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Original Article

Clinical Profile of Patients With Ordinary, Submassive, and Massive Pulmonary Thromboembolism in Rajaie Cardiovascular Medical and Research Center

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ABSTRACT

Background: Acute pulmonary thromboembolism (PTE) is a common condition with an increasing incidence that causes severe complications and death. We herein describe the clinical profile of patients with PTE who were referred to a large tertiary university heart hospital.

Methods: In this retrospective cohort study, the demographic, clinical, and admission data of patients with PTE admitted to Rajaie Cardiovascular Medical and Research Center in 2 consecutive years were reviewed and analyzed. Based on echocardiography findings, clinical presentation, and pulmonary computed tomography findings, the patients were divided into massive, submassive, and minor PTE groups. The study variables, as well as in-hospital mortality, were compared between the groups.

Results: The study population consisted of 328 patients with PTE: 210 patients (64.0%) with ordinary PTE, 88 (26.8%) with submassive PTE, and 30 (9.1%) with massive PTE. The patients with massive PTE were significantly younger (P=0.007) and had a higher rate of tachypnea (P=0.002), tachycardia (P=0.013), and hypotension (P<0.001) at presentation. The patients with submassive PTE were more likely to be male and had higher uric acid levels (P=0.002). Chest pain and hypertension were more frequent in the patients with ordinary PTE (P=0.019 and P=0.016, respectively). In pulmonary computed tomography angiography, the involvement of the left and right pulmonary arteries was more frequently observed in the patients with submassive PTE (P=0.013 and P=0.007, respectively). More patients in the massive PTE group received thrombolytic therapy (P<0.001) with a significantly higher mortality rate (P<0.001), a shorter ICU stay (P=0.001), and a shorter hospitalization period (P<0.001).

Conclusions: Patients with massive PTE have a higher risk of mortality and should be considered for more aggressive therapy. ***(Iranian Heart Journal 2022; 23(1): 95-105)***

KEYWORDS: Pulmonary thromboembolism, Epidemiology, Massive pulmonary emboli, Treatment outcome

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Acute pulmonary thromboembolism (PTE) is a common condition with an increasing incidence that can lead to severe complications and death. [1,2] The global prevalence of PTE ranges from 1.2% to even 8% based on the setting and the underlying etiology. [3-5] A wide range of risk factors can cause PTE, including old age, immobility, major surgery, malignancies, infections, hormonal changes, hypercoagulability state, and several medications. [3,6-8] Patients also vary in symptoms, and they may present with nonspecific mild symptoms to severe dyspnea. [9] Although a positive D-dimer test may propound PTE, the definite diagnosis of PTE is mostly made based on imaging modalities. [10] Currently, computed tomography angiography of pulmonary arteries (CTA) is considered the gold-standard diagnostic imaging for PTE, and its combination with D-dimer is the most-preferred diagnostic plan. [11,12] Nonetheless, other tools such as transesophageal echocardiography and ventilation/perfusion scan can be used with less sensitivity and specificity. [13-15]

Despite advances in diagnostic and treatment modalities, the burden of PTE is still noticeable. [16-18] This may result from the multidimensional etiologic and pathophysiologic characteristics of the condition; therefore, the recognition of the risk factors and their prevalence can help to plan preventive and treatment measures to reduce the burden of PTE. [19] To that end, research data from all countries could help to have a better understanding of the various aspects of PTE. In 1 instance, data from 4 prospective international studies provided a real picture of PTE in the world and its risk factors. [20] This study showed that age- and sex-standardized incidence of venous thromboembolism, as well as the prevalence of cardiovascular risk factors, was substantially higher in high-income countries than in middle and low-income ones. [20] Consequently, several socioeconomic factors may play a role as potential risk factors for PTE.

