

## Original Article

# Clinical characteristics of pulmonary embolism patients in a Chinese tertiary hospital

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**Abstract:** Objective: Pulmonary embolism (PE) remains largely underdiagnosed due to nonspecific symptoms. The present study aimed to describe the clinical features and risk factors of PE patients in a Chinese tertiary hospital. Methods: Clinical data of PE patients on admission between January 2012 and May 2015 at the Affiliated Dongyang Hospital of Wenzhou Medical University were retrospectively reviewed. PE was diagnosed according to the European Society of Cardiology Guidelines. Patient's symptoms, accompanying disorders and risk factors were collected. Concurrent chest radiographs, CT scans and echocardiographic examinations were performed and recorded. Results: PE patients presented a broad range of clinical symptoms. Cough, dyspnea, hypoxia and tachypnea were most frequently experienced, accounting for more than 60%; while symptoms such as pleuritic pain, syncope and hemoptysis occurred less frequently. Elder patients presented more symptoms of tachypnea and hypoxia than in younger patients. Patients with comorbidities such as hypertension, COPD and atrial fibrillation were more likely to have PE than patients without these comorbidities. In addition, surgery rate was significantly higher in patients with bilateral thrombus than patients with unilateral thrombus. Conclusions: PE patients had nonspecific clinical signs or symptoms. Doctors should pay more attention on patients at-risk.

**Keywords:** Pulmonary embolism, retrospective study, clinical symptoms

## Introduction

Pulmonary embolism (PE) is a potentially life-threatening disease with various symptoms that range from mild discomfort to shock or sudden death [1, 2]. The management of PE relies on timely diagnosis, accurate risk stratification and a well-monitored anticoagulation [3]. However, PE remains largely underdiagnosed due to vague and nonspecific clinical manifestations [4-6].

In the process of diagnosis, clinical symptoms are recommended to be first assessed ideally by a validated prediction model [7], although the final diagnosis is mainly based on clinical findings [8], laboratory tests [9, 10] and imaging data [11-13]. Some earlier reports have demonstrated that dyspnea followed by pleuritic pain and cough presented as the most

common symptom of PE. Surprisingly, a large amount of patients including those with large PE had mild or nonspecific symptoms, or were even asymptomatic [2, 14]. In the prospective investigation of pulmonary embolism diagnosis II (PIOPED II) study, the incidence of various symptoms were listed as follows: dyspnea at rest or with exertion (73%), pleuritic pain (44%), cough (37%), orthopnea (28%), calf or thigh pain and/or swelling (44%), wheezing (21%) and hemoptysis (13%). Some patients had a delayed presentation over weeks or days. In a recent large prospective study aimed to assess the impact of delay in presentation on the diagnostic management and clinical outcome of patients with suspected PE, PE patients with diagnostic delay more frequently had centrally located PE [8]. It is noticeable that symptoms may be mild or absent even in large PEs [2, 15, 16]. One systematic review of 28 studies re-

## Clinical characteristics of pulmonary embolism

**Table 1.** Demographic characteristics of study subjects

Variable	Total (n=342)	
	n	%
Age, years (mean $\pm$ SD)	71.40 $\pm$ 12.10	
Male	200	58.50
Symptom		
Dyspnea	232	67.80
Tachypnea	215	62.90
Hemoptysis	57	16.70
Pleuritic pain	30	8.80
Syncope	46	13.50
Hypoxia	220	64.30
Cough	233	68.10
Fever	79	23.10
Comorbidity		
HPN	151	44.20
COPD	126	36.80
AF	48	14.00
DM	28	8.20
History		
Surgery	52	15.20
Cancer	41	12.00
Drinking	85	24.00
Smoking	117	34.20

HPN: hypertension; COPD: chronic obstructive pulmonary disease; AF: atrial fibrillation; DM: diabetes mellitus.

vealed that one-third of 5,233 patients with deep vein thrombosis (DVT) had asymptomatic PE [15]. In the contrary, a meta-analysis of 19 studies (25,343 patients) revealed that clinical impression alone had a sensitivity of 85% and a specificity of 51% for the diagnosis of PE [17].

