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RESEARCH ARTICLE

Evaluation of pulmonary embolism patients in a tertiary hospital with clinical, radiological and laboratory features

Emre Bacaksız[1], **Emine Özsarı**[2], **Suat Konuk**[2]

[1]Giresun Ali Menekşe Chest Diseases Hospital, Chest Diseases, Giresun, Türkiye
[2]Bolu Abant İzzet Baysal Training and Research Hospital, Chest Diseases, Bolu, Türkiye

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ABSTRACT

Objective: Pulmonary thromboembolism (PTE) presents with a wide range of symptoms, outcomes, and radiographic features. We evaluated the clinical, laboratory, and radiological features of PTE.

Materials and Methods: A retrospective study was conducted on patients diagnosed with pulmonary thromboembolism (PTE) between 2019 and 2021 at the Department of Chest Diseases, Abant Izzet Baysal University Hospital. Patients with suspected acute PTE and those diagnosed with pulmonary embolism based on CT angiography were included. Patients with chronic PTE, as diagnosed by ventilation/perfusion scintigraphy, were excluded.

Results: Of the 100 patients included, 42% were female and 58% were male. The mean age of the patients was 70.50 ± 13.54 years. The most common symptom was dyspnea, followed by cough and chest pain. Troponin I levels were elevated in 62 individuals. D-dimer concentrations of all patients were above the upper limit of 0.55 mg/L. Massive PTE was seen in 15% of patients, submassive PTE in 40%, and non-massive PTE in 45%. In addition, systolic pulmonary artery pressure (sPAP) was high in 67% of the cases. Patients with elevated sPAP had a higher mean age, had received more thrombolytic therapy, and had a higher rate of major and submassive pulmonary embolisms. Troponin I values were seen to be elevated in massive PTE, as expected (p=0.024). D-dimer values were significantly higher in patients with pulmonary embolism in the main branch (p=0.018).

Conclusion: In light of the data we obtained from our study, we believe that a detailed cardiovascular system evaluation, including Troponin I and systolic pulmonary artery pressure measurements, is very important in the diagnosis process and in predicting the prognosis after diagnosis in patients presenting with suspected pulmonary thromboembolism.

Keywords: D-dimer, pulmonary embolism, systolic pulmonary artery pressure

Corresponding author: Emre Bacaksız **E-mail:** bacaksizemre@gmail.com
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INTRODUCTION

Pulmonary thromboembolism (PTE) occurs when one or more thrombi, typically originating from the deep veins of the lower and upper extremities, migrate from the systemic circulation to the pulmonary vascular bed (1,2). PTE and deep vein thrombosis are different manifestations of the same pathological process and are collectively referred to as venous thromboembolism (VTE). PTE is the third most common cause of death from cardiovascular conditions, following myocardial infarction and cerebrovascular accident (3-5). Scoring patients with suspected PTE according to their symptoms, findings, laboratory test results, and risk factors, then classifying them as "low, intermediate, or high probability" is useful for empirical diagnosis and treatment approaches. Computed Tomography Pulmonary Angiography (CTPA) is a frequently used and easily accessible imaging tool with high diagnostic accuracy for PTE (6,7). Despite this, PTE still causes high morbidity and mortality; therefore, great importance should be given to the diagnosis and treatment of the disease (8,9). The aim of this study was to evaluate the clinical, laboratory, and radiological findings of patients diagnosed with PTE who presented to the Chest Diseases Clinic of Abant İzzet Baysal Training and Research Hospital.

MATERIALS AND METHODS

In the study, 100 patients who were admitted to the Chest Diseases Department of Abant İzzet Baysal Education and Research Hospital between January 2019 and January 2021 and diagnosed with pulmonary embolism were retrospectively examined. Patients diagnosed with chronic pulmonary thromboembolism, and patients diagnosed with pulmonary thromboembolism via ventilation/perfusion scintigraphy were excluded from the study; only patients diagnosed with acute pulmonary thromboembolism via CTPA were included. The demographic information of all patients diagnosed with acute PTE were documented, including age, gender, presence of concomitant diseases, symptoms at the time of admission, D-dimer and troponin I levels and ECHO findings. When classifying PTE clinically and hemodynamically according to the patient's risk factors, the presence or absence of deep vein thrombosis (DVT) and the location of thromboembolism on CTPA were also taken into consideration. Lower Extremity Venous Doppler Ultrasonography was performed to scan common, deep, superficial and crural veins using Samsung RS 85 device. Pulmonary hypertension was assessed by measuring systolic pulmonary artery pressure (sPAP) via transthoracic echocardiography. It was also noted whether the patients received thrombolytic therapy during their follow-up.