Due to the importance of this condition and its burden on the healthcare system, the development of registries on PTE and the prospective recording of patients' natural history and follow-up, as well as storing biological samples in a biobank for further analysis, are the best way to provide valuable evidence and practice guide on PTE. [2] Notably, there is no comprehensive database or registry on PTE in Iran, although the incidence is noteworthy. However, the establishment of such a registry would be an immense national project demanding big budgets and professional human resources. Until then, single- or multicenter reports on PTE from Iran could provide useful data for clinicians and researchers. Accordingly, we aimed to describe the epidemiologic, clinical, imaging, and laboratory characteristics of patients with PTE who were referred to a large tertiary university heart hospital.

METHODS

Study Population

In this retrospective cohort study on patients admitted to Rajaie Cardiovascular Medical and Research Center in 2 consecutive years, all patients who had a primary diagnosis of PTE and were treated accordingly and were finally labeled by the same diagnosis in the discharge note were eligible to enter the study. The primary diagnosis of PTE was based on clinical and imaging findings or by the diagnosis of primary or referral physicians, with or without deep vein thrombosis. Patients were included in the study if they had diagnostic findings on pulmonary CTA, lung perfusion scan, echocardiography, or pulmonary angiography. All the patients were admitted in the period of evaluation. Totally, 523

patients diagnosed with pulmonary embolism were entered into the study. Among them, 332 patients had a final diagnosis of pulmonary embolism and were assigned for this study. Four patients were excluded because of a lack of information. Ultimately, 328 patients were evaluated in the final analysis.

Evaluations and Measurements

Baseline assessments, including clinical examinations, lab findings, treatment, electrocardiography, and transthoracic echocardiography data, were retrieved from the patients' documents.

In our center, pulmonary CTA is the primary method of PTE diagnosis, followed by lung perfusion scan, transesophageal echocardiography, and conventional pulmonary angiography in those unable to undergo pulmonary CTA because of critical conditions, sensitivity to contrast media, renal failure, or after all, diagnosis ambiguity.

An expert cardiologist performed echocardiography as per our routine. Transthoracic echocardiography was performed while the patient was in the left lateral decubitus position with the Vivid3 echocardiography machine (General Electric Medical System Vingmed Ultrasound AS, Horten, Norway), equipped with a 3.6 MHz transducer. All dimensions were achieved according to the American Society of Echocardiography guidelines by the echocardiographers.

In patients who underwent right heart catheterization, pressures were obtained with the Swan Ganz Catheter (Edwards Lifesciences, Irvine, USA). PTE diagnosis was confirmed if one of the following scenarios was met: PTE was obvious in pulmonary CTA, there was a high probability of PTE in the perfusion scan according to the PIOPED study criteria, a clot was observed directly in echocardiography, and embolism was confirmed by pulmonary angiography. In rare cases, magnetic resonance angiography was done.

Patients with acute PTE symptoms and signs were divided into 3 groups based on echocardiography findings, clinical presentation, and pulmonary CTA. [21] The first group consisted of patients with massive PTE, a systolic blood pressure below 90 mm Hg, and a substantial burden of embolism in imaging studies. The second group was composed of patients with submassive PTE and significant right ventricular enlargement or failure in echocardiography. Additionally, patients with a systolic blood pressure below 90 mm Hg at presentation, which later increased to more than 90 mm Hg following initial fluid resuscitation, were also considered to have submassive PTE. The submassive PTE group also encompassed patients with a massive burden of clots on pulmonary CTA and no hemodynamic or echocardiographic findings in favor of submassive PTE. All the other patients with no evidence of submassive or massive PTE comprised the ordinary (minor) PTE group.

Ethics

The study protocol was approved by the Research Board and Ethics Committee of Rajaie Cardiovascular Medical and Research Center, and written informed consent was obtained from the entire study participants at the time of admission for the use of their clinical data for research purposes.

