EFFECT OF YEARLY SEASONAL CHANGES AND METEOROLOGICAL PARAMETERS ON THE SEVERITY OF PULMONARY THROMBOEMBOLISM

MEVSİMSEL DEĞİŞİKLİKLER VE METEOROLOJİK PARAMETRELERİN PULMONER TROMBOEMBOLİZM ÜZERİNE ETKİSİ

SEASONAL CHANGES AND PULMONARY THROMBOEMBOLISM

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Öz

Amaç: Pulmoner tromboemboli için risk faktörü olmayan hastalarda pulmoner tromboemboli ile nemlilik, sıcaklık, basınç arasındaki ilişki hakkında sınırlı bilgi mevcuttur. Bu çalışma; pulmoner tromboemboli için risk faktörü olan ve olmayan hastalarda pulmoner tromboembolinin sıklığı-şiddeti ile meteorolojik faktörler veya mevsimsel değişkenlikler arasında ilişkisi olup olmadığını araştırmıştır. Gereç ve Yöntem: 2009-2011 yılları arasında 81 pulmoner tromboemboli tanısı alan hasta bu restrospektif çalışmaya alındı. Tanı anındaki meteorolojik faktörler geriye dönük olarak Meteoroloji Genel Müdürlüğü verileri kullanılarak kaydedildi. Sıcaklık, atmosferik basınç, nemlilik ve hasta özellikleri istatistiksel olarak değerlendirildi. Bulgular: 22 hasta (%27.2) ilkbaharda, 25 (%30.9) hasta yaz mevsiminde tanı almıştı. Pulmoner tromboemboli sıklığı düşük nem düzeyleriyle negatif ilişkideydi (p: 0,001). Orta düzeydeki atmosferik basınçta pulmoner tromboemboli sıklığı daha yüksekti (p: 0,001). Pulmoner tromboemboli için risk faktörü olan ve olmayan hastalarda meteorolojik faktörlerle (sıcaklık, basınç ve nem değerleri) pulmoner tromboemboli şiddeti arasında istatistiksel olarak anlamlı bir ilişki saptanmamıştır. Tartışma: İlkbahar ve yaz mevsiminde pulmoner tromboemboli sıklığı daha fazla olabilir. Çalışmamız gösterdi ki; nemlilik ile pulmoner tromboemboli arasında ilişki vardır. Bilinen risk faktörü olmayan pulmoner tromboemboli hastalarına yaklaşımda mevsimsel değişimler akılda tutulmalıdır.

Anahtar Kelimeler

Atmosferik Basınç; Nemlilik; Meteorolojik Parametreler; Pulmoner Tromboembolizm; Sıcaklık

Abstract

Aim: There is inadequate knowledge about the relationship between pulmonary thromboembolism and humidity, temperature, and pressure in patients without risk factors for pulmonary thromboembolism. This study investigated whether or not there is an association between the frequency and severity of pulmonary embolism and meteorological parameters. Material and Method: A total of 81 patients who were diagnosed with pulmonary thromboembolism during the years 2009-2011 were included in this retrospective study. Meteorological factors at the time of diagnosis were recorded retrospectively, using data from the Turkish State Meteorological Service. Temperature, atmospheric pressure, humidity, and patient features were evaluated statistically. Results: Twenty-two patients (27.2%) were diagnosed in the spring, while 25 (30.9%) were diagnosed in summer. The incidence of pulmonary thromboembolism was negatively correlated with decreasing humidity (p: 0.001). Pulmonary thromboembolism incidence was higher in moderate atmospheric pressure (p: 0.001). We found no statistically significant relationship between the severity of pulmonary embolism and meteorological factors (temperature, atmospheric pressure, and humidity) in patients with or without risk factors for pulmonary thromboembolism. Discussion: We observed that incidence of pulmonary thromboembolism may be higher in spring and summer. Our study demonstrated that there was an association between pulmonary thromboembolism and humidity. Seasonal variations in meteorological parameters should be considered in treatment of patients with pulmonary thromboembolism but no known risk factors.

