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Relationship between Meteorological Factors and Emergency Department Visits for Epistaxis in Korea

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한국인에서 비출혈의 발생과 기상조건과의 연관성

김종준 · 최재원 · 임현우 · 송용진 · 여남경

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Background and Objectives Epistaxis may be related to changes in weather, but this relationship has not been well-defined. We investigated the effects of climate fluctuations (temperature, humidity, and barometric pressure) on the number of emergency department (ED) visits for epistaxis.

Subjects and Method In total, our study population included 1910 patients who visited the ED of a large, urban hospital during a 5-year period for epistaxis. Patients with clear etiology for epistaxis (trauma, iatrogenic, coagulopathy, and/or hypertension) were excluded, leaving 912 patients for subsequent analysis. Daily climate data was collected through the Korea Meteorological Administration. Correlation between epistaxis ED visits and weather variables were investigated using Poisson distribution and multiple regression analysis. The effect of climate factor was evaluated on the day and up to 3 days prior to ED presentation. Additionally, analyses were conducted separately for children (<15 years-old), adults (15−64 years-old), and elderly patients (≥65 years-old).

Results Changes in the lowest temperature 2 days prior to ED presentation significantly increased the number of ED visits for epistaxis (β=−0.043, p=0.033). No associations were found between the number of ED visits and changes in humidity or atmospheric pressure. However, in children, interday changes in the highest atmospheric pressure between 2 and 3 days prior to ED presentation were both significantly associated with increased number of epistaxis ED visits.

Conclusion Cold temperatures 2 days prior to ED presentation were related to the increased incidence of epistaxis. Fluctuations in barometric pressure appear to influence the number of pediatric ED visits for epistaxis. Korean J Otorhinolaryngol-Head Neck Surg 2014;57(4):233-8

Key Words Epistaxis · Incidence · Meteorological factors · Temperature · Weather.

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Introduction

Epistaxis is a commonly encountered clinical disease and is one of the most frequent causes for emergency room visits. Data estimate that as much as 60% of the population has suffered from at one episode of epistaxis in their lifetime.[1,2] Epistaxis can be triggered by many causes including trauma, mucosal dysfunction, vascular abnormality, or clotting factor disturbance. Several extrinsic factors−such as the weather−have been purported as precipitating factors in spontaneous epistaxis. Multiple researchers have hypothesized that a close association between epistaxis and alterations in climate exists,[3-8] but no definitive data have been established.

Prior to the 1990s, evidence of an association between epistaxis and weather changes focused solely on pattern of yearly incidence of epistaxis.[3] Since then, multiple articles have

studied relationships between changes in precise weather or meteorological factors and the occurrence of epistaxis.[4-9] In several of those studies, temperature showed the strongest correlation with epistaxis,[5-7] whereas other articles reported the opposite finding.[8]

Therefore, we investigated the relationship of meteorological factors on the number of emergency department (ED) visits for epistaxis in a Korean population compared the difference of known result from previous studies. Relative humidity, atmospheric pressure, and temperature (both average temperature and daily temperature range) showed the most relevance in previous work, and these parameters were used in our study. We hypothesized that there will be several days of delay until weather conditions impact the development of epistaxis. To study this proposal, we analyzed the influence of the aforementioned meteorological factors from the day of ED visit and 3 days prior to ED presentation on the occurrence of epistaxis. In addition, we investigated whether there was an age-difference of meteorological conditions on epistaxis.

Subjects and Method

This research was a retrospective, observational study using review of medical records and meteorological databases. This study reviewed publically available data which was exempted from protocol review by the Gangneung Asan Institutional Review Board. Clinical data were collected through our hospital information system. We identified 1910 patients that visited the ED of Gangneung Asan Hospital, University of Ulsan College of Medicine in South Korea for epistaxis during a 5-year period (January 1, 2007−December 31, 2011). We included only those patients who visited the ED and not to ENT clinic by outpatient appointment, because we would evaluate the epistaxis on the day and the effect of short-term meteorological factors. We excluded cases with a history of nasal or sinus surgery within the preceding 3 months, traumatic epistaxis, anticoagulant use, hematologic disorders, hereditary hemorrhagic telangiectasia, and/or recurrent bleeding within 1 month prior to ED presentation. In total, 912 patients were available for analysis.

