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Original Article

Relationship Between Pulmonary Thromboembolism, its Mortality and Seasonal, Meteorological Factors

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ABSTRACT

Objective: Seasonal and weather changes may affect the development of pulmonary embolism. The effects of seasonal and meteorological factors on mortality are controversial. We aimed to investigate the effects of seasons and meteorological data on patients with a low and high pulmonary embolism severity index and those with 30-day mortality.

Methods: Pulmonary embolism cases were included in our study. Daily pressure, humidity, temperature, and wind values were taken from the general online information by the Directorate of Meteorology. All cases were divided into the low-risk and high-risk group, using a simplified pulmonary embolism severity index.

Results: Eighty-six patients diagnosed with pulmonary thromboembolism were included in the study. Comparison between the two groups revealed that the disease was detected during winter in the high-risk group (31.3%) and during summer in the low-risk group (59.1%) ($p=0.011$). No statistically significant results were found on the day of diagnosis and pressure, humidity, temperature, and wind averages on the 7th day based on the severity index ($p>0.05$). There were no statistically significant results detected when comparing the average air pressure, humidity, air temperature, season, and wind for mortality in 30 days ($p>0.05$).

Conclusion: In the light of these data, it was determined that seasonal and meteorological factors had no effect on mortality in pulmonary embolism.

INTRODUCTION

Pulmonary thromboembolism (PTE) is defined as the occlusion of the pulmonary artery and its branches with thrombus coming from the systemic veins. Most of the cases of PTE develop due to thrombi occurring in the deep veins of the legs.

Today, when the patients with PTE are investigated, it can be observed that there is an underlying genetic factor and an environmental factor for the development of thrombus.[1] However, despite all the studies performed, no other factors have been found in some patients with PTE and DVT.[2] PTE is a hardly identifiable disease with high mortality. In PTE undiagnosed cases, mortality rates rise to 10%. Although many scoring systems have been used for prognostic evaluation, the most current Pulmonary Embolism Severity Index (PESI) is the most commonly used one. However, the Simplified Pulmonary Embolism Index (sPESI) with fewer parameters was found to have the same effectiveness as PESI.[3]

Thromboembolic events such as PTE, transient ischemic attack, and acute myocardial infarction were more frequently seen during some seasons.[4,5] In a study, it was determined that deaths from PTE were more frequent in cold seasons.[5] In addition, there are also studies in which no relation could be found between meteorological factors and PTE.[6–8] Although the incidence rates of pulmonary embolism may show seasonal variations, contradictory study results have been published. In a large-scale study, it was determined that the number of both PTE and DVT patients were significantly increased in the winter and decreased in the summer months.[9]

Some researchers have shown that hospitalizations due to pulmonary embolism increased during the winter months.[10–12] Furthermore, some studies have shown that the air temperature and a low atmospheric pressure are also associated with the incidence of pulmonary embolism.[13] Although seasonal differences in the mortality rates from pulmonary embolism are observed, no seasonal differences were detected with regard to mortality rates in a study evaluating the mortality in pulmonary embolism.[14]

A scarce number of data are available in the Mediterranean countries where there are immense differences in the air temperature, and four seasons differ significantly. For this reason, we aimed to investigate the effects of seasons and meteorological data on PTE cases with lower and higher sPESI scores and their effects on the 30-day mortality in PTE cases in the metropolitan city we lived in.

MATERIALS AND METHODS

The study included PTE cases diagnosed at the Chest Diseases Clinic of our hospital between January 2015 and December 2016. The files of the patients were examined retrospectively, and the months and seasons when they were diagnosed with PTE were determined. Data related to age, gender, cancer, and chronic cardiopulmonary disease history, heart rate, systolic blood pressure, arterial O2 saturation, and 30-day mortality were recorded.