Keywords

Atmospheric Pressure; Humidity; Meteorological Parameters; Pulmonary Thromboembolism; Temperature

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Introduction

It is well established that cardiovascular and cerebrovascular events show seasonal and monthly variation. There is conflicting information about the seasonal distribution of pulmonary thromboembolism (PTE). A meta-analysis of studies up to January 2010 showed that incidence of PTE was higher in winter and in January [1]. The exact mechanism to explain infradian (seasonal) variations in PTE is still obscure, but some studies have pointed out that seasonal variations might be the cause of altered coagulation. Elucidating the underlying mechanism may allow clinicians to diagnose PTE earlier and to decide on different prophylaxis strategies in high-risk seasons or months. A recent study showed that there were seasonal variations in episodes of idiopathic PTE and that there was also a significant association between decreased atmospheric pressure and increased temperature [2]. The aim of this study was to investigate the relationship between PTE and humidity, atmospheric pressure, and temperature.

Material and Method

All outpatient clinic admissions were investigated between January 2009 and December 2012.A total of 81 patients who were diagnosed as PTE were included in the study. Data were retrospectively investigated using the local patient database system and patients' anamnesis forms. Patients from different regions of the country (that is, who did not live locally) were not included. Immobility, recent long-distance travel, genetic thrombophilia, surgical intervention, and malignity are considered risk factors for PTE, and patients with or without risk factors were evaluated separately. Local weather information for the province of Ankara was obtained from the Turkish State Meteorological Service. Weather temperature, humidity, and atmospheric pressure data were recorded as part of the study. Time passed from onset of symptoms to diagnosis was recorded for each patient. The meteorological values attributed to each patient were the means of the values in the three days preceding the time of diagnosis of PTE [3,4]. Diagnosis was made with multislice spiral computed tomography pulmonary angiography (CTPA). The patients were divided into three subgroups as non-massive, sub-massive, and massive [5]. Massive PTE is characterized by systemic hypotension or shock. A subgroup of patients with non-massive PTE who are hemodynamically stable but with right ventricular dysfunction or hypokinesis confirmed by echocardiography is classified as sub-massive PTE.

Statistical Analysis

All analyses were performed using SPSS 11.5 package software. As descriptive statistics, the arithmetic mean standard deviation [median (min-max)] was used for quantitative variables and the frequency (%) was used for qualitative variables. Chi squared test for equality of proportions were used. In order to determine which groups differ, post-hoc tests (Mann Whitney U with Bonferroni correction) were used with pairwise comparison. A p value of less than 0.05 was considered as statistically significant. Analysis was performed in Ankara, Turkey.

Results

47 (58%) of the 81 patients were female and the mean age of patients was 65 ± 15 years. Forty-six (56%) patients had no known risk factors. Poor mobility/immobility in 8 patients, malignity in 12 patients, surgical intervention in 9 patients, and genetic thrombophilia were encountered as risk factors. Most of the patients were diagnosed in the spring (n= 22, 27.2%) and in summer (n= 25, 30.9%, p= 0.339). Also, the months when the most patients were diagnosed were May (n= 12, 14.8%, p= 0.656) and August (n= 9, 11.1%). Season and month distribution of pulmonary thromboembolism cases is shown in Table 1.

The mean temperature was 13.8 ± 9.61 ^{0}C, mean atmospheric pressure was 914.1 4.35 hPa, and mean humidity was 57 ± 16.1%, computed as means of the values for the three days preceding the time of diagnosis of PTE. PTE diagnosis was higher in low-moderate atmospheric pressures. The frequency of PTE was higher in low-moderate humidity and the difference was of statistical significance (p< 0.001) (Table 2).

