

ORIGINAL ARTICLE

Medicine Science 2020;9(3):569-72

An examination of forensic autopsy cases with pulmonary embolism

** Ahmet Sedat Dunder¹,  Mucahit Oruc¹,  Ismail Altin¹,  Bedirhan Sezer Oner²,
 Semih Petekkaya³,  Emine Turkmen Samdanci⁴,  Osman Celbis¹**

¹Inonu University Faculty of Medicine Department of Forensic Medicine, Malatya, Turkey²Amasya University Faculty of Medicine Department of Forensic Medicine, Amasya, Turkey³Canakkale 18 Mart University Faculty of Medicine Department of Forensic Medicine, Canakkale, Turkey⁴Inonu University Faculty of Medicine Department of Pathology, Malatya, Turkey

Received 10 February 2020; Accepted 10 April 2020

Available online 16.05.2020 with doi: 10.5455/medscience.2020.09.9231

Abstract

The aim of this study was to examine the frequency, origin, histopathology, and risk factors of PE, the vascular characteristics causing obstruction and the direct or indirect effect on mortality. A retrospective examination was made of autopsies conducted between 2013 and 2016 in the Malatya Forensic Medicine Group Directorate. Cases determined with PE were evaluated in respect of age, gender, event origin, risk factors, history of hospitalization, size of the vessels obstructed by the thromboembolism and histopathological examination. Pulmonary embolism is a frequently seen complication during hospitalization and is one of the leading causes of preventable hospital deaths. When advanced diagnostic methods are used, deep vein thrombosis is determined in 79% of PE patients. The annual incidence in Turkey is approximately 15/10,000 cases, which is comparable to rates in western populations. Although PE is seen more at advanced ages, attention must be paid to young cases with trauma-related injuries. Histopathological examination is of the greatest importance as the mortality rate associated with large vessel obstruction is high and obstructions in small vessels alone also contribute to mortality.

Keywords: Autopsy, death, pulmonary thromboembolism, risk factors**Introduction**

Pulmonary thromboembolism (PTE) is a clinical table that forms as a result of obstruction, often of thrombus and less often of fat particles, amniotic fluid, air, neoplastic cells or foreign matter [talc binding to intravenous drugs, catheter particles in cases applied with various intravenous drugs, etc] [1, 2-4]. The most common source of PTE is thrombus pieces forming in the deep veins [2, 3]. These thrombi settle in the pulmonary artery branches or sometimes in the main pulmonary artery or in the right side of the heart [2]. In more than 90% of cases, the source of the thrombus is lower extremity deep veins, primarily the iliac, femoral and popliteal veins [2, 4]. Occasionally, thrombus developing in the left ventricle following myocardial infarct (MI), in the tricuspid valve, the pulmonary valve, or in the right atrium following endocarditis, may be the source of the embolism [5-7].

Venous stasis, vascular wall damage and hypercoagulability may be found in the etiopathogenesis of thrombus [6, 8]. Following pulmonary thromboembolism, dead-space ventilation develops as a result of vascular obstruction, then bronchoconstriction in the terminal bronchioles associated with histamine-serotonin expression, impairment in ventilation/perfusion, reduced diffusion and hypoxemia as a result of shunt [8]. Risk factors for PTE include surgical intervention within the previous 4 weeks, immobilisation (bedrest lasting 2 days or longer within the previous 4 weeks), trauma within the previous 3 months, a history of DVT/PTE, obesity, malignancy (newly diagnosed cases, those receiving treatment, those treated within the previous 6 months, those receiving palliative care), stroke, coronary artery disease, heart failure, cigarette smoking and hypertension [9, 10]. In young PTE cases, pregnancy, the use of oral contraceptives, and genetic thrombophilia are also seen as risk factors [11]. In up to 20% of cases, no known risk factor can be determined [12].

The aim of this study was to investigate the risk factors contributing to PTE, and whether or not PTE contributes directly or indirectly to mortality.