Ethical approval was obtained from the Bolu Abant İzzet Baysal Clinical Research Ethics Committee, and permission was obtained from the Chief Physician of the Bolu Abant İzzet Baysal Training and Research Hospital for the research (Ethics Committee Number: 2022/134).

Since this was a retrospective study, informed patient consent was not required.

The collected data were transferred to a computer for analysis. The results were presented as mean ± standard deviation, frequency and percentage. The Mann-Whitney U test was used to analyse variables between groups. Kruskal-Wallis variance analysis was applied when the number of groups was more than two because it did not comply with the normal distribution. Spearman correlation analysis was used for correlation analysis. The Chi-square test was used to compare categorical variables. In the statistical analysis, the confidence interval was set at 95% and the significance level was set at $p<0.05$.

RESULTS

The mean age of the patients was 70.50 ± 13.54 years. Of the 100 patients, 42 (42%) were female and 58 (58%) we were male. When the accompanying diseases were examined, 66% of patients had an additional disease. These included cancer (18%), hypertension (HT) (18%), chronic obstructive pulmonary disease (COPD) (9%), atrial fibrillation (AF) (8%), heart failure (CHF) (5%), asthma (4%), cerebrovascular accident (CVA) (2%), chronic renal failure (1%) and obesity (1%).

Shortness of breath, which was observed in 70% of the patients, was the most common presenting symptom, followed by chest pain (14%), and cough (3%). In addition, 30% of the patients had DVT and 67% had high sPAP (Table 1).

Table 1. Demographic characteristics–clinical and radiological findings

	Number (n)	Percentage (%)
Gender		
Female	42	42.0
Male	58	58.0
The Average Age(years)	**70.50±13.54**	
DVT		
Yes	30	30.0
No	70	70.0
High sPAP		
Yes	67	67.0
No	33	33.0
Type of Pulmonary Embolism		
Massive	15	15.0
Submassive	40	40.0
Non-massive	45	45.0
Pulmonary Embolism Site		
Major	27	27.0
Segmental	51	51.0
Subsegmental	22	22.0
Complaint		
Shortness of breath	70	70.0
Chest Pain	14	14.0
Cough	3	3.0
Hemoptysis	3	3.0
Syncope	3	3.0
Fatigue	2	2.0
Pain in Leg	2	2.0
Nausea	1	1.0
Stomach Ache	1	1.0
Back Pain	1	1.0

DVT: Deep Vein Thrombosis, sPAP: systolic pulmonary artery pressure.

Table 2. Analysis of D-dimer values by gender and pulmonary embolism distribution

Gender	D-dimer (mg/L)	P
Female	7.26±6.71	0.035
Male	5.57±11.06	
Pulmonary Embolism Site		
Major	9.38±15.36	0.018
Segmental	5.99±6.50	
Subsegmental	3.13± 2.79	

When laboratory test results were compared according to gender, it was found that D-dimer values of female patients were higher than those of male patients (p=0.035). D-dimer values of patients with main branch pulmonary embolism were found to be significantly higher than those with segmental or subsegmental pulmonary embolism (p=0.018) (Table 2).

Although there was no statistically significant difference in age distribution according to the type of pulmonary embolism, the mean age of patients with submassive pulmonary embolism was higher (p=0.051). In addition, D-dimer values of patients with submassive pulmonary thromboembolism were significantly higher than those of patients with massive and non-massive pulmonary embolisms (p=0.011). Troponin I values of patients with massive pulmonary thromboembolism were significantly higher than those of patients with submassive and non-massive pulmonary embolisms (p=0.024) (Table 3).

