Pulmonary embolism: a difficult diagnostic problem

Andrzej Łabyk[1], Anna Kalbarczyk[1], Agata Piaszczyk[1], Maciej Kostrubiec[2], Anna Kaczyńska[2], Anna Bochowicz[1], Piotr Pruszczyk[2]

[1] Department of Internal Medicine, Hypertention and Angiology, Medical University, Warszawa, Poland

[2] Department of Internal Medicine and Cardiology, Medical University, Warszawa, Poland

Abstract: Introduction. The mortality of untreated pulmonary embolism (PE) is estimated at approximately 30% of patients, whereas treatment decreases it to 2–8%. A specific combination of symptoms present in PE may suggest other cardiac or lung disorders. **Objectives.** To evaluate frequencies of clinical symptoms and changes in results of diagnostic investigations misleading to the diagnosis of acute coronary syndrome (ACS) or lung diseases (Ld) in PE patients. **Patients and Methods.** Retrospective analysis of 154 records of individuals with recognized PE allowed to divide patients into groups suggestive of ACS (min. 2 of: chest pain, ischemic changes on electrocardiogram [ECG] and elevated cardiac troponin T level [cTnT >0.01 ng/ml]) or suggestive of the Ld (min. 2 of: dyspnea, cough, fever, lung consolidations on chest radiograph). **Results.** Fifty-five (36%) patients were classified to the ACS group and 54 (35%) to Ld group, while 69 (45%) patients were not included to either group. Twenty-four (16%) patients fulfilled the criteria of both groups. There were no significant differences in the frequency of coronary heart disease, heart failure, atrial fibrillation and chronic obstructive pulmonary disease between groups. Elevated troponin level was observed in 68% of patients with chest pain and changes on ECG, and in 26% of patients without coexistence of these symptoms ($p < 0.05$). **Conclusions.** In most patients with final diagnosis of PE, symptoms and initial investigation results can mislead to the diagnosis of ACS or lung disease. The chest pain and ischemic changes on ECG are frequently associated with the myocardial injury resulting in increased troponin levels in PE patients.

Key words: acute coronary syndromes, diagnosis lung diseases, pulmonary embolism, troponin

INTRODUCTION

The mortality of untreated pulmonary embolism (PE) is estimated at approximately 30% of patients, whereas an appropiate treatment decreases it to 2–8% [1]. Therefore, it is of great importance to establish the prompt and accurate diagnosis of PE. The clinical symptoms of PE are often nonspecific.

The most frequent symptoms of PE are: dyspnea (80%), tachypnea (70%), pleuritic chest pain (52%), tachycardia (26%), cough (20%), syncope (19%), objective evidence of deep-vein thrombosis (15%), chest pain (12%), cyanosis (11%), hemoptysis (11%) and fever (7%) [2,3]. A specific combination of these symptoms may suggest other cardiac or lung disorders.

The aim of the present study was to evaluate the prevalence of clinical symptoms and abnormalities in diagnostic investigations that mislead to the recognition of acute coronary syndrome (ACS) or lung diseases (Ld) in PE patients.

Correspondence to:
prof. dr hab. med. Piotr Pruszczyk, Klinika Chorób Wewnętrznych i Kardiologii, ul. Lindleya 4, 02-005 Warszawa, Poland, phone: +48-22-502-11-44, e-mail: piotr.pruszczyk@amwaw.edu.pl
Received: March 8, 2007. **Accepted in final form:** April 27, 2007.
Conflict of interest: none declared
Pol Arch Med Wewn. 2007; 117 (3): 68-72

PATIENTS AND METHODS

Retrospective analyses of medical records of individuals with recognized PE confirmed by typical findings from contrast- enhanced spiral CT scanning (sCT) or by high- probability lung scintigraphy. A total of 145 consecutive patients (89 women, 64 men; mean age 62 ±17 years) admitted to Department of Internal Medicine, Hypertention and Angiology in Warsaw between 1999 and 2005, diagnosed with acute PE were included in the study.

