Original article

Role of Computed Tomography Pulmonary Angiogram in Patients with History of Shortness of Breath and Deep Vein Thrombosis

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ABSTRACT

Background: Computed tomography pulmonary angiography (CTPA) is vital for detecting pulmonary embolism (PE) arising from deep vein thrombosis (DVT) and presenting with shortness of breath. This study aimed to establish CTPA diagnostic role in patients with breathlessness and DVT risk factors, accurately detecting PE and associated vascular abnormalities, thus improving patient outcomes.

Subjects and methods: This retrospective study was conducted at Department of Radiology, Ittefaq Hospital Lahore over four months. The patient aged over 16-45 with 28 females and 48 males who had a history of DVT and shortness of breath were part of research. CTPA was performed with bolus tracking. Data was collected after filling consent form, including the duration from onset of symptoms such as leg pain, swelling, chest pain and shortness of breath. Radiologists categorized CT images to report PE findings. Statistical analysis utilized descriptive statistics to describe basic features and chi-square tests was used to compare the dependent groups. The p-value less than 0.05 was considered as statistically significant.

Results: According to CTPA findings, among 76 patients (48 males, 28 females), CTPA confirmed PE in 69 (90.8%), with bilateral involvement in 60.5%. Common findings included intraluminal defects (68.4%), pleural thickening (52.6%), segmental collapse (52.6%), and subsegmental opacification (47.4%), bronchiectasis (40.8%), unilateral PE (39.5%), consolidation (39.5%), and ground glass opacity (35.5%).

Conclusion: Conclusively, CTPA's diagnostic utility was evident, identifying PE in a significant proportion with associated findings like bilateral involvement and vascular abnormalities. It provided crucial information for timely PE diagnosis and management in patients with shortness of breath and predisposing DVT risk factors.

Keywords:

Pulmonary embolism, CT pulmonary angiography, deep vein thrombosis, shortness of breath.

INTRODUCTION

Pulmonary embolism must be diagnosed and treated with caution as it has the potential to be fatal. Computed tomography pulmonary angiogram (CTPA) is exceptionally skilled at identifying thrombus, making it ideal choice for examining individuals who are at risk.[1] Recent finding indicate that CTPA is a viable preference for screening of patients suspected of having deep vein thrombosis and pulmonary embolism.[2] Deep vein thrombosis (DVT) usually involves lower venous system due to the stasis of blood flow. Thrombus originate in deep calf veins subsequently being caught to the right heart cavities. About 90% blockages of blood vessel, known as emboli.[3] Pulmonary embolism is indicated by occlusion of blood flow in pulmonary arteries when venous emboli travel through venous circulatory system from a vein in lower extremity. The incidence of pulmonary embolism is about 60 to 120 per 100000 individuals per year.[4] Swelling, calf pain, tenderness, tachycardia, Edema, presence of varicose veins, warmth and superficial vein dilatation are warning signs of deep vein thrombosis, which occur in legs.[5] Certain circumstances can heighten the formation of venous thrombi by a Virchow's triad, it encompasses endothelial injury, hypercoagulability and stasis. Computed Tomography pulmonary angiogram (CTPA) is the diagnostic imaging modality, yielding high resolution images for the evaluation of structural and morphological abnormalities.[6] CTPA has high sensitivity and specificity 90%, a high positive predictive value for patients with intermediate to high pre-test probability of PE and high negative predictive value in patients with low to intermediate pre-test probability.[7] The

Conflict of interest: The authors declared no conflict of interest exists.
Citation: Arooj N, Saeed I, Afzal MIL, Zohaib H, Arshad Z, Imran N. Role of computed tomography pulmonary angiogram in patients with history of shortness of breath and deep vein thrombosis. J Fatima Jinnah Med Univ. 2024; 18(1):03-05.

DOI: http://doi.org/10.37018/JFJMU/2345

rationale of this study was to depict the early diagnosis of venous pulmonary occlusion by minimize the risk of thrombus formation.

PATIENTS AND METHODS

This was a retrospective review of data collected from the Radiology Department of Ittefaq Hospital Lahore, over a period of four months from February till May 2023. The study involved all patients, of both genders, aged over 16-45 years reported in indoor and outdoor Patient Departments who underwent CTPA with the suspected diagnosis of PE and DVT. The relevant imaging results were reported by radiology specialists. The signs and symptoms included were shortness of breath, history suggestive of deep vein thrombosis or PE, unilateral leg pain or edema, surgery or fracture during last three months, pain on palpation of lower extremity, chest pain and cough. The duration of these signs and symptoms varied from 3 to 6 months. The study included both diagnosed and suspected cases of PE. Patients with high risk of bleeding, instability, embolectomy and amputation were excluded. The 128 slice CT scanner (TOSHIBA Acquilion, 128 slice) was used to acquire the images of the thorax in a caudal-cranial direction. The scout view was obtained from apices to diaphragm. This direction was used because most blood clot blockages are found in lower region of lungs. Contrast was administered through the antecubital vein using cannula of 18 to 20 gauge in size. Bolus tracking was done while monitoring the slice (region of interest) below the area of carina at the level of pulmonary trunk bifurcation. The scanner was adjusted with the threshold of 90 vHU and 110 HU at the region of interest (ROI). The volume of 50-60ml of iodinated contrast media was given with a 50ml of saline and injected at a rate of 4.5 to 5ml/s. The scan was started with the injection of contrast media. Contrast filling in SVC and RA and PT were seen dynamically. As the contrast density reached 90 HU, voice instruction for breath-hold start and within 5 seconds, contrast density reaches 110 HU and acquisition of pulmonary tree from lung base to apices was obtained caudocranially. CT angiogram was read by consultant radiologists however patient history was noted by medical officers or residency trainees. All the data for research was collected through questionnaire consisting of all the parameters i.e. patient's history and CTPA findings. A data sheet was compiled later on which was then entered in SPSS version 23. Statistical analysis was made through SPSS. Pearson's chi-square test was used to determine the difference in two groups. Descriptive analysis was used to depict the CT findings. The CTPA findings were categorized based on severity and location of pulmonary embolism such as unilateral PE, bilateral PE, consolidation, ground glass opacity, bronchiectasis, segmental collapse, opacification of subsegmental branches, pleural thickening and intraluminal filling defect are correlated with the patient's clinical presentation.

