

Does the Incidence and Mortality of Pulmonary Thromboembolism Change Over the Years?

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Abstract

OBJECTIVES: In the last 20 years, with the use of computed tomography (CT) angiography, the number of patients diagnosed with pulmonary thromboembolism (PTE) has increased. At the same time, data show that pulmonary embolism mortality has also reduced in this duration.

MATERIAL AND METHODS: In this study, we analyzed records of patients with PTE (using ICD's) in the hospital automation system from 2001 to 2013. Data regarding age, sex, date of diagnosis, diagnosis of cancer, hemodynamic status, initial and maintenance treatment, hospital length of stay, and hospital mortality were recorded. Primary endpoints of the study were hospital length of stay and all-cause hospital mortality.

RESULTS: The total number of patients included in the study was 1185. The median age was 61 years in 2001 and 71 years in 2013. The number of patients who were diagnosed using CT increased from 10% to 92.8%. Between 2001 and 2013, the number of patients diagnosed with PTE increased, and of all patients with PTE, 13.7% was diagnosed in 2009. The hospital length of stay of 13 days declined to 9 days. The use of a vena cava filter in 2007 was 1.1% and that in 2013 was 4.6%. Mortality rate was 15%, however hospital mortality did not significantly differ over the years but varied between 9.4% and 18.8%. Increased use of thrombolytics in patients with massive PTE has been observed over the years. Massive PTE ratio in 2006 was 8.5% and thrombolytic use was 5.8%, however in 2013, these ratios were 2.6%, 6% respectively ($p=0.017$).

CONCLUSION: Finally, despite the increased number of patients diagnosed with PTE over the years, the mortality rate was not observed to have changed from 2001 to 2013.

KEYWORDS: Pulmonary thromboembolism, heparin, thrombolytic, mortality, incidence

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INTRODUCTION

Pulmonary thromboembolism (PTE) is an important public health concern that causes mortality and morbidity. Its non-specific symptoms and findings lead to difficulties in confirming its diagnosis. However, with the use of computed tomography (CT) angiography in recent years, an important step has been taken in the diagnosis of PTE. Moreover, improvements, such as the development of new anticoagulants and mechanical interventions, have occurred in the treatment of PTE. In parallel with all these improvements, data on the incidence and outcomes of the disease seems to be restricted.

In a study conducted in USA the incidence of PTE was reported to increase from 23/100,000 to 65/100,000 [1]. On the other hand, in a study conducted in Canada, no significant change was observed in the incidence of PTE in the last decade [2]. A study was conducted on 60853 patients in Italy, and an increase was found in the incidence of PTE in the last 10 years [3]. In our study, the data of patients diagnosed with PTE between 2001 and 2013 were obtained from hospital recordings and were analyzed.

MATERIAL AND METHODS

In our study, the records of patients diagnosed with PTE between 2001 and 2013 were obtained from the hospital's automations system (with the International Classification of Diseases ICD I26.0 and I26.9 coding system) and analyzed. The study was performed after approval from the local ethics committee of Karadeniz Technical University (ethics committee number: 2016/55). Because retrospective design of the study, written informed consent was obtained. Other causes of PTE (fat embolism, septic embolism, etc.) were ruled out by examining the epicrises of the patients.

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Data on age, sex, diagnosis dates, diagnostic methods, presence of cancer, hemodynamic states, first-line and maintenance treatments, hospitalization length, and in-hospital mortality were recorded. The primary endpoint was considered to be in-hospital mortality and hospitalization length.

A systolic arterial blood pressure of <90 mmHg at admission was taken into consideration for the diagnosis of massive PTE. However, PTE was defined as massive only in patients requiring a mechanical ventilator during hospitalization and developing hypotension in the follow-up period.

Statistical Analysis

The Kolmogorov-Smirnov test was used for the parametric and non-parametric distribution of data. Data were presented as mean±SD and median±interquartile range. A p-value of <0.05 was accepted to be significant. Data were recorded on Statistical Package for the Social Sciences (version 13.01, serial number 9069728, SPSS Inc., Chicago) and were analyzed.