Statistical Analysis

The results are presented as the mean ± the standard deviation (SD) for numerical variables or frequencies and percentages for categorical variables. Comparisons across groups were made with the one-way analysis of variance (ANOVA), the χ^2 test, the χ^2 test for trend, or the Fisher exact test as

appropriate. Normal distribution of the numerical variables was met across the 3 groups according to the Shapiro–Wilk test of normality (P>0.05). All the analyses were performed with SPSS software, version 20.0, (SPSS, Inc, Chicago, IL). A 2-tailed P value of 0.05 or less was considered statistically significant.

RESULTS

This retrospective study enrolled 328 patients with PTE, consisting of 210 patients with minor PTE (64.0%), 88 patients with submassive PTE (26.8%), and 30 patients with massive PTE (9.1%). The clinical and laboratory characteristics of the patients with PTE are described in Table 1. The mean age of the patients with massive PTE was significantly lower than that of the other 2 groups (P=0.007). Nonetheless, more male patients had submassive PTE (P=0.039). The serum level of uric acid was also significantly higher in the submassive PTE group (P=0.002). As regards the initial symptoms, tachypnea (P=0.002), tachycardia (P=0.013), and hypotension (P<0.001) were more frequent among the patients with massive PTE, whereas chest pain (P=0.019) and hypertension (P=0.016) were more frequent in those with minor PTE. The mean systolic and diastolic blood pressure was significantly lower in the massive PTE group than in the other groups (P<0.001 for both). The details of the comparison of the baseline characteristics between the 3 study groups are described in Table 1.

Chronic thromboembolic pulmonary hypertension was less common in the patients with minor PTE (P=0.045).

Other risk factors did not differ significantly between the groups (Table 2).

Pulmonary CTA was the most common diagnostic tool in the study population, and all the study groups benefited equally from it. In the pulmonary CTA images, the involvement of the left and right pulmonary arteries was observed more frequently in the submassive PTE group than in the other groups (P=0.013 and P=0.007, respectively). There were no other significant differences between the 3 groups in terms of the findings of pulmonary CTA. Echocardiography was performed more frequently in the submassive and massive PTE groups, while transesophageal echocardiography was performed more frequently in the massive PTE group (P<0.001). Color Doppler of lower extremity veins was performed more frequently in the minor PTE group (P=0.022). The imaging characteristics of the patients with PTE are demonstrated in Table 3.

Heparin therapy was implemented more commonly in the minor PTE group, while more patients in the massive PTE group received thrombolytic agents (P=0.009 and P<0.001, respectively). The duration of thrombolytic therapy was significantly higher in the massive PTE group (P=0.018), whereas there was no significant difference between the groups in the duration of heparin therapy. The treatment characteristics of the patients with PTE are summarized in Table 4.

The mortality rate was significantly higher in the massive PTE group (P<0.001). On the other hand, the massive PTE group had a significantly shorter duration of hospital and intensive care unit (ICU) stay than the other 2 groups (P=0.001 and P<0.001, respectively). The details of the in-hospital outcome of the study population are summarized in Table 5.

Table 1. Clinical and laboratory characteristics of the studied patients with pulmonary thromboembolism in Rajaie Cardiovascular Medical and Research Center