To date, few studies have focused on the Chinese PE population. Whether the clinical features of Chinese patients are similar with previously reported findings remains unknown. Moreover, very few studies have investigated the risk factors of PE patients. In the present study, we evaluated the clinical manifestations and risk factors of PE patients in a Chinese tertiary hospital for ultimately optimizing risk stratification.

### Methods

#### *Ethics statement*

This study was approved by the Human Investigation Ethics Committee of the Affiliated

Dongyang Hospital of Wenzhou Medical University (Dongyang, China). Oral informed consent was obtained from all enrolled patients. Patients records/information was anonymized and de-identified prior to analysis.

#### *Subjects and sample collection*

Clinical data of a total of 568 patients at the affiliated Dongyang Hospital of Wenzhou Medical University between January 2012 and May 2015 were retrospectively reviewed. According to the criteria of European Society of Cardiology Guidelines [1], PE was confirmed by an identified filling defect in the pulmonary artery system in CT pulmonary angiography (CTPA) or positive venous ultrasound of extremity DVT in patients with typical symptoms of PE (chest pain or dyspnoea). In addition, a positive D-dimer or ventilation-perfusion (V/Q) scintigraphy supports a high probability for PE, as recommended in those guidelines. All clinical data including symptoms, vital signs, accompanying disorders and risk factors were collected on admission. Concurrent chest radiographs, CT scans and echocardiographic examinations were performed and recorded.

#### *CTPA examination*

Thoracic CT scans were performed using a 64-detector multi-sectional CT scanner (Brilliance 64-slice; Philips, Amsterdam, Netherlands) with an intravenously injected contrast agent. For multidetector scans, contrast (100 ml) was injected at 4 mm/s and 1.25-mm images were obtained at 1.2-mm intervals using a pitch of 1.0:1.0. CTPA results were categorized as positive for PE when an intraluminal filling defect was observed within a pulmonary arterial vessel, and considered negative for PE when no filling defect was seen. Scans were considered technically inadequate only if main or lobar pulmonary vessels were not visualized.

#### *Statistical analysis*

For comparing categorical data, Chi-square test or Fisher's exact test was performed (Tables 2-5). Participants were categorized into one of four subgroups depending on age quartile. Statistical tests were evaluated at the two-sided 0.05 significance level. All statistical calculations were performed using SPSS 17.0 for Windows.

## Clinical characteristics of pulmonary embolism

**Table 2.** Subgroup analysis according to age quartile

Variable	1-25% 14-64 years		26-50% 65-74 years		51-75% 75-81 years		76-100% 81-88 years		P
	n=86	%	n=89	%	n=93	%	n=74	%	
	Gender (Male)	49	56.90	47	52.80	65	69.90	39	
Dyspnea	52	60.50	65	73.00	64	68.80	51	68.90	0.344
Tachypnea	40	46.50	60	67.40	63	67.70	52	70.20	0.003
Hemoptysis	17	19.70	19	21.30	12	12.90	9	12.10	0.258
Pleuritic pain	10	11.60	6	6.70	7	7.50	7	9.40	0.669
Syncope	12	13.90	9	10.10	14	15.00	11	14.80	0.752
Hypoxia	44	51.10	62	69.70	62	66.70	52	70.20	0.030
Cough	51	59.30	64	71.90	66	70.90	52	70.20	0.226
Fever	24	27.90	12	13.50	22	23.60	21	28.40	0.074
HPN	22	25.60	41	46.10	53	57.00	35	47.30	0.001
COPD	17	19.70	35	39.30	45	48.40	29	39.20	0.001
AF	3	3.40	9	10.10	17	18.30	19	25.70	0.001
DM	4	4.60	9	10.10	12	12.90	3	4.10	0.098
Surgery	24	27.90	13	14.60	6	6.50	9	12.10	0.001
Cancer	13	15.10	13	14.60	11	11.80	4	5.40	0.220
Drinking	23	26.70	19	21.30	25	26.90	18	24.30	0.809
Smoking	32	37.20	30	33.70	32	34.40	23	31.10	0.879

HPN: hypertension; COPD: chronic obstructive pulmonary disease; AF: atrial fibrillation; DM: diabetes mellitus.

