one region. Most of the emboli were seen at segmental (53.75%) and lobar (30.0%) levels, followed by at subsegmental level (18.75%). MDCT made the detection of subsegmental emboli which is difficult in single detector scanner.
- Using the Wells score, out of 44, 1 patient with low risk of PE went to be diagnosed with PE on CTPA. 24 patients with moderate risk and 19 patients with high risk on Wells score went to be diagnosed with PE on CTPA. There is significant association between CT pulmonary angiography diagnosis and Wells grade (P value <0.05).
- Out of 44 patients, 43 patients with positive d-dimer value went to diagnosed PE on CTPA. 1 patient with negative d-dimer value went to diagnosed PE on CTPA. There is no significant association between CT pulmonary angiography diagnosis and D-dimer status (P value >0.05). D-dimer had very low specificity also.
- In 36 of 80 patients (45%), non-embolic pathologies were demonstrated including evidence of interstitial lung disease (n = 7), pneumonia (n = 6), congestive cardiac failure (n = 4), COPD (n = 4) and malignancy (n = 3).

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