A frequency of clinical symptoms: chest pain suggestive of angina pectoris, dyspnea, fever, cough and hemoptysis were obtained on admission. Pathological changes in serial 12 – lead electrocardiograms were recorded such as signs of myocardial ischemia (T – wave inversion in precordial leads, ST – depression more than 1 mm at least in two leads), atrial fibrillation (AF) and right bundle branch block (RBBB). Chest radiographs were evaluated for the presence of pulmonary consolidations.

Blood samples were collected from 115 patients at hospital admission to determine cTnT concentrations. Cardiac TnT levels were measured quantitatively (electrochemiluminescence method, ECLIA, Roche). Detectable concentrations of cTnT >0.01 ng/ml were regarded as indicating myocardial injury.

The presence of comorbidities such as coronary heart disease (CHD), heart failure (HF) and chronic obstructive pul-

monary disease (COPD) also were assessed in the study.

Patients were divided into groups suggestive of ACS (at least 2 of 3 symptoms: chest pain, signs of myocardial ischemia on ECG, elevated level of cardiac troponin T) or suggestive of Ld (at least 2 of 4 symptoms: dyspnea, fever, cough, lung consolidations on chest radiogram). The third group consisted of the patients, who not fulfilled the criteria for the ACS or Ld groups.

According to the European Society of Cardiology (ESC) guidelines [4], on the basis of clinical course and echocardiographic signs of RV overload, patients were identified as having massive PE with systolic blood pressure (SBP) <90 mmHg, submassive PE with SBP >90 mmHg and echocardiographic signs of RV overload and non-massive PE with SBP >90 mmHg without RV overload.

Data of a normal distribution are expressed as mean values followed by standard deviation. Parameters with a non-normal distribution are expressed as a median with range. The Student`s t – test or Mann-Whitney test were used to compare the two groups and the Kruskal-Wallis test to compare more than 2 groups. The chi^2 test was used to compare discrete variables. A p-value of <0.05 was considered statistically significant.

Table 1. Clinical symptoms and relevant findings in a Patient Population

Symptoms	n = 154
Dyspnea	140 (91%)
Chest pain (thoracic pain)	74 (48%)
Cough	46 (30%)
Fever	18 (12%)
Medical history	
Coronary artery disease	45 (29%)
Heart failure	28 (18%)
COPD	17 (11%)
Laboratory abnormalities	
T-wave inversion	80 (52%)
cTnT (>0,01 ng/ml)	66 (43%)
Consolidation HRCT/ChR	51 (33%)
Right bundle branch block	31 (20%)
Atrial fibrillation	15 (10%)

cTnT – cardiac troponin T, HRCT – high resolution computer tomography, COPD – chronic obstructive pulmonary disease, ChR – chest radiograph

RESULTS

Most of patients complained of dyspnea at enrollment (91%; tab. 1). Other signs and symptoms were either rare or irrelevant and included: chest pain (48%), cough (30%), fever (12%).

Comorbidities were present in 58 patients and included: coronary heart disease in 43 (29%) patients, chronic HF in 28 (18%), COPD in 17 (11%). Massive PE was diagnosed in 5 (3%) patients, non-massive PE in 28 (18%) and submassive PE in 121 (79%) patients.

The ECG abnormalities were present in 108 (67%) patients and included: inverted T wave in precordial leads in 78 (52%) patients and ST – depression in 15%. ST – depression (>1 mm) at least in 2 leads were recorded in 10 patients. Other electrocardiographic changes such as the S1S2S3 pattern (9 patients), S1Q3 pattern (37 patients), RBBB in 28 (20%) and atrial fibrillation in 11 (10%) patients were found. The ECG showed no abnormalities in 37 (24%) subjects.

Cardiac troponin T was elevated (cTnT >0.01 μg/ml) in 43% patients on admission.

55 (36%) patients were included to the ACS group. The coexistance of chest pain, ECG changes and elevated level c TnT was observed in 19 patients (fig. 1). There was one case of a 67-year-old woman with severe chest pain and cTnT = 0.042 ng/ml; coronary angiography was performed, but there was no abnormalities in coronary arteries. Submassive PE was confirmed.

In group with symptoms suggesting ACS, coronary artery disease coexisted in 18 patients, additionally in 8 patients chronic heart failure was diagnosed. Among these, more frequently than in others patients with PE, RBBB was present (20 [34%] vs 8 [9%], p < 0,05). Massive PE was diagnosed in 3 (2%) patients, non – massive PE in 5 (3%) and submassive PE in 47% (31%).