Climate data for average temperature, daily temperature range, relative humidity, and atmospheric pressure from Gangneung, Korea were gathered from the Korea Meteorological Administration during the same 5-year timeframe. We assessed the aforementioned meteorological parameters on the day of ED visit and up to 3 days prior to ED presentation, including subsequent days in-between. Delayed effects of meteorological factors on the development of epistaxis were hypothesized, and time-lags of up to 3 days were accounted for in the analyses. The reasons that we considered the time-lags up to 3 days were as in following. First, there were previous well-established studies that reported the relationship between weather and asthma in the time-lags up to 3−5 days.[10,11] Secondly, it was difficult to analyze the association of weather and epistaxis with overfull variables. To evaluate for any age-related effects, we divided patients into children (<15 years-old), adults (15−64 years-old), and the elderly (≥65 years old). We analyzed seasonal distributions of nosebleeds and correlations with the 4 meteorological variables in each age group.

Statistical analysis

Epistaxis visits were investigated for correlations with weather variables using Poisson distribution and multiple regression analysis. Poisson regression model has been commonly used for comparing predicted random occurrences of clustered incidences with incidences observed as a response to influencing events.[12] Initially, Poisson regression was applied to the entire study group with data from more than 4 meteorological parameters, but the regression model was found to be unstable as climate factors showed statistical correlation between independent variables. Therefore, meteorological variables were limited to 4 parameters (relative humidity, atmospheric pressure, average temperature, and daily temperature range) that showed strong correlation in an effort to control for any potential between-variable correlations. We then analyzed for the probability of epistaxis occurring depending on changes of the 4 meteorological parameters on the day of ED visit and up to 3 days prior to ED presentation.

We calculated β regression correlation coefficients and *p*-values for each meteorological variable. *p* values <0.05 were considered statistically significant. Positive β coefficients signify positive correlation whereas negative β coefficients indicate negative correlation. All statistical analyses were performed using SAS, version 9.1 (SAS Institute Inc., Cary, NC, USA).

Results

Of the 912 patients studied, 555 were males (60.9%), and 359 were females (39.1%). Mean patient age was 50.9 years-old± 21.2 (range: 1−93 years-old). Age-specific groupings were as follows: 105 children (11.5%), 541 adults (59.3%), and 266 elderly patients (29.2%).

The incidence of epistaxis for the entire study population showed a seasonal pattern with the number of ED visits highest in February and November and conversely, lowest in July and August. Adults and elderly patients had similar patterns of ED visits. However, children showed the highest incidence of ED presentations in April and the lowest in August (Fig. 1).

We studied the effects of relative humidity, atmospheric pressure, average temperature, and daily temperature range from the day of ED visit and up to 3 days prior to presentation. A significant association was observed between average temperature 2 days prior to ED presentation and epistaxis (β=−0.044, p=0.033)−indicating that lower average temperatures 2 days prior ED visit increased incidence of epistaxis (Table 1). No associations were found with changes in humidity and atmospheric pressure on ED visit incidence.

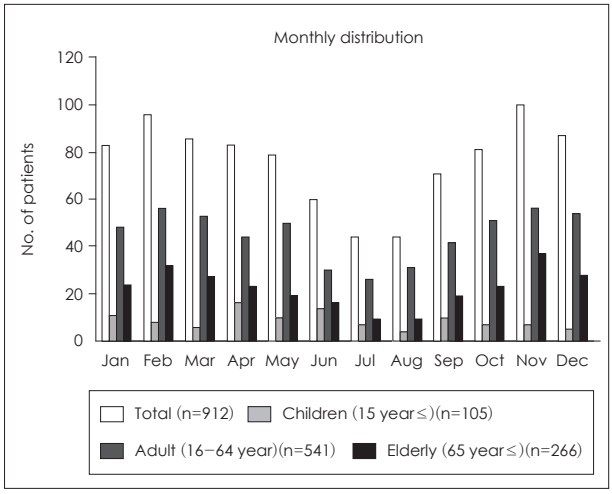

Fig. 1. Monthly distribution of epistaxis. In the total study population and in elderly patients, epistaxis was most common in February and November and least common in July and August. In adults, similar results are shown with the lowest incidences in June and July. In children, epistaxis was most common in April and least common in August. No.: number.