RESULTS

A total of 1409 patients were scanned using ICD's (I26.0 and I26.9) between 2001 and 2013. After a complete analysis of patient's records, it was observed that final diagnosis was PTE in 1185 (84.1%). The number of patients diagnosed with PTE gradually increased between 2001 and 2013. The patients diagnosed with PTE in 2009 constituted 13.7% of the total number of patients diagnosed (Figure 1). The median age of all patients was 70 years (range, 57-78 years). While the median age was 61 years (range, 45-75 years) in 2001, it was 71 years (range, 58-80 years) in 2013. The diagnostic method was CT in 92.8% of the patients, perfusion scan in 3.7%, and clinical and Doppler ultrasonography (USG) for investigating the presence of deep venous thrombosis in the remaining 3.5%. While the rate of patients diagnosed by CT was 10% in 2001, it increased to up to 98.4% in 2005 ($p<0.001$). On the other hand, the rate of diagnosing PTE by scan was 60% in 2001, 56% in 2002, and 18.8% in 2003. During the same years, the rates of diagnosing PTE by clinical and Doppler USG were 30%, 28%, and 3.1%, respectively. General data of the patients are presented in Table 1. While the longest hospitalization length was 13 days (range, 12-20 days) in 2001, it decreased to 7 days (range, 6-13 days) in 2013. ($p<0.001$) (Figure 2). While the rate of vena cava filter use was 1.1% in 2007, it was 4.6% in 2013.

In our study, the rate of standard heparin (SH) use in the acute phase of PTE in all patients was 45.5% the rate of low molecular weight heparin (LMWH) use was 40.2%, and the rate of thrombolytic use was 5%. While the rate of SH use was 72.1% in 2013, it decreased to 17.1% in 2013 ($p<0.001$, Table 1).

The general mortality rate was 13% and the in-hospital mortality rate fluctuated between 9.4% and 18.8% over the years from 2001 to 2013. No significant difference was found among the years in terms of the mortality rate

