



Original article

Influence of Atmospheric Pressure on the Incidence of Spontaneous Pneumothorax[☆]

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A B S T R A C T

Background: This study analyses the relationship between the incidence of idiopathic spontaneous pneumothorax (ISP) and atmospheric pressure (AP).

Methods: A total of 288 cases of ISP were included, 229 men and 59 women. The AP of the day of diagnosis, of the 3 prior days and the monthly average were registered. The association between the incidence of ISP and AP was analyzed by calculating standardized incidence ratio (SIR) and Poisson regression.

Results: The AP on the day of admission (mean±standard deviation) (1017.9±7 hectopascals [hPa]) was higher than the monthly average AP (1016.9±4.1 hPa) ($P=.005$). There was a monthly distribution pattern of ISP with the highest incidence in the months of January, February and September and the lowest in April. When AP was less than 1014 hPa, there were fewer cases registered than what would statistically have been expected (58/72 cases). In contrast, when the pressure was higher than 1019 hPa, the registered cases were more than expected (109/82 cases) (SIR=1.25; 95% CI: 1.04–1.51). The risk of ISP increased 1.15 times (95% CI: 1.05–1.25, $P=.001$) for each hPa of AP, regardless of gender, age and monthly average AP. A dose–response relationship was observed, with progressive increases in risk (IRR=1.06 when the AP was 1014–1016 hPa; 1.17 hPa when the AP was 1016–1019 hPa and 1.69 when the AP was superior to 1019 hPa) (P for trend=.089).

Conclusion: AP is a risk factor for the onset of idiopathic spontaneous pneumothorax.

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Influencia de la presión atmosférica sobre la incidencia de neumotórax espontáneo

R E S U M E N

Introducción: Se analiza la relación entre incidencia de neumotórax espontáneo idiopático (NEI) y presión atmosférica (PA).

Métodos: Se incluyen 288 casos de NEI, 229 hombres y 59 mujeres. Se recogió PA el día del diagnóstico, PA en los 3 días previos y PA media mensual. Se analizó la asociación entre incidencia de NEI y PA mediante cálculo de razón de incidencia estandarizada (RIE) y regresión de Poisson.

Palabras clave:

Neumotórax espontáneo

Neumotórax idiopático

Presión atmosférica

Variación estacional

Temperatura

Hectopascales

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Resultados: La PA el día del ingreso (media \pm desviación típica) ($1.017,9 \pm 7$ hectopascales [hPa]), fue más elevada que la PA media mensual ($1.016,9 \pm 4.1$ hPa; $p = 0,005$). Hubo un patrón de distribución mensual del NEI, con mayor incidencia los meses de enero, febrero y septiembre y menor en abril. Cuando la PA fue inferior a 1.014 hPa se registraron menos casos de los que estadísticamente hubiera sido esperable encontrar (58/72 casos); sin embargo, cuando la PA fue superior a 1.019 hPa se registraron más casos de los esperados (109/82 casos) (RIE = 1,25; IC95%: 1,04–1,51). El riesgo de NEI aumentó 1,15 veces (IC 95%: 1,05–1,25; $p = 0,001$) por cada hPa de PA, independientemente del género, la edad y la PA media mensual. Se observó relación dosis-respuesta, con aumentos progresivos del riesgo (IRR = 1,06 cuando la PA fue 1.014–1.016 hPa; 1,17 cuando la PA fue 1.016–1.019 hPa y 1,69 cuando la PA fue superior a 1.019 hPa) (p de tendencia = 0,089).

Conclusiones: La PA es factor de riesgo para la aparición de neumotórax espontáneo idiopático.

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Introduction

Idiopathic spontaneous pneumothorax (ISP) is usually caused by air exiting the pleura from bullae located at the apex of the upper lobe of the lung.^{1,2}

The process that makes the bullae' wall to break and triggers the ISP is unknown. Probably, the changes in transpulmonary gradient (pressure difference between alveoli and pleural cavity) have an important role. Thus, the breakage would occur by increasing the gradient of transpulmonary pressure, disrupting the balance between the bulla and the surrounding parenchyma.³ It may be that something common in everyday life, such as barometric variations dependent on the weather, could influence the balance between alveolar and pleural pressures, predisposing an onset of ISP. Several studies have looked for an influence of atmospheric pressure (AP), temperature changes, humidity, season, and atmospheric storms; something that would be consistent with the observation that ISP cases are grouped together.^{4–11} This assumption is attractive, but the published results do not provide conclusive data. This study aimed to evaluate the influence of 2 climatic factors, seasonality and AP, on the occurrence of spontaneous pneumothorax.

Materials and Methods

Data were retrospectively gathered from all patients consecutively admitted with ISP diagnosis at the Hospital Príncipe de Asturias de Alcalá de Henares [Prince of Asturias of Alcalá de Henares Hospital] (Madrid), between January 1, 2002 and December 31, 2010. During this time, this hospital center was the only one in health area III of the Community of Madrid and was serving approximately 400,000 inhabitants. All first or second level emergencies would come to this center, after being evaluated by primary care.

In our center, patients with $ISP > 20\%$ (distance between visceral pleura and chest wall > 2 cm) are admitted and treated with pleural drainage. Patients with $ISP < 20\%$ remain in 24-h emergency observation; in the event of ISP progression, pleural drainage tubes are placed. In the event of ISP stability or decrease, patients are discharged with follow-up consultations.

This study included only patients treated with pleural drainage. Small pneumothorax cases seen in the emergency room (less than 20%), those under observation and those not admitted were not included. Access to these patients' clinical information is very limited, and also, their chronology is more uncertain. Patients with secondary spontaneous pneumothorax due to COPD or previous chronic lung disease were also not included.

Each patient's AP was recorded on the day the pneumothorax was diagnosed, which was the first day of hospitalization. Mean AP was also recorded for the 3 previous days and the mean BP for the month. Measurements performed at the meteorological observatory at Barajas Airport, located 15 kilometers from Alcalá de Henares, were recorded. These data were obtained from the Agencia Estatal de Meteorología [State Meteorological Agency] (AEMET) database (<http://www.aemet.es>). The geographical area covered is in a great plain, with zero altitude variations and identical weather conditions.

A database was developed and then analyzed with the Stata statistics program, version 11. Cases were grouped and stratified by month, year and gender. The time series was plotted graphically; annual trend and seasonality were analyzed, and adjusted for age and gender, using generalized linear Poisson regression models.

Multi-variant analysis of the association between AP and pneumothorax occurrence, adjusted for age, gender and mean AP for the month, was performed using Poisson regression, assuming that the number of cases followed a negative binomial distribution. The association between the number of cases and mean AP for 3 days prior to admission was also analyzed. Results are expressed as incidence rate ratio (IRR) and its confidence interval (CI) of 95%. IRR is an associated risk measure similar to relative risk.

Results

The studied series included 288 ISP cases; all of them needed pleural drainage. Of the total, 229 (79.5%) were men and 59 (20.5%) women, with a mean age of 30.7 (± 13) years. Computed tomography was performed in 94 cases (32.6%), with 83 cases (28.8%) showing apical bullae. In 63 patients (21.9%), thoracoscopy and bulla resection were performed.

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