The mean age of patients with high sPAP was higher than that of patients without high systolic pulmonary artery pressure (p=0.001). In addition, massive and submassive pulmonary embolisms were found to be more prevalent in the high sPAP group (p=0.000001); therefore, they received more thrombolytic therapy (p=0.001). sPAP was significantly higher in those with pulmonary embolism in the main branch (p=0.030), compared to those with segmental (p=0.047) and subsegmental (p=0.009) branches (Table 4).

Table 3. Distribution of age, D-dimer and troponin I by pulmonary embolism type

	Type of Pulmonary Embolism			
	Massive	**Submassive**	**Non massive**	**P**
Age	64.27±13.98	73.75±10.86	69.69±14.90	0.051
D-dimer (µg/L)	4.28±2.25	9.83±13.71	3.79±3.84	0.011
Troponin-I (ng/ml)	209.36±584.64	33.92±71.80	24.65±56.15	0.024

Table 4. Age, PTE type and treatment method according to sPAP

			sPAP		
			High	**Not High**	**P**
Age			73.63±11.41	64.15±15.37	0.001
Thrombolytic	**Received**	n	16	0	0.001
		%	23.9	0.0	
	Not received	n	51	33	
		%	76.1	100	
Type of Pulmonary Embolism	**Massive**	n	14	1	0.000001
		%	20.9	3.0	
	Submassive	n	35	5	
		%	52.2	15.2	
	Nonmassive	n	18	27	
		%	26.9	81.8	
Pulmonary Embolism Site	**Major**	n	23	4	0.03
		%	34.3	12.1	
	Segmental	n	33	18	
		%	49.3	54.5	
	Subsegmental	n	11	11	
		%	16.4	33.3	

PTE: Pulmonary Thrombo Embolism, sPAP: Systolic pulmonary artery pressure.

DISCUSSION

Pulmonary Thromboembolism is a disease with high morbidity and mortality rates despite the increasing possibilities of radiological and laboratory diagnostic methods. Although both scoring and exclusion criteria are used in diagnosis and treatment, managing the disease can be quite complex and challenging due to factors such as age, gender, comorbidities, and smoking. This study aims to discuss the radiological, laboratory, and clinical features of PTE cases diagnosed in a tertiary center where the disease is frequently encountered, and both medical and surgical risk factors coexist, in light of current data.

The annual mean incidence rate of VTE is 23-269 per 100,000 people. PTE primarily affects the elderly. Except for risk factors specific to women, such as pregnancy and oral contraceptive use, the incidence, recurrence, and mortality rates of PTE are similar

between genders (7). Women constituted 42% of the patients in our study. This figure is consistent with the rates published in Turkey (10). Additionally, in line with previous studies, we evaluated whether gender had a significant impact on the risk of pulmonary embolism and found no such association. However, women diagnosed with PTE were found to have higher D-dimer levels compared to men. No statistically significant relationship was found between gender and D-dimer levels in Kaçmaz's thesis study (11). The relevant findings in our study, which are contradictory to previous studies, could be associated with menstrual cycle variations and oral contraceptive use. However, since relevant data could not be collected for this retrospective analysis, this can only be considered as a limitation of the study.

DVT is one of the risk factors for PTE, affecting 30% of patients. In a study conducted in Turkey by Aytemur Solak et al., DVT was detected in 7 of 17 patients diagnosed with PTE (12), while in a study conducted by Hacıevliyagil et al. (13), DVT was detected in 50% of 20 cases using Doppler ultrasonography. Similar to other studies in the literature, DVT was detected in 30% of patients diagnosed with PTE in our study. According to clinical reports, the most common symptoms in patients with PTE are chest discomfort and shortness of breath. In the study conducted by Erbaycu et al., the most common symptoms were shortness of breath (57.1%) and chest discomfort (55.1%) (14). In the study conducted by Solak et al., the most common symptoms were found to be dyspnea (75.9%) and chest pain (50.0%) (12). In our study, chest discomfort was reported in 14% of patients and shortness of breath was present in 70%. The most common causes of these two symptoms are thought to be hypoxia and infarct areas resulting from ventilation/perfusion imbalance.