54 (35%) patients were included to the Lg group. Pulmonary consolidations on chest radiographs were observed in 30 (19%) patients, dyspnea with cough, fever and pulmonary consolidations on chest radiographs in 2; a combination of 3 of 4 criteria for this study group were identified in 10 patients and coexisting of 2 of 4 criteria in 42 patients (tab. 2). Six patients were suffering from lung disease (Ld). Interestingly, 31 of the patients from this group had inverted T wave in ECG, atrial fibrillation was in 5 patients, RBBB in 11. Among the Ld group, there were more patients with submassive PE than in other patients with PE (9 [30%] vs 18 [15%], p = 0.06).

24 (16%) patients fulfilled the criteria of the ACS and Ld groups.

Sixty-nine (45%) patients were not included to either group. Investigated abnormalities occurred in some patients in this group. Dyspnea occurred in 57 patients. The ECG changes like T-wave invertion was present in 19. No significant differences in the frequency of atrial fibrillation, coronary heart disease, HF and COPD were observed between predefined groups and other patients with PE. Foorteen (9%) patients were diagnosed as having non-massive PE, and 55 (36%) submassive PE. Massive PE was not diagnosed in this group.

Elevated level cTnT was observed in 68% patients with chest pain, signs of myocardial ischaemia in ECG in compared

Table 2. Number of patients among Ld group depends on fulfilled criteria

Symptoms among patients with Ld	number of patients
Fever + cough	1 (0,7%)
Fever + dyspnea	4 (3%)
Fever + infiltration	3 (2%)
Dyspnea + cough	15 (10%)
Dyspnea + consolidation	19 (12%)
Cough + consolidation	0 (0%)
Dyspnea + cough + fever	4 (3%)
Dyspnea + cough + consolidation	4 (3%)
Dyspnea + consolidation + fever	2 (1%)
Cough + consolidation + fever	0 (0%)
All four symptoms	2 (1%)
Total	54 (35%)

Ld – lung disease

with 26% of the remaining patients, p <0.05 (fig. 2). Elevated level cTnT was also observed in this group, p <0.05 (fig. 3).

DISCUSSION

An appropiate diagnosis playsa main role in the PE because determines a correct treatment and leads to the reduction of mortality [1]. Even in 80% of subjects with PE proved at autopsy have antemortem diagnosis [1]. Patients with PE at hospital admission more often complain of dyspnea (80%) and chest pain (64%) [2,3]. The clinical symptoms of PE are non-

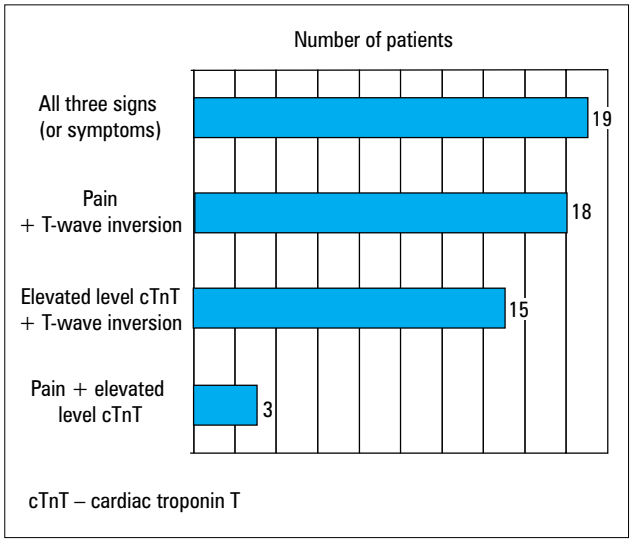

Fig. 1. The frequency distribution of some abnormalities among patients with symptoms suggesting acute coronary syndrome (ACS)