### Results

#### Characteristics of the study population

A total of 342 patients with PE were included in this study, and average age of patients was  $71.4 \pm 12.1$  years old. Male subjects dominated in PE patients (58.5%). Patients presented a broad range of clinical symptoms. Among all symptoms, cough (68.1%), dyspnea (67.8%), hypoxia (64.3%) and tachypnea (62.9%) were most frequently observed in more than 60% of PE patients. Pleuritic pain (8.8%), syncope (13.5%) and hemoptysis (16.7%) occurred less frequently. PE patients with the following comorbidities were regarded at risk: hypertension (HPN, 44.2%), chronic obstructive pulmonary disease (COPD, 36.8%) and smoking (34.2%). Furthermore, 6.1% of patients including those with large PE have nonspecific symptoms or are asymptomatic (**Table 1**).

#### Subgroup analysis according to age quartile

The incidence of tachypnea and hypoxia increased along with the increase of age. Older patients with comorbidities of HPN, COPD and AF were more prone to PE. Surgery history in patients in the 14-64 years age group was

higher compared with patients in other groups (27.9%,  $P=0.001$ ; **Table 2**).

#### Subgroup analysis according to the appearance of dyspnea and cough

PE patients with dyspnea were more likely to concurrently have symptoms of tachypnea, hypoxia and cough; while patients without dyspnea had a higher incidence of syncope. PE patients with cough were more likely to be accompanied by symptoms such as dyspnea, tachypnea and hemoptysis; while PE patients without cough tended to experience syncope. Dyspnea and cough were more frequently observed in PE patients with COPD and smoking history. Moreover, more PE patients with surgery history had dyspnea compared with PE patients without surgery history (**Table 3**).

#### Subgroup analysis according to COPD and HPN

PE patients with COPD tended to have more symptoms compared with patients without COPD. However, a similar phenomenon was not observed in PE patients with HPN. In comparing PE patients with and without HPN, there were no significant differences in incidence among

## Clinical characteristics of pulmonary embolism

**Table 3.** Subgroup analysis according to the appearance of dyspnea and cough

Variable	With Dyspnea		Without Dyspnea		P	With Cough		Without Cough		P
	n=232	%	n=110	%		n=233	%	n=109	%	
Gender (Male)	139	60.00	61	55.50	0.434	151	64.80	48	44.00	0.001
Dyspnea						182	78.10	50	45.90	0.001
Tachypnea	205	88.40	10	9.10	0.001	183	78.50	32	29.40	0.001
Hemoptysis	40	17.20	17	15.50	0.679	54	23.20	3	2.80	0.001
Pleuritic pain	24	10.30	6	5.50	0.135	24	10.30	6	5.50	0.150
Syncope	23	9.90	23	20.90	0.005	19	8.20	27	24.80	0.001
Hypoxia	167	72.00	53	48.20	0.001	157	67.40	63	57.80	0.104
Cough	182	78.40	51	46.40	0.001					
Fever	52	22.40	27	24.50	0.662	63	27.00	16	14.70	0.013
HPN	97	41.80	54	49.10	0.205	94	40.30	57	52.30	0.032
COPD	115	50.00	11	10.00	0.001	119	51.10	7	6.40	0.000
AF	36	15.50	12	10.90	0.252	33	14.20	14	12.80	0.765
DM	16	6.90	12	10.90	0.206	14	6.00	14	12.80	0.030
Surgery	29	12.50	23	20.90	0.043	31	13.30	21	19.30	0.142
Cancer	27	11.60	14	12.70	0.772	30	12.90	10	9.20	0.334
Drinking	58	25.00	27	24.50	0.928	61	26.20	24	22.00	0.432
Smoking	89	38.40	28	25.50	0.019	91	39.10	26	23.90	0.007

HPN: hypertension; COPD: chronic obstructive pulmonary disease; AF: atrial fibrillation; DM: diabetes mellitus.

all symptoms, except for pleuritic pain and cough (**Table 4**).

