Original Article

Comparison of Plasma D - Dimer Levels with Computed Tomography Pulmonary Angiography (CTPA) Findings in Patients Suspected of Pulmonary Embolism Clinically

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ABSTRACT

Objective: To determine the diagnostic accuracy of plasma D-Dimer levels in clinically suspected patients of pulmonary embolism (PE) taking computed tomography pulmonary angiography (CTPA) as gold standard.

Study Design: Descriptive Cross sectional study

Place and Duration of Study: This study was conducted at the In Sahiwal Teaching Hospital in collaboration of Pathology and Radiology Departments of Sahiwal Teaching Hospital from 15th June ,2022 – 14th December, 2022.

Materials and Methods: We enrolled 50 subjects of suspected pulmonary embolism based on clinical signs and symptoms e.g. chest pain and shortness of breath. Their D-dimer levels and CTPA were done. Data was analyzed using SPSS version 23.0. Descriptive statistics were applied. Degree of association was also analyzed between Plasma D-dimer levels and pulmonary thromboembolism on CTPA by applying chi-square test. The p-value ≤0.05 was considered as statistically significant. Sensitivity, specificity, positive predictive value and negative predictive value of Plasma D-dimer levels in pulmonary thromboembolism were calculated taking CT pulmonary angiography as gold standard. Association was also analyzed between pulmonary thromboembolism on CTPA and other findings noted on HRCT chest images.

Results: Among 50 included subjects, 58 % were males and 42 % were females with mean age of 49.5 $\pm$ 7.55. D-Dimers were found to be elevated ($\geq$ 500 ng/ml) in 44% of cases. Pulmonary thromboembolism was seen by CTPA in 54 % of cases. While in 46 % of cases, PE was not detected. Statically significant association was seen between collapse/consolidation and presence of pulmonary thromboembolism (p-value 0.0001) on CTPA. D-dimers were found to be significantly higher in patients with pulmonary thromboembolism (p-value 0.024). The sensitivity, specificity, positive predictive value (PPV) , negative predictive value(NPV) and diagnostic accuracy of D-dimer levels in predicting existence of thromboembolism were 59.2 % , 73.9 % , 72.8 % , 60.7 % and 66.0 % respectively.

Conclusion: Although D-Dimer levels exhibits low sensitivity and specificity to diagnose pulmonary embolism, it is helpful for initial workup of the disease. However, CTPA stands as gold standard modality for definitive diagnosis of Pulmonary Embolism.

Key Words: Computed tomography pulmonary angiography (CTPA), D-Dimer, Pulmonary embolism

INTRODUCTION

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Pulmonary Embolism (PE) is a frequent lethal disorder affecting cardiovascular system.[1] Venous thrombo-embolism leading to PE due to blockage of pulmonary artery or its branches, makes it the third usual etiology of cardiovascular death[2]. PE results when a piece of thrombus from deep veins disrupts the pulmonary circulation[3]. The incidence of PE is about 0.6 per 1000 per annum that increases in older age[4]. PE exhibits a diverse clinical picture, sometimes presents with typical features and at times only with few mild respiratory symptoms. So , clinicians should be cautious to miss the diagnosis of PE as it is a quite lethal condition[5].

Pulmonary embolism is a cause of many co-morbidities. So , its timely diagnosis is essential. For its diagnosis, validated diagnostic algorithms are present. Clinically patient can be scored according to Wells or modified Geneva, further testing to laboratory markers

such as D-Dimers can be proceeded. Based on combined results of scoring system and D-Dimer levels, further relevant non-invasive imaging techniques like computed tomography pulmonary angiography (CTPA), can be used[6].

D-Dimers are protein fragments resulting from dissolution of blood clots in our body. Levels of d-dimers are found to be high in cases of pulmonary embolism. But there are many other causes leading to high levels of D-dimers[7]. Although the D-dimers are considered to be a sensitive marker to diagnose PE , but it has low specificity, the sensitivity and specificity being 80% to 100% and 23% to 63% respectively[8,9].

In our region, no data has been published to ascertain the role of D-Dimers and CTPA to diagnose cases of PE, so we planned this study to determine the diagnostic accuracy of plasma D-Dimer levels in clinically suspected cases of PE taking CTPA findings as gold standard.

MATERIALS AND METHODS

This descriptive cross sectional study was conducted in Sahiwal Teaching Hospital from 15th June ,2022 – 14th December, 2022 in collaboration of Pathology and Radiology Department of Sahiwal Teaching Hospital. After taking permission from Institutional Review Board (IRB), 50 subjects of suspected pulmonary embolism irrespective of gender, between 20 – 85 years of age, based on clinical signs and symptoms pulmonary embolism e.g. chest pain and shortness of breath were included in the study. Patients with past history of PE and contrast reaction were excluded from the study. After taking informed consent, their d-dimers and CTPA were done. D-Dimer levels were taken on AU-680 fully automated chemistry analyzer and level ≥500 ng/ml was considered as positive. All CTPA scans were done using GE 128 slice optima-660 CT scanner. Automated injector was used for administration of intravenous contrast material. Data was analyzed using SPSS version 23.0. Descriptive statistics were applied. Mean and standard deviation were calculated for continuous variables like age. For nominal variables, frequency and percentages were calculated. Association was analyzed between presence or absence of thromboembolism and other findings noted on CTPA such as collapse/consolidation, pleural effusion and pulmonary vessel enlargement. Degree of association was also analyzed between thromboembolism and d-dimer values by applying chi-square test. Sensitivity, specificity, positive & negative predictive values and diagnostic accuracy of Plasma D-dimer levels in pulmonary thromboembolism were calculated. The p-value ≤0.05 was considered as statistically significant.