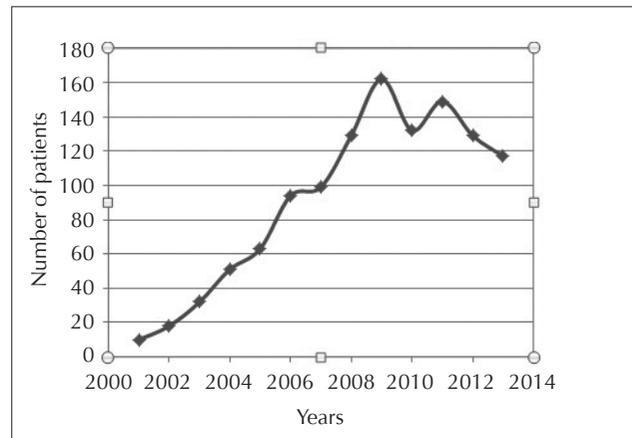


Figure 1. Number of patients over to the years

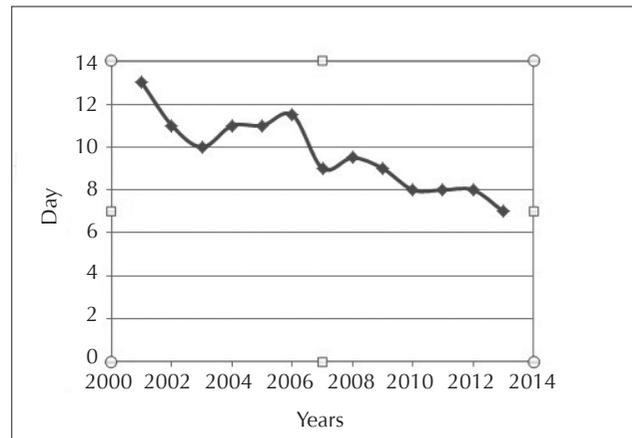


Figure 2. Hospitalization length over the years

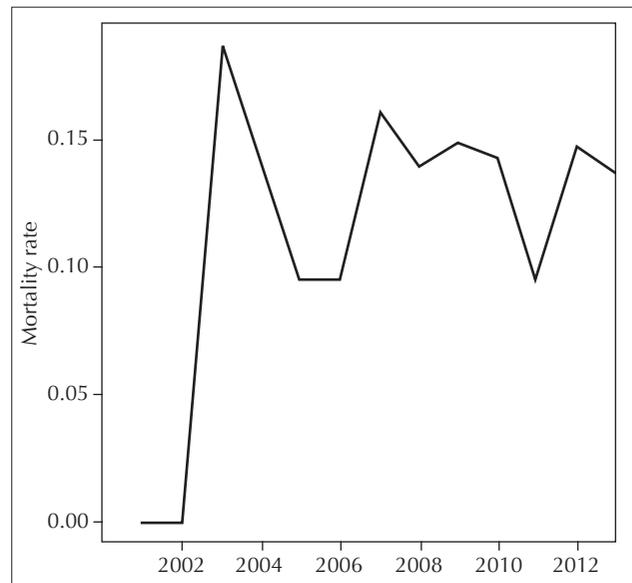


Figure3. Mortality rate over the years

($p<0.05$) (Figure 3). While mortality rate was 12.9% in male patients, it was 13.1% in female patients. There was a statistically significant difference between both sexes with regard to the mortality rate.

The rate of thrombolytic use increased in patients with massive PTE over the years. While the rate of massive PTE pa-

Table 1. Change in the rate of pulmonary thromboembolism over the years

Year	Number of patients	Age (median), years	Cancer, %	Males, %	Massive PTE, %	Mortality rate %	Diagnosis by CT %	Thrombolytic use	SH use, %	LMWH use, %	VCF use, %	Hospitalization length, days
								At the beginning %	%	%	%	
2001	10	61	20	20.0	0	0	10					13
2002	18	52	11.1	61.1	0	0	16.7					11
2003	32	63	6.2	50.0	20	18.8	78.1					10
2004	51	66	15.7	41.2	19.6	13.7	98.0					11
2005	63	63	12.7	38.1	19	9.5	98.4					11
2006	94	70	11.7	40.4	8.5	9.6	95.7	5.8	72.1	24.7	-	11.5
2007	99	69	11.2	45.5	12.2	16.2	97.0	9.4	65.6	36	1.1	9
2008	129	70	7	41.1	12.6	14.0	95.3	5	68.3	34.5	5.5	9.5
2009	161	71	10.5	35.8	5	14.8	97.5	2.7	66	41.3	1.4	9
2010	132	71	15.9	16.7	5.3	14.4	96.2	4.6	66.2	56.9	0.9	8
2011	149	69	13	41.6	11.4	9.4	94.6	8.2	50	57.3	0.8	8
2012	129	74	13.4	44.2	7.8	14.7	92.2	5.5	32.8	71.8	3.4	8
2013	117	71	17.6	44.7	2.6	13.7	90.6	6.0	17.1	82.6	4.6	7
Total	1185	70	16.5	38.7	9.2	13	92.8	5	45.5	40.2	1.7	9
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	NS	<0.001	NS	<0.001	0.001	NS	<0.001

VCF: vena cava filter; SH: standard heparin; LMWH: low molecular weight heparin; NS: non-significant

tients was 8.5% in 2006, the rate of thrombolytic use was 5.8%. In 2013, the rate of patients diagnosed with massive PTE was 2.6%, but the rate of thrombolytic use was 6% (p=0.017). Thus, it was observed that thrombolytic use increased in non-massive patients over the years.

DISCUSSION

In this study, it was found that the number of patients diagnosed with PTE gradually increased over time but that the mortality rate did not change. Moreover, an increase in the rate LMWH use was observed both in the acute stage and the maintenance period. While the mean hospitalization length was 13 days in 2001, it was 7 days in 2013. Over the years, the hospitalization length was observed to decrease.

The clinical course of PTE can vary from asymptomatic cases to sudden deaths. Data obtained till date show that the number of patients diagnosed with PTE has increased. Similarly, the number of PTE patients has apparently increased according to our clinical observations. In our study, it was found that the number of patients diagnosed with PTE relatively decreased in 2011. The most important cause for this decrease is that technical capacities and clinical experiences in diagnosing and treating PTE have increased in other hospitals of Eastern Black Sea Region.