### *Differences in symptoms, comorbidities and risk factors of PE patients with bilateral or unilateral thrombus in main pulmonary arteries and branches*

All patients with PE were divided into two groups according to the site of the thrombus (main pulmonary arteries or other arterial branches). In PE patients with either bilateral or unilateral thrombus in the main pulmonary artery, the percentage of symptoms and risk factors did not significantly differ. Slight differences in the distribution of symptoms and risk factors existed in PE patients with branch thrombus. In this group, patients that had prior surgery were more likely to have bilateral thrombus, while patients with COPD, HPN or smoking had a higher proportion of unilateral thrombus. In addition, more patients with unilateral branch thrombus presented with cough, compared with patients with bilateral branch thrombus (**Table 5**).

### **Discussion**

The present study evaluated clinical symptoms, comorbidities and risk factors in a Chinese PE

population. These results demonstrate that most PE patients experienced symptoms of cough, dyspnea, hypoxia and tachypnea; while pleuritic pain, syncope and hemoptysis occurred less frequently. Elderly patients were more likely to have symptoms of tachypnea and hypoxia. HPN, COPD and AF were more frequent in older patients than in younger ones. Furthermore, surgery rate was significantly higher in patients with bilateral thrombus than those with unilateral thrombus in pulmonary artery branches.

Different studies produced diverse results concerning major signs and symptoms in PE patients. The most common presenting symptom in our study was dyspnea, which is similar to previous studies [8, 17, 18]. However, conflicting findings were observed in some other studies, which revealed that pleuritic pain and hemoptysis were the most frequent mode of presentation in PE patients. Stein *et al.* claimed that the most common presenting symptom was dyspnea followed by pleuritic pain and cough [2]. A recent study indicated that most PE patients featured at least one of these four symptoms: sudden onset of dyspnea, chest pain, syncope and hemoptysis [7]. However, in the present study, fewer PE patients had pleuritic pain and hemoptysis. These differences

## Clinical characteristics of pulmonary embolism

**Table 4.** Subgroup analysis according to COPD and HPN

Variable	With COPD		Without COPD		P	With HPN		Without HPN		P
	n=126	%	n=216	%		n=151	%	n=191	%	
Gender (Male)	87	69.00	113	52.30	0.002	85	56.30	115	60.20	0.465
Dyspnea	115	91.30	117	54.20	0.001	97	64.20	135	70.70	0.205
Tachypnea	116	92.10	99	45.80	0.001	89	58.90	126	66.00	0.208
Hemoptysis	27	21.40	30	13.90	0.071	20	13.20	37	19.40	0.131
Pleuritic pain	9	7.10	21	9.70	0.416	7	4.60	23	12.00	0.016
Syncope	7	5.60	39	18.10	0.001	25	16.60	21	11.00	0.134
Hypoxia	94	74.60	126	58.30	0.002	102	67.50	118	61.80	0.269
Cough	119	94.40	114	52.80	0.001	94	62.30	139	72.80	0.032
Fever	30	23.80	49	22.70	0.812	32	21.20	47	24.60	0.457
HPN	46	36.50	105	48.60	0.030					
COPD						46	30.50	80	41.90	0.030
AF	14	11.10	34	15.70	0.234	24	15.90	24	12.60	0.379
DM	8	6.30	20	9.30	0.344	20	13.20	8	4.20	0.002
Surgery	7	5.60	45	20.80	0.001	24	15.90	28	14.70	0.752
Cancer	8	6.30	33	15.30	0.014	14	9.30	27	14.10	0.169
Drinking	35	27.80	50	23.10	0.339	43	28.50	42	22.00	0.168
Smoking	61	48.40	56	25.90	0.001	46	30.50	71	37.20	0.194

HPN: hypertension; COPD: chronic obstructive pulmonary disease; AF: atrial fibrillation; DM: diabetes mellitus.