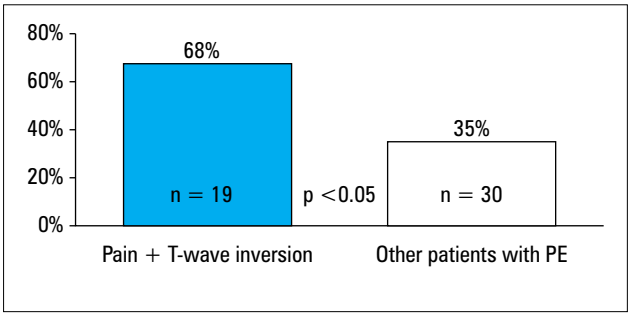

Fig. 2. The percentage of patients with elevated cTnT. Abbreviations: PE – pulmonary embolism

specific and can mislead to the inappropiate diagnosis. In our study, symptoms suggestive ACS or Ld were presentin 55% of patients with PE. In 36% of patients, on admission there were at least 1 of 2 symptoms: chest pain, sign of myocardial ischemia on ECG and elevated level troponin T, that met the criteria for the ACS. Acute right ventricular pressure overload in PE can lead to myocardial injuryand the release of cTnT in 30–40% of patients [5,6]. Therefore, elevated levels of myocardial ischemia indicators may not distinguish between PE and ACS. In some cases echocardiography is a useful tool to confirm right ventricular dysfunction and hypokinesis which are typical of PE.

Elevated cTnT levels in patients with PE indicate a high-risk group that require accurate monitoring and probably more aggressive treatment [8,9].

Elevated cardiac troponin level was observed significantly more frequently in patients with chest pain and signs of myocardial ischaemia on ECG [10]. Among patients with PE, the most frequent symptom was dyspnea, that is nonspecific and can occur both in lung disease and heart disease. The prevalence of 2 out of 4 symptoms (dyspnea, fever, cough, pulmonary consolidations on chest radiogram) suggestive pneumonia were found in 27% of patients. Pulmonary congestions on chest radiographs that can be a sign of pulmonary infarction were observed in 15% of patients with PE [11,12]. Dyspnea that was associated with pulmonary congestion on chest radiogram was found in 12% of all patients in the present study. These clinical symptoms and signs suggesting pneumonia led to treatment with antibiotics. It seems that differentiation between lung disease and PE is important especially during nonspecific lung disease, clinical symptoms and absence of evidence of deep-vein thrombosis.

In such cases, measurement of plasma B-type natriuretic peptide concentrations appears to have clinical utility by helping to exclude a diagnosis of heart diseases in patients with dyspnea [13].

In this study, submassive PE was diagnosed in 75% of all patients. Interestingly, there were more patients with submassive PE among the lung diseases group than among other patients with PE. Thus, it appears to confirm the presence of clinical expierences of moderate PE underlying the lung disease.

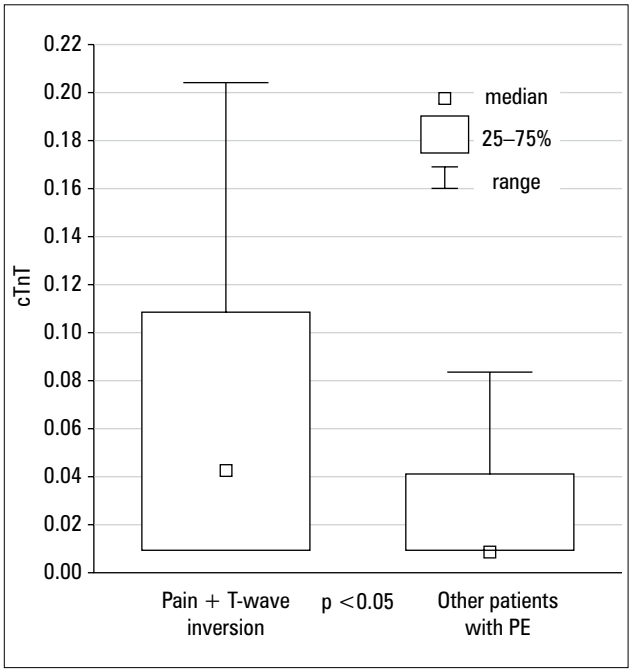

Fig. 3. Box-whisker plot of cTnT in study group

Most patients with chest pain, ECG abnormalities and elevated cTnT levels on admission, probably have ACS, and patients with cough, dyspnea and pulmonary consolidations on chest radiograph have pneumonia. The study group does not allow to estimate the frequency PE in these groups. In the present study, the frequency clinical symptoms suggesting ACS or lung disease was analysed in patients with PE. It is unknown how often diagnosis of PE is misslead and how often PE is treated like mentioned diseases. It is difficult to estimate this number because some episodes of thrombosis can resolve without anticoagulation and moreover, heparin is an appropriate treatment in ACS.