The meteorological parameters (atmospheric pressure, air temperature, and humidity averages) of the patients for 7 days before the date of diagnosis and at the time of diagnosis were obtained from the General Directorate of Meteorology, and the mean values were calculated. For the prognostic scoring, the Simplified Pulmonary Embolism Severity Index (sPES), calculated for each patient using parameters such as the age, presence of cancer, heart rate, systolic blood pressure, history of COPD, and O2 saturation, was used. The cases were divided into two groups, according to the sPESI scores, as low- (sPESI=0; Group 1) and high- (sPESI ≥1; Group 2) risk groups.

Statistical analysis

The SPSS 20.0 statistical program was used in the data analysis. The fitness of continuous variables to normal distribution was tested using the Kolmogorov–Smirnov test. The independent T-test was used to compare the group averages of the continuous variables with normal distribution. In the statistical evaluation of categorical variables, the chi-square and Fisher's exact tests were used. Continuous variables with normal distribution were expressed as the mean ± standard deviation, while the percentage and frequency values were given for categorical variables. P-values <0.05 were considered to be statistically significant.

RESULTS

A total of 86 PTE cases diagnosed in our hospital were included in our study. The mean age of the group, which consisted of 48 (55.8%) female and 38 (44.2%) male patients, was 58.2+16.9 years. The study patients applied to us with complaints of chest pain (n=58), shortness of breath (n=57), nosebleed (n=19), and palpitations (n=7). According to the sPESI, 22 cases were evaluated in the low-risk (Group 1), and 64 cases in the high-risk groups (Group 2). Demographic characteristics are given in Table 1.

The cases of PTE were distributed according to the seasons, and they were seen most frequently in the summer (31.1%) and then in the winter months (26.7%). When the distribution of patients with PTE was analyzed according to the months, it was seen that they were mostly diagnosed in July (15.1%) and then in December (11.6%) (p>05). A statistically significant difference was not detected between the seasons and months as for the times of the PTE diagnosis (p>0.05).

The two groups classified based on the sPESI were compared with regard to the time of diagnosis. The patients in Group 1 were mostly diagnosed in the summer (59.1%), whereas Group 2 patients were most frequently diagnosed in the winter (31.3%). A statistically significant intergroup difference was found as for the diagnosis of PTE seasonality (p=0.011; Fig. 1).

Table 1. Demographic characteristics

	All groups	Low risk group	High risk group	p
Age	58±17	45±14	62±15	<0.001
Male/female	48/28	5/17	43/21	<0.001
SO_2 (%)	92±4	94±5	90±6	<0.001
Avarage atmospheric pressure–day of diagnosis (hPa)	1013±7	1013±7	1013±6	0.944
Avarage atmospheric pressure–last 7 days (hPa)	1013±5	1012±5	1013±5	0.496
Avarage Temperature- day of diagnosis (°C)	18±8	20±8	18±7	0.163
Avarage Temperature–last 7 days (°C)	18±7	20±7	17±7	0.083
Avarage humidity–day of diagnosis (%)	72±9	71±8	72±10	0.645
Avarage humidity–last 7 days (%)	72±7	71±7	73±8	0.335
Avarage wind–day of diagnosis (m/sn)	1.7±0.6	1.9±0.9	1.7±0.4	0.169
Avarage wind–last 7 days (m/sn)	1.7±0.3	1.8±0.4	1.7±0.3	0.128
Deep vein thrombosis, n (%)	32 (37.2)	5 (5.8)	27 (31.4)	<0.001
Computed tomography angiography (n)	70	22	48	<0.001
V/Q scintigraphy (n)	16	2	14	<0.001

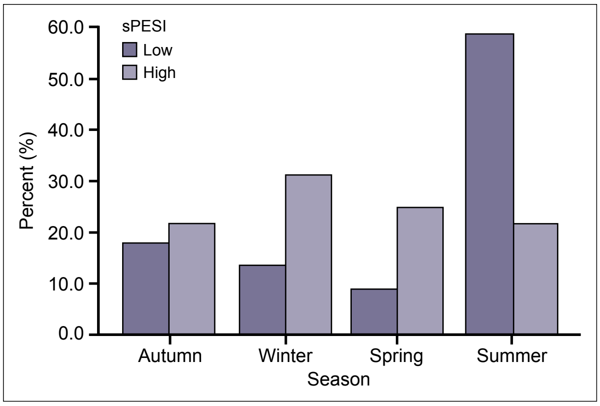

Figure 1. Seasonal distribution of low and high-risk pulmonary embolism patients.