Variables	OPTE (n=210)	SMPTE (n=88)	MPTE (n=30)	*P* value
Age (y)	58.86±17.54	53.28±16.33	50.87±19.13	0.007
Sex				0.039
Male	92 (43.8)	50 (56.8)	10 (33.3)	
Female	118 (56.2)	38 (43.2)	20 (66.7)	
Tachypnea	38/207 (18.4)	27 (30.7)	12 (40.0)	0.002
Dyspnea	178 (84.8)	75 (85.2)	28 (93.3)	0.313
Cough	26 (12.4)	16 (18.2)	2 (6.7)	0.213
Hemoptysis	18 (8.6)	7 (8.0)	3 (10.0)	0.912
Tachycardia	88 (41.9)	40 (45.5)	21 (70.0)	0.013
Hypotension	10 (4.8)	0	23 (76.7)	<0.001
Hypertension	44 (21.0)	16 (18.2)	0	0.016
Syncope	22 (10.5)	8 (9.1)	7 (23.3)	0.086
SBP (mm Hg)	131.95±24.63	129.95±20.18	86.01±88.35	<0.001
DBP (mm Hg)	81.70±16.30	82.19±15.07	55.23±6.23	<0.001
Chest pain	100 (47.6)	26 (29.5)	11 (36.7)	0.019
WBC	8712.19±2984.30 (n=201)	8950.72±3028.70 (n=83)	11840.40±5071.63 (n=25)	<0.001
Neutrophil	69.06±11.72 (n=199)	69.35±11.02 (n=83)	73.35±14.14 (n=25)	0.227
Platelet	218.61±62.03 (n=198)	206.61±69.97 (n=82)	238.58±106.95 (n=24)	0.115
Hemoglobin	12.01±1.71 (n=201)	12.51±1.98 (n=83)	12.03±2.17 (n=25)	0.103
BUN	20.63±13.43 (n=204)	22.33±12.29 (n=87)	25.83±15.71 (n=24)	0.155
Cr	1.26±0.49 (n=203)	1.31±0.49 (n=87)	1.24±0.62 (n=25)	0.71
FBS	138.31±62.56 (n=197)	131.55±77.49 (n=83)	135.41±56.61 (n=22)	0.739
Uric acid	5.76±1.85 (n=145)	6.80±2.24 (n=67)	6.39±2.10 (n=15)	0.002
EF (%)	47.24±8.75	45.80±10.25	44.33±8.88	0.174
SPAP	48.49±17.61	69.47±21.03	76.63±24.77	<0.001
TR gradient	37.75±16.83	56.11±20.39	63.63±23.80	<0.001
RV size, mm	3.39±0.65 (n=73)	4.42±0.63 (n=38)	4.27±1.09 (n=9)	<0.001
TAPSE	11.16±8.74 (n=95)	9.10±9.72 (n=48)	11.38±7.71 (n=6)	0.425

Data are presented as mean ± SD or n (%).

MPTE, Massive pulmonary emboli; SMPTE, Submassive pulmonary emboli; OPTE, Ordinary pulmonary emboli; WBC, White blood cell; BUN, Blood urea nitrogen; Cr, Creatinine; FBS, Fasting blood sugar; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; EF, Ejection fraction; SPAP, Systolic pulmonary arterial pressure; TRG, Tricuspid regurgitation gradient; RV, Right ventricle; TAPSE, Tricuspid annular plane systolic excursion

Table 2. Diagnostic characteristics of the studied patients with pulmonary thromboembolism in Rajaie Cardiovascular Medical and Research Center

Variables	OPTE (n=210)	SMPTE (n=88)	MPTE (n=30)	*P* value
Diagnostic Methods				
VQ-scan				0.929
No lung perfusion scan	185 (88.1)	80 (90.9)	28 (93.3)	
Low-probability lung perfusion scan	1 (0.5)	0	0	
Intermediate-probability lung perfusion scan	7 (3.3)	1 (1.1))	0	
High-probability lung perfusion scan	17 (8.1)	7 (8.0)	2 (6.7)	
Echocardiography				<0.001
No echocardiography	25 (11.9)	0	1 (3.3)	
TEE	10 (4.8)	12 (13.6)	7 (23.3)	
TTE	154 (73.3)	63 (71.6)	20 (66.7)	
Both TEE and TTE	21 (10.0)	13 (14.8)	2 (6.7)	
MRI	2 (1.0)	0	0	0.999