Pulmonary embolism is recognized in 20% of cases seen at necropsy [14,15]. It appears that the incidence of clinically diagnosed pulmonary embolism is significantly higher because patients, in whom PE was diagnosed and undergone appropriate treatment, survived. These data indicate how important is distinguishing heart disease and lung disease from pulmonary embolism. In most patients with final diagnosis of acute PE, symptoms and initial investigation results can mislead to the diagnosis of ACS or lung disease. In patients with chest pain and ECG abnormalities during acute PE, myocardial injury with release cardiac troponin occur more frequently.

Horizontal line in box: 50th percentile (median); limits of box: 25th and 75th percentile; whiskers: 10th and 90th percentile

ACKNOWLEDGEMENT

This study was partly supported by grant 2PO 5B 06 927.

REFERENCES

1. Goldhaber SZ, Visani L, De Rosa M. Acute pulmonary embolism: clinical outcomes in the International Cooperative Pulmonary Embolism Registry (ICOPER). Lancet.1999; 353: 1386-1389.
2. Palla A, Petruzzelli S, Donnamaria V, et al. The role of suspicion in the diagnosis of pulmonary embolism. Chest. 1995; 107: 21S-24S.
3. Miniati M, Prediletto R, Formichi B, et al. Accuracy of clinical assessment in the diagnosis of pulmonary embolism. Am J Respir Crit Care Med. 1999; 159: 864-871.
4. Torbicki A, Van Beek ERJ, Charbonnier B, et al. Guidelines on diagnosis and management of acute pulmonary embolism. Eur Heart J. 2000; 21: 1302-1336.
5. Konstantinides S, Geibel A, Olschewski M, et al. Importance of cardiac troponins I and T in risk stratification of patients with acute pulmonary embolism. Circulation. 2002; 106: 1263-1268.
6. Giannitsis E, Muller-Bardorff M, Kurowski V, et al. Independent prognostic value of cardiac troponin T in patients with confirmed pulmonary embolism. Circulation. 2000; 102: 211-217.
7. Pruszczyk P, Szulc M, Horszczaruk G, et al. Right Ventricular Infarction in a Patient With Acute Pulmonary Embolism and Normal Coronary Artery. Arch Intern Med. 2003; 163: 1110-1111.
8. Pruszczyk P, Bochowicz A, Torbicki A, et al. Cardiac troponin T monitoring identifies high-risk group of normotensive patients with acute pulmonary embolism. Chest. 2003; 123: 1947-1952.
9. Kostrubiec M, Pruszczyk P, Bochowicz A, et al. Biomarker-based risk assessment model in acute pulmonary embolism. Eur Heart J. 2005; 26: 2166-2172.
10. Kaczyńska A, Bochowicz A, Kostrubiec M, et al. Elektrokardiografia i ocena ryzyka uszkodzenia mięśnia serca u pacjentów z zatorowością płucną. Pol Arch Med Wewn. 2004; 112: 1039-1046.
11. Elliott CG, Goldhaber SZ, Visani L, et al. Chest radiographs in acute pulmonary embolism. Results from the International Cooperative Pulmonary Embolism Registry. Chest. 2000; 118: 33-38.
12. Cayley WE Jr. Diagnosing the causa of chest pain. AM Fam Physician. 2005; 72: 2010-2021.
13. Cowie MR, Jourdain P, Maisel A, et al. Clinical applications of B-type natriuretic peptide (BNP) testing. Eur Heart J. 2003; 24: 1710-1718.
14. Gillum RF: Pulmonary embolism and thrombophlebitis in the United States, 1970–1985. Am Heart J. 1987; 114: 1262-1264.
15. Karwinski B, Svendsen E. Comparison of clinical and postmortem diagnosis of pulmonary embolism. J Clin Pathol. 1989; 42: 135-139.