***Corresponding Author:** Ismail Altin, Inonu University Faculty of Medicine Dean's Office Building 1st Floor Forensic Medicine Department Battalgazi / Malatya, Turkey E-mail: drsmilt@gmail.com

Materials and Methods

A retrospective evaluation was made of the records of 2421 autopsy cases performed between 1 January 2013 – 1 January 2017 in the Malatya Forensic Medicine Group Directorate. In the cases determined with PTE, hospital documents were examined, together with the autopsy reports, histopathology reports, scene of crime reports prepared by the police or armed forces, witness reports and defendant statements. Any cases with a doubtful diagnosis or those diagnosed with PTE with insufficient information in the records were excluded from the study.

Evaluations were made of the sociodemographic data, complaints on presentation, imaging methods, underlying cause of the PTE, medical history, bone fractures, history of surgical intervention and hospitalisation, the size of obstructed vessels (large/medium/small vessels), the localisation of the obstructed vessel (right/left AC) and cause of death.

The cases were grouped as young (< 40 years) and elderly (>65 years) according to the World Health Organisation (WHO) criteria. When evaluating body mass index (BMI), the WHO criteria were applied (obesity >30).

Results

A total of 20 cases were determined with PTE as a result of a medicolegal autopsy applied for forensic reasons. The incidence of PTE was 0.8% of the examined records. The 20 patients comprised 11 (55%) females and 9 (45%) males, with a mean age of 60 years (range, 26 - 90 years). According to the WHO criteria, 6 (30%) patients were young and 14 (70%) were elderly. The mean BMI value of all the cases was 29.02, with 13 (65%) cases determined as overweight.

The reasons for autopsy were classified as traumatic and non-traumatic. In 13 cases, the reason was traumatic, and in 7, non-traumatic (Table 1).

Table 1. Reasons for Autopsy of the Cases

REASON FOR AUTOPSY			
Traumatic Reasons	No of cases	Non-Traumatic Reasons	No of cases
1. Traffic accidents	7 (%35)	1. Suspicious death (on a long journey, drug use, malignancy)	6 (%30)
2. Suspicious death (found dead at home)	3 (%15)	2. Malpractice (Malignancy)	1 (%5)
3. Explosion	1 (%5)		
4. Fall	1 (%5)		
5. Sharp instrument trauma	1 (%5)		
Total	13	Total	7

In the evaluation of the risk factors, all the cases were seen to have more than one risk factor. Immobilisation was seen in 15 cases, advanced age in 14, and obesity and trauma history in 13 (Table 2).

Table 2. Distribution of Cases according to Risk Factors

Socio-Economic Status	No of cases
1. Immobilisation	15
2. Advanced age (>65 years)	14
3. Obesity (BMI >30)	13
4. Trauma	13
5. Surgical intervention	9
6. Drug use	3
7. Malignancy	2
8. Diabetes Mellitus	7
Hypertension	7
9. Cardiovascular system diseases	
Coronary Artery Disease	4
Myocardial Infarct	3
Heart failure	3

In the lower extremity dissection applied in the autopsy, thrombus was not determined macroscopically in 14 (70%) cases.

Macroscopic thrombus was determined in the bilateral lower extremity veins in 3 (15%) cases and in the deep veins of the left leg in 3 (15%) cases.

As a result of histopathological examination, thrombus was seen to have formed an obstruction in both pulmonary veins in 15 (75%) cases, and in the right pulmonary vein in 5 (25%) cases. The lumen of the vein where the thrombus was located were determined to be completely obstructed in 13 (65%) cases and partially obstructed in 7 (35%) cases.