**Table 5.** Differences in symptoms, comorbidities and risk factors of PE patients with bilateral or unilateral thrombus in main pulmonary arteries and branches

Variable	Thrombus in main pulmonary arteries				P	Thrombus in pulmonary arteries branches				P
	Bilateral thrombus		Unilateral thrombus			Bilateral thrombus		Unilateral thrombus		
	n=26	%	n=41	%		n=133	%	n=191	%	
Gender (Male)	15	57.70	29	70.70	0.273	68	51.10	122	63.90	0.022
Dyspnea	22	84.60	28	68.30	0.135	90	67.70	126	66.00	0.749
Tachypnea	17	65.40	28	68.30	0.805	81	60.90	121	63.40	0.611
Hemoptysis	4	15.40	10	24.40	0.377	21	15.80	33	17.30	0.724
Pleuritic pain	3	11.50	3	7.30	0.670	14	10.50	15	7.90	0.407
Syncope	4	15.40	4	9.80	0.489	19	14.30	23	12.00	0.554
Hypoxia	20	76.90	23	56.10	0.083	88	66.20	121	63.40	0.602
Cough	12	46.10	28	68.30	0.072	83	62.40	141	73.80	0.024
Fever	3	11.50	6	14.60	1.000	32	24.10	46	24.10	0.996
HPN	9	34.60	14	34.10	0.969	49	36.80	95	49.70	0.022
COPD	5	19.20	12	29.30	0.358	39	29.30	84	44.00	0.007
AF	4	15.40	9	22.00	0.508	16	12.00	27	14.10	0.583
DM	0	0.00	5	12.20	0.148	11	8.30	16	8.40	0.973
Surgery	6	23.10	7	17.10	0.545	26	19.50	22	11.50	0.045
Cancer	3	11.50	11	26.80	0.134	14	10.50	23	12.00	0.673
Drinking	6	23.10	15	36.60	0.245	29	21.80	50	26.20	0.367
Smoking	6	23.10	16	39.00	0.176	39	29.30	74	38.70	0.080

HPN: hypertension; COPD: chronic obstructive pulmonary disease; AF: atrial fibrillation; DM: diabetes mellitus.

may be explained by the different distributions of age and population.

Elderly patients had a higher tendency of having PE [19]. Our findings supported this con-

## Clinical characteristics of pulmonary embolism

cept, since the average age in the current study was  $71.4 \pm 12.1$  years old, and elder patients had a higher incidence of PE than younger ones. The greater rate among the elderly is partly due to their tendency to have increased procoagulant activity and more complicated medical conditions. Factors such as age, surgery, immobilization and other comorbid features also influenced the overall likelihood of venous thromboembolic comorbidities [20].

It is interesting that dyspnea, when presented in PE patients, was often accompanied by other symptoms like tachypnea, hypoxia and cough. A reasonable explanation was that PE was more likely to be incidentally detected when patients had obvious symptoms [21]. The prevalence of dyspnea in PE patients with COPD in this study was 91.3%, which was similar to a latest study [22]. The clinical diagnosis of PE in patients with COPD was often difficult due to the similarity of symptoms in these two conditions [22, 23]. Compared with PE patients without COPD, symptoms of dyspnea, tachypnea, hypoxia and cough were more often seen in PE patients with COPD. In addition, smoking history was related with a higher incidence of PE in patients with COPD. All these findings suggest that more attention should be given in COPD patients with smoking history, in whom PE would be easily underdiagnosed.

The timely detection of PE is an essential prerequisite of a prompt and effective treatment [3]. The current study indicates that clinical symptoms combined with risk factors may provide useful information in identifying highly susceptible PE patients, although clinical manifestations of PE were often nonspecific.

There are some limitations in this study. First, this is a single center study with a small sample size. These results may not be applicable in larger populations. Second, we did not investigate the etiology of PE in this retrospective study. Third, the relationship between the thrombus site and lower extremity DVT was not revealed. Therefore, further studies are necessary to validate the diagnostic value of these clinical characteristics.

### Conclusions

PE patients had nonspecific clinical signs or symptoms. Doctors should pay more attention on patients at-risk.

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### Disclosure of conflict of interest

None.

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## Clinical characteristics of pulmonary embolism

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