Pulmonary angiography	2 (1.0)	1 (1.1)	0	0.999
Pulmonary CTA	166 (79.0)	65 (73.9)	22 (73.3)	0.302
Pattern of Pulmonary Artery Involvement in Pulmonary CTA				
Right pulmonary artery	83/166 (50.0)	46/65 (70.8)	14/22 (63.6)	0.013
Right lobar	67/165 (40.6)	24/65 (36.9)	8/21 (38.1)	0.658
Right segmental	80/165 (48.5)	35/65 (53.8)	12/21 (57.1)	0.34
Right peripheral	65/166 (39.2)	19/65 (29.2)	8/20 (40.0)	0.352
Right pleural effusion	34 (16.2)	7 (8.0)	5 (16.7)	0.159
Left pulmonary artery	69/166 (41.6)	42/65 (64.6)	11/22 (50.0)	0.007
Left lobar	61/165 (37.0)	21/65 (32.3)	9/21 (42.9)	0.647
Left segmental	72/166 (43.4)	32/65 (49.2)	8/21 (38.1)	0.6
Left peripheral	---	---	---	---
Left pleural effusion	33 (15.7)	5 (5.7)	3 (10.0)	0.052
Peripheral pulmonary lesion in CT scan	(n=166)	(n=65)	(n=20)	0.236
No lesion	87 (52.4)	41 (63.1)	11 (55.0)	
Unilateral lesion	33 (19.9)	15 (23.1)	5 (25.0)	
Bilateral lesion	46 (27.7)	9 (13.8)	4 (20.0)	
Color Doppler of lower extremity veins	147 (70.0)	58 (65.9)	14 (46.7)	0.022
Above the knee	41/147 (27.9)	16/58 (27.6)	4/14 (28.6)	0.991
Below the knee	43/147 (29.3)	23/58 (39.7)	3/14 (21.4)	0.248
Popliteal	58/147 (39.5)	31/58 (53.4)	6/14 (42.9)	0.19

Data are presented as n (%).

TEE, Transesophageal echocardiography; TTE, Transthoracic echocardiography; MRI, Magnetic resonance imaging; CTA, Computed tomography angiography; MPTE, Massive pulmonary emboli; SMPTE, Submassive pulmonary emboli; OPTE, Ordinary pulmonary emboli

Table 3. Treatment characteristics of the studied patients with pulmonary thromboembolism in Rajaie Cardiovascular Medical and Research Center

Variables	OPTE (n=210)	SMPTE (n=88)	MPTE (n=30)	*P* value
Treatment				
Heparin	203 (96.7)	86 (97.7)	25 (83.3)	0.009
Infusion	194 (92.4)	80 (90.9)	24 (80.0)	0.06
Bolus intermittent	41 (19.5)	13 (14.8)	2 (6.7)	0.065
Duration (d)	(n=198)	(n=83)	(n=24)	0.063
<4	13 (6.6)	8 (9.6)	3 (12.5)	
=4	14 (7.1)	1 ((1.2)	13 (12.5)	
>4	171 (86.4)	74 (89.2)	18 (75.0)	
Thrombolytic Agents				
Streptokinase	30 (14.3)	36 (40.9)	16 (53.3)	<0.001
Duration (h)	(n=30)	(n=34)	(n=15)	0.018
<24	7 (23.3)	2 (5.9)	8 (53.3)	
24	4 (13.3)	9 (26.5)	1 (6.7)	
48	12 (40.0)	17 (50.0)	5 (33.3)	
72	7 (23.3)	6 (17.6)	1 (6.7)	
Warfarin	190/206 (92.2)	79/86 (91.9)	18/28 (64.3)	<0.001

Data are presented as n (%).

MPTE, Massive pulmonary emboli; SMPTE, Submassive pulmonary emboli; OPTE, Ordinary pulmonary emboli

Table 4. Outcome characteristics of the studied patients with pulmonary thromboembolism in Rajaie Cardiovascular Medical and Research Center

Variables	OPTE (n=210)	SMPTE (n=88)	MPTE (n=30)	*P* value
Death	14 (6.7)	14 (15.9)	14 (46.7)	<0.001
Hospital stay (d)	12.57±7.07	16.07±12.07	9.93±8.37	0.001
ICU stay (d)	5.61±5.88	9.89±10.79	4.70±5.83	<0.001
General ward stay, (d)	6.92±5.29	6.25±5.08	5.10±5.73	0.171

Data are presented as mean ±SD or n (%).