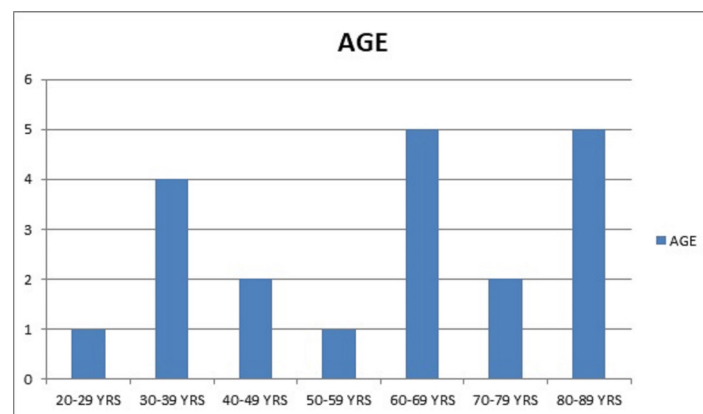


Figure 1. Distribution of the Ages of the Cases

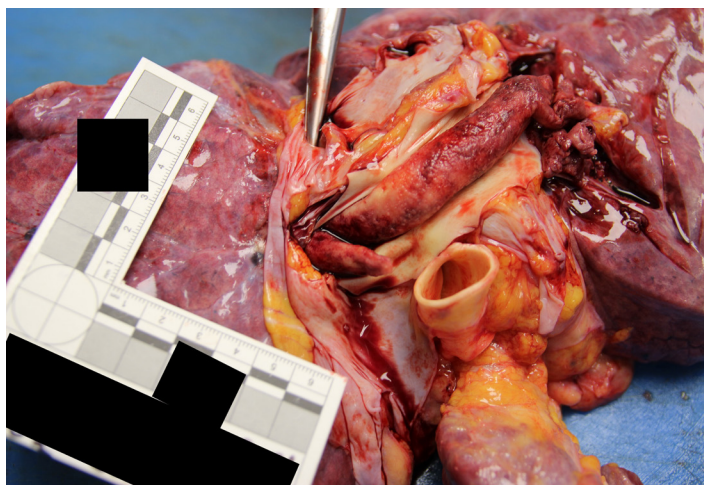


Figure 2. Thrombus completely obstructing the lumen in the left pulmonary artery



Figure 3. Microscopic appearance of pulmonary emboli

Discussion

Cardiovascular diseases are the most frequent cause of death worldwide, and PTE is the third most common acute cardiovascular disease after MI and stroke [13]. However, as non-specific clinical findings are seen in PTE, which has high morbidity and mortality rates, the real incidence is not known [14]. The PTE rate was reported as 1.95% in a study of 23,892 autopsies in Budapest [15], as 3.8% in a study of 7661 autopsies and as 4% in another study in Brazil [16], and as 2.5% in a study in China [17]. Unlike previous studies in literature, the rate of PTE determined in the current study was seen to be low. This was thought to be due to the success of anticoagulant therapy applied after surgery, and the high death rate associated with firearms injuries, which are a frequent reason for autopsies performed in our centre.

Previous studies have shown more risk factors in females and therefore a higher incidence of PTE. Consistent with these findings in literature, the rate was seen to be higher (55%) in the current study [15, 16, 18, 19]. The incidence of PTE increases associated with the increase in comorbidities in the later decades of life. However, PTE may also develop associated with complications at an earlier age, when the risk of trauma is higher [14]. The cases in the current study were in the age range of 26-90 years, with the mean age determined as 60 years, which was consistent with

literature [15, 16, 18].

The immobilisation, surgery and antithrombotic prophylaxis of patients presenting at hospital as a result of trauma are known to increase the risk. In a study of 141 patients, the most frequently seen risk factors were reported as immobilisation and recent surgery in both young and elderly age groups [16]. In contrast, a study conducted in Budapest determined no significant difference between a trauma group and a natural death group. It was also reported that an increase in the incidence of obesity and malignancy in both groups did not significantly affect the severity of PTE [15]. In the 13 cases of the current study who presented as a result of trauma, the most important risk factors in the development of PTE were thought to be the mean 11.2 days hospitalisation within the previous month and bone fractures in 12 cases, and surgical intervention in 9 cases.