RESULTS

Among 50 included subjects, 58 % (29) were males and 42 % (21) were females. The mean age of subjects was 49.5 ± 7.55. Fig.1
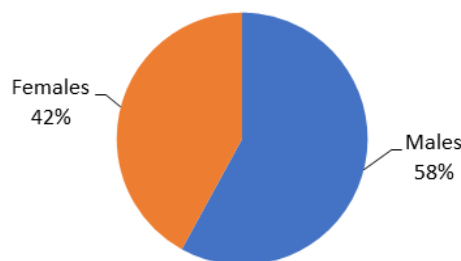

Figure No. 1: Gender Distribution

Frequency of collapse/consolidation, pleural effusion and pulmonary vessel enlargement was higher in subjects with pulmonary thromboembolism while only statically significant association was seen between collapse/consolidation and presence of pulmonary thromboembolism (p-value 0.0001). Table I.

Table No.I: Association of other CT-Scan features in patients with and without PE diagnosed on CTPA.

Variables	Pulmonary thromboembolism absent n=23	Pulmonary thromboembolism present n=27	p-value
Collapse/Consolidation	3 (13.0%)	24 (88.9%)	0.0001*
Pleural Effusion	6 (26.0%)	9 (33.3%)	0.758
PulmonaryVessel Enlargement	3 (13.0%)	6 (22.2%)	0.479

p-values are calculated by Chi-Square Test

Level of d-dimers were significantly higher in patients with pulmonary thromboembolism (p-value 0.024). Table 2.

Table No.2: Association of D-Dimer levels in patients with and without PE diagnosed on CTPA.

D-Dimer Levels	Pulmonary thrombo-embolism absent n=23	Pulmonary thrombo-embolism present n=27	p-value
< 500 ng/ml	17	11	
≥500 ng/ml	6	16	0.024*

p-values are calculated by Chi-Square Test

Table No.3: Diagnostic Accuracy of D-dimer levels in patients with and without PE diagnosed on CTPA.

Variables	D-Dimers
Sensitivity	59.2 %
Specificity	73.9 %
Positive predictive value	72.8 %
Negative predictive value	60.7 %
Diagnostic Accuracy	66.0 %

The sensitivity, specificity, positive predictive value (PPV), negative predictive value(NPV) and diagnostic accuracy of D-dimer levels in predicting existence of thromboembolism is shown in Table 3.

DISCUSSION

PE is a fatal disease of venous thromboembolic etiology and constituting the third common cause of cardiovascular death. Its early diagnosis is essential to ensure timely proper management. Our study highlights the importance of clinical symptoms along with laboratory parameters and imaging modalities for prompt diagnosis of the disease. Our study demonstrated the low sensitivity and specificity of plasma d-dimer levels for prompt diagnosis of PE, therefore CTPA still remains the modality of choice for accurate diagnosis.

A local study conducted in Rawalpindi, revealed the most frequent finding on CTPA in patients of PE being collapse/consolidation that also correlates with our study[10]. A study by Rivera-Lebron B, et al , also highlighted the importance of combining clinical, laboratory and imaging parameters for prompt diagnosis of PE as recommended by Pulmonary Embolism Response Team (PERT)[11]. A study by Kearon C, et.al, also highlighted the high negative predictive value of plasma d-dimers level in diagnosis of PE and recommended to increase the threshold of d-dimer levels to rule out PE[12].

A study by Hepburn-Brown M emphasized the importance of using CTPA in the diagnostic workup of PE[13]. A study by Soffer S et al. also demonstrated CTPA as gold standard in diagnosis of PE[14]. Another study by Zantonelli G, et al. highlighted its high diagnostic accuracy for diagnosis of PE[15].

A small sample size was the main limitation in our study. More studies analyzing large number of patients needs to be conducted in our area.

CONCLUSION

We concluded from our study that d-dimer levels are important for initial workup of PE despite low sensitivity and specificity. However , CTPA remains a modality of choice for confirmatory diagnosis of Pulmonary Embolism.

Author's Contribution:

Concept & Design of Study:	Muhammad Saleem Akhtar
Drafting:	Amna Arooj
Data Analysis:	Muhammad Rafi Abbas
Revisiting Critically:	Muhammad Saleem Akhtar, Amna Arooj
Final Approval of version:	Muhammad Saleem Akhtar

Conflict of Interest: The study has no conflict of interest to declare by any author.

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