MPTE, Massive pulmonary emboli; SMPTE, Submassive pulmonary emboli; OPTE, Ordinary pulmonary emboli

Table 5. Risk factors of the studied patients with pulmonary thromboembolism in Rajaie Cardiovascular Medical and Research Center

Variables	OPTE (n=210)	SMPTE (n=88)	MPTE (n=30)	*P* value
No specific risk factor	61 (29.0)	30 (34.1)	10 (33.3)	0.42
Cardiovascular disease	21 (10.0)	8 (9.1)	3 (10.0)	0.901
Deep vein thrombosis	21 (10.0)	7 (8.0)	2 (6.7)	0.46
CTEPH	11 (5.2)	12 (13.6)	3 (10.0)	0.045
Orthopedic surgery	33 (15.7)	7 (8.0)	3 (10.0)	0.111
Major operations	19 (9.0)	4 (4.5)	2 (6.7)	0.299
Malignancy	6 (2.9)	5 (5.7)	1 (3.3)	0.42
Oral contraceptive pill use	11 (5.2)	3 (3.4)	2 (6.7)	0.722
Long travel	6 (2.9)	1 (1.1)	0	0.837
Bed-ridden (rest)	10 (4.8)	4 (4.5)	1 (3.3)	0.999
Antiphospholipid syndrome	1 (0.5)	3 (3.4)	0	0.104
CNS problem	7 (3.3)	1 (1.1)	1 (3.3)	0.558
Obesity	7 (3.3)	3 (3.4)	2 (6.7)	0.583

Data are presented as n (%).

MPTE, Massive pulmonary emboli; SMPTE, Submassive pulmonary emboli; OPTE, Ordinary pulmonary emboli; DVT, Deep vein thrombosis; CTEPH, Chronic thromboembolic pulmonary hypertension; CNS, Central nervous system

DISCUSSION

This retrospective study was performed on patients with PTE admitted to a tertiary heart hospital in Tehran, Iran, which is also a referral center for PTE. Based on our findings, the massive PTE group patients were younger and had a higher rate of tachypnea, tachycardia, and hypotension at presentation than the submassive and ordinary PTE groups. The most common risk factor in the study population was a surgical operation. Nevertheless, there was no specific risk factor related to the occurrence of massive PTE, and only a history of chronic thromboembolic pulmonary hypertension was present less frequently in the massive PTE group than in the submassive and minor PTE groups. Pulmonary CTA was the imaging modality most frequently used for the diagnosis of our patients. According to its findings, the right and left pulmonary arteries were more likely to be involved in the submassive PTE group. The massive PTE group patients were treated more frequently with thrombolytic therapy. The overall mortality rate of the PTE patients in this study was 12.8%, and the massive PTE group patients were more likely to die.

In a study at a university hospital in Croatia, the majority of PTE patients were female, and prolonged bed rest, malignancy, history of recent surgery, and deep vein thrombosis were the predictors of mortality. However, a