PTE, which affects the prognosis of patients treated in hospital and can progress to be fatal, is a frequently encountered complication in hospital admissions and is one of the most important causes of preventable hospital deaths [13, 14]. While the incidence of PTE is 6%-15% of all hospital deaths, in the presence of hemodynamic imbalance or comorbidities, this risk has been reported to rise to 20%-30% [20]. Parallel to this, a previous study reported that in 76.3% of PTE cases, at least 2 comorbidities were diagnosed [16]. In the current study, 3 diagnoses in addition to PTE were determined in 4 (20%) cases, 2 additional diagnoses were determined in 5 (25%) cases and 1 in 4 (20%) cases. Of the high rate (65%) of obesity in the current cases, cardiovascular disease was determined in 13 (65%), DM in 7 (35%), antipsychotic drug use for psychotic disorder in 3 (15%), and malignancy in 2 (10%) cases.

According to literature, there is evidence of DVT in the lower extremity of approximately 79% of PTE cases, and pulmonary embolisation has been reported in 50% of DVT patients [21]. In a small-scale study of 8 autopsy cases with postmortem MR images, the lower extremity veins were examined and these were determined to be the thrombus source as a result of autopsy in 3 cases and as a result of MRI in 6 cases [22]. In another study, DVT was diagnosed at the rate of 18.2% and this was reported to be low compared to literature [23]. Similarly, the 30% rate of DVT diagnosis in the current study was determined to be low. This was attributed to the difficulties experienced in the determination of thrombus, despite dissection having been performed very carefully (differentiation between postmortem clotting and clots embolized at the vital level).

As a multifactorial disease, PTE cases also have many risk factors. The vast majority of cases admitted to intensive care units in particular have multiple risk factors [24]. Moreover, just as PTE in isolation may be a cause of death, it can also lead to mortality together with chronic disease, trauma and mobilisation [25]. If there is any pulmonary or cardiovascular disease in cases developing PTE, even if the cross-sectional area of the artery where the obstruction has formed is small, the pathophysiological changes that occur can lead to very serious outcomes [24]. The clinical table of the patient varies according to the presence of cardiopulmonary disease, the extent of the pulmonary vascular obstruction, and the number, size and localisation of clots [25].

Conclusion

When performing autopsies on cases with PTE risk factors, there must be careful examination of the lungs, and veins must be more carefully examined in respect of PTE. Sensitivity must be shown when opening the pulmonary vessels during the autopsy, and care must be taken that the fragmentation of the thrombus is not confused with postmortem coagulation. In cases determined with PTE during autopsy, the deep calf veins must be dissected and examined in respect of thrombosis. For pathological examination of the lungs, more samples should be taken from the main vessels and around the hilus in particular, and these must be carefully evaluated.

Although individuals with cardiac diseases are at risk of PTE, patients with mortality due to traumatic causes and those who have been immobile and medically treated for a lengthy period must also be carefully examined in respect of PTE.

In conclusion, from the results of this study with a limited number of cases, it is thought that in forensic cases with increased risk factors there will be an indirect increase in the frequency of PTE observed. It is also thought that the obstruction of large/medium-sized vessels by the clot that has developed, and the extent of the obstructed vessel lumen directly increase the mortality rate.

Conflict of interests

The authors declare that they have no conflict of interest and any financial disclosures.

Financial Disclosure

This study was supported by Inonu University scientific research project.

Ethical approval

Our study was conducted with the permission of The Ethics Committee of The Inonu University Medical Faculty and The Istanbul Forensic Medicine Institute.