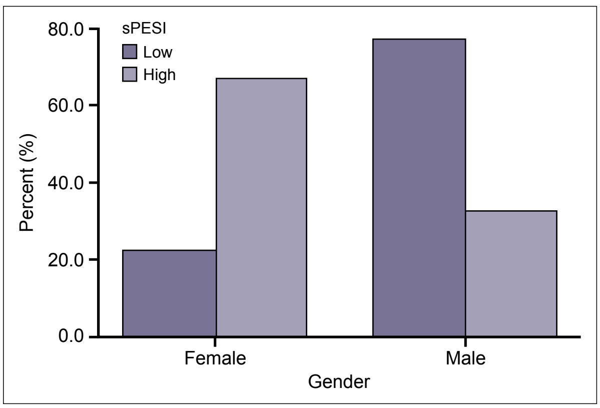

Figure 2. Gender distribution in patients with low and high risk pulmonary embolism.

There were no any statistically significant differences found between Groups I and 2 when group averages were compared individually as for the day of diagnosis and 7 days before diagnosis, in terms of average values for barometric pressure, humidity, air temperature, and weather (p>0.05). When the cases were divided into two groups, that is, with and without DVT, there were no statistically significant intergroup differences in terms of the barometric pressure, humidity, air temperature, and weather averages on the day of diagnosis and in the preceding 7 days (p>0.05). In addition, there was no significant difference between the groups with and without DVT in terms of seasonal differences (p>0.05).

Eight (88.9%) patients in the high-risk group (Group 2) and 1 (1.1%) patient in the low-risk group (Group 1) died within 30 days. A statistically significant difference was not found when the barometric pressure, humidity, temperature, and weather averages on the day of diagnosis, and within 7 days before diagnosis were compared with respect to 30-day mortality rates (p>0.05). When the mortality rates were examined by months, 4 of the 9 deaths (44.4%) were observed in June. However, there was no statistically significant difference in terms of mortality as for the months of diagnosis (p>0.05).

The age and oxygen saturation values (SaO_2) in Groups 1 and 2 were compared, and the mean age of the cases in the high-risk group was higher. The mean oxygen saturation (SaO_2) was lower with a statistically significant intergroup difference (p<0.001).

When the patients in Group 1 and Group 2 were compared according to gender, the proportion of women was higher (67.2%) in Group 2, while the proportion of men (77.3%) was higher in Group 1, with a statistically significant intergroup difference (p<0.001) (Fig. 2).

A higher death rate was observed in the group of patients with a higher mean age, whereas the mean SaO_2 value was statistically significantly lower in this group (p=0.015, p=0.003). In patients with PTE, the 30-day mortality rate was found to be higher in men (88.9%) than in women (p>0.05).

DISCUSSION

In the studies that examined the seasonal effects on PTE, clear-cut results could not be achieved, and very different results have been obtained. In our study, the effects of seasonal and meteorological data on PTE were investigated. Although no seasonal intergroup differences were detected, a statistically significant seasonal difference was detected between the groups when the cases were divided into low- and high-risk groups. It was determined that the high-risk group was seen more frequently in winter and low-risk group in summer.