The rate of mortality due to PTE has generally decreased over the years. In particular, the detection of clinically insignificant patients can contribute to a decreased mortality rate. In a study conducted in USA, the mortality rate was reported to decrease from 7.1% to 3.2% over 20 years [1]. In another study conducted in Australia, it was revealed that the mortality rate decreased over years but that PTE was still an important cause of mortality and morbidity in females and the elderly population [4]. In our study, the overall mortality rate

was around 13%, and no change was observed in the mortality rate over the years. The mortality rate was found to be 13% in our two prospective studies between 2008 and 2009 and between 2012 and 2014 [5,6]. However, while the PTE-related mortality rate was 5.6% in our first study, it was 4.4% in the other one. Based on many factors that can influence the mortality rate, such as accompanying co morbid disorders, the application of clinically more severe patients to our hospital because of the provision of tertiary health care, and not performing autopsy for finding the real cause of death, the mortality rate was not observed to have changed over the years in our current study.

The use of CT for the diagnosis of PTE increased for five times in between 2001 and 2009 [7]. In another study, while no change was found in the incidence of PTE in the years before the use of CT pulmonary angiography, the incidence increased to 81% with the use of CT [8]. Further, in our study, a dramatic increase was observed with the use of CT between 2001 to 2013, compared to the first years. The increased rate of PTE diagnoses may reveal another problem. Complications developing in association with anticoagulant therapy lead to mortality and morbidity. The clinically significant complication of bleeding was reported to have developed at the rate of 12% during anticoagulant use for 3-6 months [9]. An increased number of patients are exposed to radiation; therefore, the effects of radiation damage will be observed in the long term.

In addition, changes in the selection of anticoagulants were also observed over the years. In the present study, the rate of SH use decreased from 72% to 17% (an approximately decrease of 4.5 times). On the contrary, the rate of LMWH use increased from 25% to 82%. In the study by Jimenez et al. on 23858 patients between 2001 and 2013, while the rate

of LMWH use increased from 77% to 84%, that of SH use decreased by around 2.5 times [10].

It has been observed that the hospitalization length and high hospital costs has shortened over time due to increased experience of physicians and increased use of LMWHs. In a study conducted in USA, the median hospitalization length was reported to have decreased from 8 days to 4 days [1]. In another study, the median hospitalization length decreased from 13.6 days to 9.3 days within a 13-year period [10]. In our study, the hospitalization length decreased from 13 days to 7 days. In clinical practice, it is seen that accompanying co morbid conditions are one of the most important factors affecting long hospitalization lengths. Another factor that may decrease the hospitalization length is the use of LMWH instead of warfarin because warfarin dosing in maintenance treatment can sometimes take a longer time due to its changing metabolism each other.

This study has some limitations. Firstly, it cannot be suggested that the study included all patients diagnosed with PTE because it was a retrospective, single-center study. Moreover, we do not know the exact number of PTE patients who were coded using other ICDs (dyspnea, respiratory failure, hemoptysis, chest pain, respiratory arrest, etc.) except than I26.0 and I26.9. In addition, we have no data on the treatments that patients received between the 2001 and 2005. Accompanying morbidities of the patients could not be documented. Hence, all-cause mortality was presented. It can be suggested that changes in the morbidity rate can change the mortality rate over the years.

In conclusion, despite the increased number of patients diagnosed with PTE, it was observed that the mortality rate did not change over the years.

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S.S.Ö., M.B.C.; Data Collection and/or Processing - S.S.Ö., M.B.C., Z.G.D., Y.B., F.Ö., T.Ö.; Analysis and/or Interpretation - S.S.Ö., M.B.C., Y.B.; Literature Search - S.S.Ö., M.B.C.; Writing Manuscript - S.S.Ö., M.B.C., Y.B.; Critical Review - S.S.Ö., M.B.C., Y.B.; Other - S.S.Ö., M.B.C., S.G.D., Y.B., F.Ö., T.Ö.

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