low rate of multidimensional CT scans was performed in that study, and the patients were routinely diagnosed using the Well criteria and D-dimer. [22] In a retrospective cohort study in Australia, Barret et al [23] identified the characteristics and outcomes of 51 patients with massive PTE and found no statistically significant differences in mortality between the 3 treatment groups of thrombolysis, surgical embolectomy, and heparin anticoagulation. Still, resource utilization was significantly higher in the embolectomy group, and all those who received no specific treatment due to their comorbidities died in the hospital with an overall mortality rate of 52%. In that study, male patients were predominant, and malignancy was the most common risk factor for PTE. This result is comparable with the 46.7% mortality rate in our patients with massive PTE; be that as it may, our female patients had higher mortality. (Note that 66.7% of our patients were female.) In an epidemiologic study in the Apulia region of Italy between 2001 and 2007, the average patient age was 68.7 years, and most of the studied patients (59%) were female. The overall mortality rate was 10.9%, and there was an increase in the raw hospitalization rate of PTE per 100 000 within the eight years of the study. The most common secondary diagnosis of these patients was a circulatory disorder, followed by diseases of the respiratory system. [24] Based on the results of the Italian Pulmonary Embolism Registry in 2012, [25] the mean age of 1716 patients with PTE was 70±15 years, and 57% of them were women. Pulmonary CTA was the most commonly used diagnostic modality (in 82.1%), followed by perfusion lung scan (in 8.6%). The overall in-hospital mortality rate was 6.7%, and age above 75 years, immobilization exceeding 3 days before the diagnosis, and unstable hemodynamics were independent predictors of in-hospital death. In another retrospective study on 35 patients with PTE in India between 2005 and 2012, the mean age of the patients was 52.1 years, and 62.8% were men. Prolonged immobilization was the most common risk factor, and dyspnea was the most common symptom at presentation. Pulmonary CTA was performed in 68.5% of the patients, and the V/Q scan was done in 40%. Massive PTE was diagnosed in 28.5%, submassive PTE in 60%, and minor PTE in 11.5%. [26]

Echocardiography can be utilized rapidly and accurately for the diagnosis and risk-stratification of patients with PTE. [13, 27] Echocardiography (transthoracic, transesophageal, or both) was performed in almost 90% of our patients, and our results showed a significantly worse condition for the massive PTE group. In a study on 286 patients with PTE, 240 patients had a baseline tricuspid regurgitation and a right ventricular-right atrial gradient of variable degrees. The presence of pulmonary hypertension was likely in 97 patients (33.9%) and possible in another 50 patients (17.4%). Additionally, older age was the only risk factor for a right ventricular-right atrial pressure gradient exceeding 31 mm Hg at follow-up echocardiography. [28] Another investigation showed reversible right ventricular dysfunction within 48 hours following thrombolytic therapy in 78% of the studied patients. [29]

In our study, the highest mortality rate was observed in the massive PTE group, and the overall mortality rate was 12.8%, which is comparable to the current evidence. [1] Kausar et al [29] reported a mortality rate of 12.6%, while in a study in the Netherlands, the mortality rates in hospitalized and home-treated patients with PTE were 6.4% and 1.1%, respectively. [30] Accordingly, in patients with minor PTE, home treatment may help reduce adverse events. Utilizing a prognostic stratification strategy based on

the current guidelines could help improve the outcome in patients with PTE.
In our study, the submassive PTE group had prolonged lengths of stay in the hospital stay, ward, and ICU. As is shown in Table 4, the shorter length of stay in the ICU and the hospital in the massive PTE group was due to a graver prognosis and a higher early mortality rate in comparison with the other groups of patients.

Study Limitations

This study has some limitations. Firstly, this is a report from a single tertiary center, and our findings may not be generalizable to the public. Secondly, the retrospective nature of the study limited our freedom to collect all related data. Thus, some rare risk factors may be missed in this study. Further, we could not retrieve data regarding the degree of obstruction and the hemodynamic effects of PTE. Thirdly, we did not have a complete post-discharge follow-up for our patients, precluding us from calculating the long-term mortality rate in the study population and comparing them between the groups.

CONCLUSIONS

Patients with massive PTE have a higher risk of mortality and should be considered for more aggressive therapy. Proper therapeutic approaches demand a prompt, detailed evaluation of patients and the concomitant risk stratification in a multidisciplinary expertise center. We highly recommend the development of a national registry for PTE in Iran.

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Conflict of Interest

The authors have no conflicts of interest to declare.

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