Boulay et al.[9] included patients with PTE and DVT in their study conducted in France. In this study, it was found that the number of PTE patients increased in winter and decreased in summer. In a study by Anar et al.,[15] a significant seasonal difference was found in pulmonary embolism. It was determined that it was most frequently seen in the spring and then in the summer season. In a study by Masotti et al.,[16] when PTE patients were separated as surgical and nonsurgical patients, and examined according to the seasons, it was found that the number of patients with PTE was mostly seen in winter months, and they were more numerous in the surgical patient group. The patients with PTE were mostly detected in January and March. In large-scale studies performed by Gallerani et al.[17] in Italy, higher numbers of PTE cases were seen in winter and most frequently in January.

In our study, when seasonal differences were evaluated among all patients, contrary to other studies, it was found that PTE was most commonly seen in summer and followed by the winter season. However, any seasonal differences were not detected when considering the PTE detection rate.

The patients were grouped according to the sPESI, and PTE was more frequently seen in the low-risk group in summer, while it was more often observed in winter in the high-risk group. Ercan et al.[18] detected pulmonary embolism cases more frequently in winter. First, in our study, the effects of seasonal and meteorological data on disease development and mortality were examined in groups divided by using the PESI.

Many studies have shown seasonal variations in the incidence of PTE. In addition, in the United States, in a large-scale study, Stein et al.[19] did not find any difference in the incidence rates of PTE and DVT according to seasons and months. Similarly, in our study, any seasonal difference was not found as for the incidence of PTE when all patients were evaluated.

In the study by Nimako et al.,[13] the PTE cases were most frequently seen in the summer, and a statistically significant seasonal variation was found. In this study, different results were detected, depending on the geographical location and changes in climate. In our study, cases with PTE were more frequently seen in the low-risk group in the summer months, where a lower barometric pressure and humidity, but higher air temperature averages, were found.[20]

It was thought that these results could be related with the higher rates of long-term travel in the summer period in our country.

However, it was also thought that dehydration could be more frequent in warmer months due to perspiration, which might cause an increase in blood viscosity and PTE. In a study that investigated the effects of seasons on PTE, an increase in the cases with embolism in cold weather, especially in autumn, and winter months had been demonstrated.

A study conducted by Diken et al.[21] that investigated the effects of meteorological data on PTE showed that the number of cases with PTE increased in line with a decreased barometric pressure and increased temperature. In this study, no statistically significant correlations could be found between the meteorological factors (air temperature, barometric pressure, and humidity) and the severity of PTE in patients with and without risk factors for PTE. Similarly, in our study, there was no statistically significant difference between low- and high-risk groups when barometric pressure, humidity, air temperature, and weather averages on the day of diagnosis and previous 7 days were compared individually.

In a study, a high barometric pressure was associated with an increase in the PTE severity and frequency.[22] Masotti et al.[16] detected that the number of PTE cases increased in the period when barometric pressures were at a low level. Similarly, Scott et al.[23] observed that the number of cases with PTE increased during the periods of decreased barometric pressures. However, Clauss et al.[24] could not demonstrate a significant correlation between the development of PTE, temperature, and barometric pressure. The studies investigating the relationship between the meteorological data and PTE are very contradictory. In our study, no difference was found in terms of the PTE development on the day of diagnosis and within previous 7 days in terms of barometric pressure, humidity, weather, and air temperature averages.

In our study, when seasonal variations in the mortality rates of patients with PTE were examined, 5 of 9 deaths (55.6%) observed within the first 30 days after the diagnosis occurred in the summer season, and 4 of 9 deaths (44.4%) were detected in June. However, no statistically significant differences were found as for the first 30-day mortality rates among the cases with PTE when examined by seasons and months. In an autopsy study, it was found that deaths due to a massive PTE were more common in spring and autumn, and they were mostly seen in October.[6]

There are also contradictory studies on PTE mortality. Masotti et al.[16] found that the PTE mortality rates had increased in winter months. In another study, deaths due to PTE were found to have skyrocketed in spring.[25] In the study, no statistically significant relationship was detected between the mortality and seasonality in PTE.[19] In our study, no statistically significant relation was detected between 30-day mortality rates and seasonality. In a study in which the early and late mortality rates were examined, a seasonal difference was not detected as for mortality rates, similar to our study.[14]