RESULTS

The study involved 76 patients, including 28 (36.8%) females and 48 (68.2%) males with the mean age of 35 years. The minimum age of patients was 16 years and maximum age was 45 years. In 69 (90%) patients, PE was present. History of shortness of breath and deep vein thrombosis (DVT), were found to be the main reasons in 73% patients at moderate to high risk of developing PE. CTPA findings of all these patients were clinically and radiologically assessed. The presence of PE accounted for 26% in 16-30 years old patients and 43% in 31-45 years old patients (Figure 1).

Out of 76 patients 30 patients had unilateral PE (39.5%), 46 had bilateral PE (60.5%), 27 had ground glass opacity (35.5%), 30 patients had consolidation (39.5%), 31 patients had bronchiectasis (40.8%), 40 patients had segmental collapse (52.6%), 36 had opacification of subsegmental branches (47.4%), 40 patients had pleural thickening (52.6%), 52 had intraluminal filling defect (68.4%) and 69 patients had massive pulmonary embolism (90.8%) (Table 1). In the age group of 31-45 years, 43% of all CTPA were positive for PE, however, the difference in both age groups was not significant (p-value = 0.635).

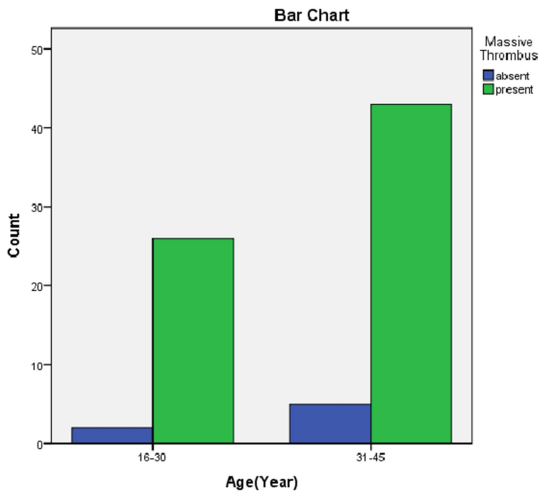

Figure 1: The presence of positive CTPA varies depending on age group.

Table 1: CT findings and extent of PE with different age-groups

Characteristics	Frequency (%)
Age	
16-30	28 (36.8%)
31-45	48 (63.25)
Gender	
Female	28 (36.8%)
Male	48 (63.2%)
Unilateral PE	
Bilateral PE	46 (60.5%)
Ground Glass Opacity	27 (35.5%)
Massive PE	69 (90.8%)
Consolidation	30 (39.5%)
Segmental collapse	40 (52.6%)
Opacification of subsegmental branches	36 (47.4%)
Pleural thickening	40 (52.6%)
Intraluminal filling defect	52 (68.4%)

DISCUSSION

Findings of this study indicate that 43% patients of DVT who underwent CTPA due to suspected PE were diagnosed with PE. Even young patients with shortness of breath and history of deep vein thrombosis should be evaluated for the final diagnosis of pulmonary embolism. In a recent study evaluating the role of CTPA in young adults with DVT. The results showed that DVT is the most common cause (90%) and pulmonary embolism was present in 70% of cases. The mean age of patients was 34 years. The most frequent risk factors were obesity, bed rest, the history of DVT, surgery or trauma. These findings associated to 73% of DVT and 90% of PE.[8] A 2021 study, found that emergency department patients tested positive for pulmonary embolism when scanned with CTPA. The results showed that 38% of individuals who underwent CTPA were found to have PE (90%) while up to 54% of cases have DVT. About 76% of patients were admitted to the hospital primarily because they were experiencing dyspnea, chest pain or both. The study results are similar to 90% of pulmonary embolism in our findings.[9] Another study in 2023 showed that risk factors in lung cancer patients with history of DVT (52%) and pulmonary embolism present in 60% of cases with symptoms of leg swelling, history of proximal DVT, surgery, prolonged immobility. In our findings DVT was found in 73% and pulmonary embolism in 90% of cases.[10]

CONCLUSION

CTPA's diagnostic utility was evident, identifying PE in a significant proportion with associated findings like bilateral involvement and vascular abnormalities. It provided crucial information for timely PE diagnosis and management in patients with shortness of breath and predisposing DVT risk factors.

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