According to disease severity, there were 61 (75%) non-massive, 14 sub-massive (17.3%), and 6 (7.4%) massive PTE cases. We found no statistically significant relationship between the severity of PTE and temperature (p= 0.363), atmospheric pressure (p= 0.093), or humidity (p= 0.519) (Table 3). Non-massive

Table 1. Seasonal and monthly distribution of pulmonary thromboembolism patients

Month of Diagnosis	n	%
January	5	6.2
February	6	7.4
March	6	7.4
April	4	4.9
May	12	14.8
June	8	9.9
July	8	9.9
August	9	11.1
September	5	6.2
October	5	6.2
November	8	9.9
December	5	6.2
Season of Diagnosis	n	%
Spring	22	27.2
Summer	25	30.9
Autumn	19	23.5
Winter	15	18.5

Table 2. Distribution of patients among temperature, pressure, and humidity intervals

		n	%	p value
Parameters and value	Temperature(°C)			
	-5 – 7	23	28.4	
	7.1- 19	27	33.3	0.411
	19.1- 31	31	38.3	
	Atmosperic Pressure (hPa)			
	900-910	14	17.3	
	911-920	60	74.1	<0.001
	921-930	7	8.6	
	Humidity (%)			
	25 - 50	28	34.6	
	50 - 75	40	49.4	<0.001
	75 - 100	13	18.5	

Table 3. Meteorological parameters and the severity of pulmonary thromboembolism

		Severity			
		Non-massive (n: 61)	Sub-massive (n: 14)	Massive (n: 6)	P value
Parameters (mean)	Temperature(ºC)	12.72 ±9.82	16.80±8.01	14.77±10.59	0.363
	Atmospheric Pressure (hPa)	914.38±4.33	912.42±4.16	916.55±4.10	0.093
	Humidity (%)	58.51±16.24	56.25±17.78	51.33±9.41	0.519

PTE was slightly more common in autumn-winter seasons than in spring-summer season. Sub-massive and massive presentation was slightly more common in spring-summer seasons than in autumn-winter seasons, although neither difference was statistically significant (Table 4, Figure 1).

We found no statistically significant association between PTE severity and temperature (p= 0.97), atmospheric pressure (p= 0.66), or humidity (p= 0.65) in patients without known risk factors (Table 5).

Table 4. Seasonal variations and the severity of pulmonary thromboembolism

Seasons		Pulmonary Thromboembolism Severity			Total
		Non-massive	Sub-massive	Massive	
Spring	(n)	15	7	0	22
	(%)	68.2%	31.8%	0.0%	100.0%
Summer	(n)	17	6	2	25
	(%)	68.0%	24.0%	8.0%	100.0%
Autumn	(n)	16	1	2	19
	(%)	84.2%	5.3%	10.5%	100.0%
Winter	(n)	13	0	2	15
	(%)	86.7%	0.0%	13.3%	100.0%
Total	(n)	61	14	6	81
	(%)	75.3%	17.3%	7.4%	100.0%

Table 5. Meteorological parameters and the severity of pulmonary thromboembolism in patients without risk factors

		Severity			
		Non-massive (n: 36)	Sub-massive (n: 7)	Massive (n: 3)	P value
Parameters (mean)	Temperature(ºC)	13.87±9.78	12.86±8.45	13.17±10.53	0.978
	Atmospheric Pressure (hPa)	914.23±4.19	913.81±3.82	915.43±4.60	0.660
	Humidity (%)	56.73±16.18	61.11±17.16	53.53±11.50	0.653

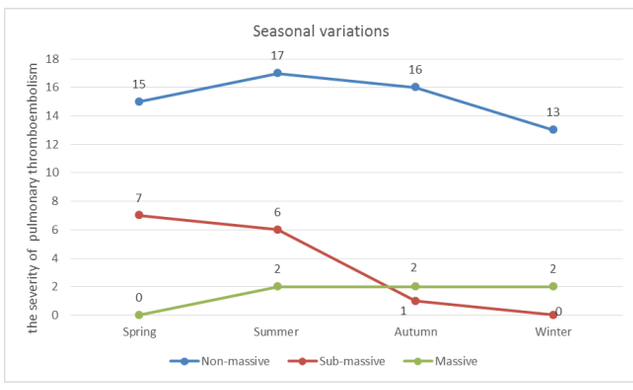

Figure 1. Seasonal variations and the severity of pulmonary thromboembolism

Discussion

We found that PTE was higher in low-moderate atmospheric pressures. The frequency of PTE was higher in lower humidity. We found no statistically significant relationship between the severity of PTE and temperature, atmospheric pressure, or humidity. Our study was the first to show that the frequency of PTE is higher at lower humidity and atmospheric pressures.