The prevalence of radiological findings is important in both diagnosis and follow-up of the disease. PTE was detected in the main branch in 27% of patients, segmental in 51% and subsegmental in 22%. In the study by Wouter et al., thrombus was detected in 7.7% of cases in the pulmonary trunk, 14.6% in the main pulmonary arteries, 28.5% in the lobar arteries, 26.9% in the segmental arteries and 22.3% in the subsegmental arteries (15). Another study reported involvement in segmental and larger arteries in 58% of cases, and involvement in subsegmental and smaller arteries in 42% (16). In our study, consistent with previous studies, the frequency of PTE was found to be higher in the main and segmental branches than in the subsegmental branches. This may be due to the lower rate of clinical symptom formation of PTE in the subsegmental branches. When the age distribution according to the types of pulmonary thromboembolism was examined, no statistically significant difference was found. However, the mean age of patients with submassive pulmonary embolisms was higher than that of patients with other types of pulmonary embolisms (p=0.051). In a relevant study, a statistically significant age difference was found between patients in the submassive group and patients in the massive and non-massive groups (17). Similarly, in our study, we evaluated the reason for the higher mean age in the submassive pulmonary embolism type as the possibility of microembolism secondary to immobilization as the age increases.

Cardiological monitoring is crucial for assessing the progression of PTE and guiding treatment decisions, as it is closely associated with disease severity. When we divided our patients into two groups based on sPAP, it was found that the mean age of patients with elevated sPAP (≥25mmHg) was higher than those with normal sPAP (p=0.001). This may be because, with age, vessels lose the ability to demonstrate the elasticity required to resist increasing pressure. In addition, patients with elevated sPAP had higher rates of major (p=0.000259) and submassive (p=0.000005) PTE compared to patients with normal sPAP (p=0.000001). In a study by Bayram, it was reported that the right ventricular diameters of patients with massive and submassive PTE were significantly higher than those of patients with non-massive PTE and the control group. sPAP values were also significantly higher in patients with massive and submassive PTE than in patients with non-massive PTE and in the control group (18). In our study, consistent with findings in the literature, sPAP was found to be higher in patients with massive PTE compared to other types of pulmonary embolism. This may be due to the greater thrombus load in the main branches and more secondary right heart involvement in the massive embolism type. In addition, sPAP was significantly higher in individuals with pulmonary embolism in the main branch (p=0.030) than in the

segmental (p=0.047) and subsegmental branches (p=0.009). According to our study, thromboembolism in the main branch affects the right heart more than embolisms in other locations, thus causing an increase in sPAP.

The two most frequently measured laboratory parameters in PTE are D-dimer and troponin I levels. In our study, D-dimer values were significantly higher in individuals with submassive pulmonary embolism compared to individuals with major or non-massive pulmonary embolism (p=0.011). In Rodoplu's thesis study, the mean D-dimer level was reported as 762.4 ± 889.6 µg /L in the major group, while it was 713.7 ± 353.9 µg/L in the non-massive group. No statistically significant difference was found between the major and non-massive pulmonary embolism groups in terms of D-dimer levels (p> 0.05) (19). The reason for the difference in our study may be that the comorbidities and age factors of the patients could not be standardized according to the type of embolism. While D-dimer and troponin I values are typically expected to be highest in massive PTE according to thrombus burden, their significance in submassive group may indicate the need for closer monitoring of these patients. This suggests that the frequency of follow-up, particularly regarding the potential need for thrombolytic therapy and the risk of developing chronic PTE, should be increased.

CONCLUSION

In our study, d dimer values were found to be significantly higher in patients with elevated troponin I levels and PTE. Troponin I values were found to be higher in patients with massive embolism. The mean age of patients with elevated sPAP was found to be higher.

Ethical approval

This study has been approved by the Bolu Abant İzzet Baysal Clinical Research Ethics Committee (approval date 10/05/2022, number 2022/134). Written informed consent was obtained from the participants.

Author contribution

Surgical and Medical Practices: EB; Concept: SK; Design: EÖ; Data Collection or Processing: EB; Analysis or Interpretation: EB; Literature Search: EB, EÖ; Writing: EB All authors reviewed the results and approved the final version of the article..

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Conflict of interest

The authors declare that there is no conflict of interest.

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