References

- Davidson BL. Risk assessment and prophylaxis of venous thromboembolism in acutely and/or critically ill patients. *Haemostasis* 2000;30:77-81.
- Wagenvoort CA. Pathology of pulmonary thromboembolism. *Chest*. 1995;107:10-7.
- Wittram C, Maher MM, Yoo AJ, et al. CT angiography of pulmonary embolism: Diagnostic criteria and causes of misdiagnosis. *Radiographics*. 2004;24:1219-38.
- Guidelines on the diagnosis and management of acute pulmonary embolism. Task Force on Pulmonary Embolism, European Society of Cardiology. *Eur Heart J*. 2014;30:33-73.
- Schonhofer B and Kohler D. Prevalence of deep venous thrombosis of the leg in patients with acute exacerbated COPD. *Pneumologie*. 1999;53:10-4.
- Kollef MH, Zahid M, Eisenberg MR. Predictive value of a rapid semiquantitative D-dimer assay in critically ill patients with suspected venous thromboembolic disease. *Crit Care Med*. 2000;28:414-20.
- Gosselin MV, Rubin GD, Leung AN, et al. Unsuspected pulmonary embolism: prospective detection on routine helical CT scans. *Radiology*. 1998;208:9-215.
- Torbicki A, Van Beek EJR, Charbonnier B, et al. Guidelines on diagnosis and management of acute pulmonary embolism *Eur Heart J*. 2000;21:1301-36.
- Palevsky HL, Kelly MA, Fishman AP. Pulmonary thromboembolic disease. In: Fishman AP, ed. *Fishman's Pulmonary Diseases and Disorders*. 3rd ed. New York: Mc Graw-Hill. 1998:1297-329.
- Arseven O. Akut pulmoner embolizm. Türktaş H, Ekim N, eds. *Göğüs Hastalıkları Acilleri*. Ankara: Bilimsel Tıp, 2000;247-65.
- British Thoracic Society Standards of Care Committee Pulmonary Embolism Guideline Development Group. British thoracic society guidelines for the management of suspected acute pulmonary embolism. *Thorax*. 2003;58:470-84.
- Torbicki A, Perrier A, Konstantinides S, et al. Guidelines on the diagnosis and management of acute pulmonary embolism: The Task Force for the Diagnosis and Management of Acute Pulmonary Embolism of the European Society of Cardiology (ESC) (practice guideline). *Eur Heart J*. 2008;29:2276-315.
- Anderson FA, Wheeler HB, Goldberg RJ, et al. The significance of critical care errors in causing preventable death in trauma patients in trauma system. *J Trauma*. 1991;31:813-9.
- Palla A, Petruzelli S, Donnamaria V et al. The role of suspicion in the diagnosis of pulmonary embolism. *Chest*. 1995;107:21-4.
- Törő K, Pongrácz R, Bartholy J, et al. Evaluation of meteorological and epidemiological characteristics of fatal pulmonary embolism. *Int J Biometeorol*. 2016;60:351-9.
- Ruppert ADP, Soeiro AM, Almeida MCF, et al. Clinical manifestations and pulmonary histopathological analysis related to different diseases in patients with fatal pulmonary thromboembolism: an autopsy study. *Emerg Med*. 2014;6:15-21.
- Yun JL and Li XY. Prevalence of pulmonary embolism at autopsy among elderly patients in a Chinese general hospital, *J Geriatr Cardiol*. 2016;13:894-8.
- Yakar A, Yakar F, Ziyade N, Yıldız M, Üzün İ. Cardiac Findings of Pulmonary Thromboembolism by Autopsy: A Review of 48 Cases, *Med Sci Monit*. 2016;22:1410-4.
- Yakar A, Yakar F, Ziyade N, et al. Fatal pulmonary thromboembolism, *Eur Rev Med Pharmacol Sci*. 2016;20:1323-6.
- Goldhaber SZ, Visani L, De Rosa M. Acute pulmonary embolism: clinical outcomes in the International Cooperative Pulmonary Embolism Registry (ICOPER). *Lancet*. 1999;353:1386-9.
- Anderson FA, Wheeler WB, Goldberg RJ, et al. A population-based perspective of the hospital incidence and case-fatality rates of deep vein thrombosis and pulmonary embolism. The Worcester DVT study. *Arch Int Med*. 1991;151:933-8.
- Jackowski C, Grabherr S, Schwendener N. Pulmonary thromboembolism as cause of death on unenhanced postmortem 3T MRI, *Eur Radiol*. 2013;23:1266-70.
- Ramzi DW and Leeper KV. DVT and pulmonary embolism: Part I. Diagnosis *Am Fam Physician*. 2004;69:2829-36.
- Cook DJ, Crowther MA, Meade MO, et al. Prevalence incidence, and risk factors for venous thromboembolism in medical-surgical intensive care unit patients. *J Crit Care*. 2005;20:309-13.
- Manganelli D, Palla A, Donnamaria V et al. Clinical features of pulmonary embolism. *Chest*. 1995;107:25-3.