Many research studies have investigated the effects of meteorological factors on the frequency of cardiovascular and cerebrovascular pathologies. Although incidence of PTE was shown to be higher in winter and at lower atmospheric pressures, there have also been studies reporting conflicting results [6-11]. The increasing interest in the relationship between PTE and meteorological parameters has arisen from the desire to better understand the mechanisms of PTE in order to take precautions against predictable risk factors. Current studies have fallen short in clarifying this relationship. Investigating the relation between coagulation factors and meteorological parameters has been another approach to establish the pathophysiology of pulmonary thromboembolism [12]. Such research may help uncover the subgroup of patients requiring more aggressive prophylaxis regimen against PTE in the absence of known risk factors.

A recent study showed that higher atmospheric pressures was linked to an increase not only in frequency but also in severity of PTE [13]. In our study, the relationship between humidity, pressure, and temperature and the severity of PTE was investigated by dividing patients with or without known risk factors into different groups. The influence of humidity, pressure, and temperature on PTE severity had not yet been specifically investigated in patients without known risk factors. We found that the frequency of PTE was higher in lower humidity. A study that had not analyzed the risk factors found an inverse correlation between humidity and PTE [3], the same as our study result.

In our study, incidence of PTE was higher in spring and summer but the correlation was statistically insignificant. In a study from Turkey, Oztuna et al. [11] found that incidence of PTE was highest (n= 72, 35%) in spring. In our study, PTE was more frequent at low atmospheric pressures and at high temperatures, but this finding was statistically insignificant, possibly due to the low number of patients. Our finding that incidence of PTE was increased with decreasing atmospheric pressure supports the findings of the study by Staskiewicz et al. [13]. Meral et al. [9] and Masotti et al. [10] also reported that incidence of PTE increased with decreasing atmospheric pressure.

Similar to the study of Nimako et al. [2], our study demonstrated that incidence of PTE increased at higher temperatures. In our case, this relationship was not statistically significant. These authors also reported that, similar to us, incidence of PTE increased with decreasing atmospheric pressure. Similar to us, Nimako et al. studied the seasonal changes of PTE frequency in patients without known risk factors for PTE.

The relationship between seasonal changes and PTE severity was taken into consideration in our study. We found no significant relationship between PTE severity and seasonal changes in those patients without known risk factors for PTE. Also, we found no significant relationship between the severity of PTE and temperature, humidity, or pressure levels. Staskiewicz et al.

[13] demonstrated that severity of PTE increased with decreasing atmospheric pressure. Further study is needed to clarify whether PTE severity depends on meteorological parameters and seasonal changes in patients without known risk factors for PTE. Such consideration may help uncover the subgroup of patients requiring more aggressive prophylaxis regimen against PTE in the absence of known risk factors during these seasons or periods of low or high humidity, temperature, or atmospheric pressure.

A limitation of our study was the relatively small sample size of patients without risk factors for PTE. The retrospective design of the study contributed to some data collection difficulties. This limitation can be overcome by planning further prospective cohort studies. Despite these limitations, the findings are valid and the stated relationships may contribute to the decision making of clinicians.

Conclusion

In conclusion, PTE may be more frequent in spring-summer seasons not only during winter seasons as has been reported in previous studies. The incidence of PTE may be higher in lower atmospheric pressures and humidity. We found no significant relationship between PTE severity and meteorological parameters or seasonal changes. Therefore, further studies are needed to reveal whether there is a relationship between PTE severity and meteorological parameters or seasonal changes, especially for those patients without known risk factors for PTE.

Competing interests

The authors declare that they have no competing interests.

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