The scarce number of cases may be considered to be among the limitations of our study. In the light of these data, when PTE cases were divided into two groups based on the sPESI as low- and high-risk groups, in the high-risk group, PTE was more frequently seen in winter, and in the low-risk group in summer. It was determined that seasonal and meteorological factors had no effect on the PTE mortality. When evaluated together with the studies in the literature, it was concluded that the risk of developing PTE, its relationship with seasons, and relevant mortality rates varied according to the regions.

Peer-review

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Authorship Contributions

Concept: S.B.S.; Design: S.C., S.B.S., N.K.; Supervision: N.K., B.C.T., C.D.; Fundings: C.D., S.B.S., E.T.P., S.C.; Materials: S.C., A.K., N.K., S.B.S.; Data: S.B.S., S.C., N.K.; Analysis: S.B.S., S.C., A.F.; Literature search: S.B.S., E.T.P., A.F.; Writing: S.B.S., G.C.T., C.D., E.T.P.; Critical revision: S.B.S., C.D., G.C.T., A.F.

Conflict of Interest

None declared.

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Pulmoner Tromboemboli ve Mortalitesinin Mevsimsel ve Meteorolojik Faktörler ile İlişkisi

Amaç: Pulmoner emboli gelişiminde mevsimsel farklılıklar görülmektedir. Mortalite üzerinde mevsimler ve meteorolojik faktörlerin etkisi tartışmalıdır. Sıcaklık farklarının yüksek olduğu, dört mevsimin belirgin olduğu Akdeniz ülkelerinde veri azdır. Bu nedenle yaşadığımız metropolde mevsimlerin ve meterorolojik verilerin pulmoner emboli ciddiyet indeksi yüksek olanlarla düşük olanlar üzerindeki etkileri ve 30 günlük mortalite üzerine etkilerini araştırmayı amaçladık

Gereç ve Yöntem: Çalışmamıza pulmoner emboli olguları dahil edildi. Günlük basınç, nem, sıcaklık, rüzgar değerleri meteoroloji genel müdürlüğünden elektronik ortamda alındı. Tüm olgular basitleştirilmiş pulmoner emboli ciddiyet indeksi kullanılarak düşük risk grubu ve yüksek risk grubu olarak ikiye ayrıldı. Veriler SPSS 20.0 istatistik programı kullanılarak analiz edildi.

Bulgular: Basitleştirilmiş pulmoner emboli şiddet indeksine göre ayrılan iki grup mevsimlere göre karşılaştırıldığında grup 1'deki hastalar daha çok yaz mevsiminde (%59.1) görülürken, grup 2'deki hastalar daha çok kış mevsiminde (%31.3) görülmüş olup aralarında istatistiksel olarak anlamlı bir fark bulunmuştur ($p=0.011$). Tanı günü ve önceki yedi günlük basınç, nem, sıcaklık, rüzgar ortalamaları hastalık ciddiyetine göre ayrı ayrı karşılaştırıldığında istatistiksel olarak anlamlı bir sonuç bulunmamıştır ($p>0.05$). Otuz günlük mortalite için tanı günü ve önceki yedi günlük basınç, nem, sıcaklık, rüzgar ortalamaları karşılaştırıldığında istatistiksel olarak anlamlı bir sonuç bulunmamıştur ($p>0.05$).

Sonuç: Bu verilerin ışığında mevsim ve meteorolojik faktörlerin pulmoner embolide mortalite üzerinde etkisi olmadığı tespit edilmiştir. Ancak hastalık ciddiyet indeksi hastalığın mevsimsel farklı sıklıkta görülmesini etkilemiştir.

Anahtar Sözcükler: Mevsim; mortalite; pulmoner emboli.