Additionally, we examined the effects of meteorological factors on epistaxis ED visits, according to age group. In children, atmospheric pressures both 2 days and 3 days prior ED presentation were significantly associated with epistaxis (β=0.0003, p=0.006; β=0.0003, p=0.003; respectively)(Table 2). These data mean that higher atmospheric pressure from both 2 days and 3 days prior ED presentation increased incidence of epistaxis. Average temperature 2 days prior to ED visit showed a trend towards significance in both adults (β=−0.0475, p=0.068) and elderly patients (β=−0.0501, p=0.060)−findings similar to the total study population (Table 3 and 4).

Discussion

The underlying etiology for epistaxis is typically idiopathic followed by primary neoplasm, trauma, or iatrogenic.[13] Many factors can influence the incidence of epistaxis, and analyz-

Table 1. Results from multiple regression analysis using Poisson distribution from the total study population (n=912 patients)

Climate parameter		Day of ED visit	1 day prior to ED visit	2 days prior to ED visit	3 days prior to ED visit
Average temperature	β	0.0245	0.0100	−0.0433	0.0202
	p-value	0.0788	0.6189	0.0336*	0.3019
Daily temperature range	β	0.0172	−0.0118	0.0244	−0.0001
	p-value	0.2413	0.4368	0.1023	0.9935
Relative humidity	β	0.0031	−0.0023	−0.0023	−0.0017
	p-value	0.3681	0.4978	0.4880	0.6078
Atmospheric pressure	β	0.0001	0.0001	0.0001	0.0001
	p-value	0.1186	0.1195	0.4108	0.4508

*p-value<0.05; p-value<0.05 was considered statistically significant. β: regression coefficient, ED: emergency department

Table 2. Results of multiple regression analysis using Poisson distribution only in children (n=105 patients)

Climate parameter		Day of ED visit	1 day prior to ED visit	2 days prior to ED visit	3 days prior to ED visit
Average temperature	β	0.0408	0.0326	0.0124	−0.0568
	p-value	0.3187	0.5857	0.8447	0.3474
Daily temperature range	β	0.0607	−0.0679	0.0255	0.0253
	p-value	0.1400	0.1305	0.5569	0.5623
Relative humidity	β	0.0060	−0.0103	0.0122	−0.0102
	p-value	0.5554	0.3030	0.2374	0.3177
Atmospheric pressure	β	0.1575	−0.0005	0.0003	0.0003
	p-value	0.1816	0.8702	0.0058*	0.0034*

*p-value<0.05; p-value<0.05 was considered statistically significant. β: regression coefficient, ED: emergency department

Table 3. Results of multiple regression analysis using Poisson distribution in adults (n=541 patients)

Climate parameter		Day of ED visit	1 day prior to ED visit	2 days prior to ED visit	3 days prior to ED visit
Average temperature	β	0.0101	0.0133	−0.0475	0.0356
	p-value	0.5744	0.6061	0.0680†	0.1608
Daily temperature range	β	0.0167	0.0069	0.0419	0.0138
	p-value	0.3820	0.7227	0.4435	0.4770
Relative humidity	β	0.0025	−0.0011	−0.0052	0.0012
	p-value	0.5741	0.7905	0.2257	0.7761
Atmospheric pressure	β	0.0316	0.0001	−0.0002	−0.0003
	p-value	0.5739	0.3594	0.7021	0.6892

†lowest *p*-value; *p*-value<0.05 was considered statistically significant. β: regression coefficient, ED: emergency department

Table 4. Results of multiple regression analysis using Poisson distribution in the elderly (n=266 patients)

Climate parameter		Day of ED visit	1 day prior to ED visit	2 day prior to ED visit	3 day prior to ED visit
Average temperature	β	0.0489	−0.0516	−0.0501	0.0106
	p-value	0.0615	0.6755	0.0601†	0.7672
Daily temperature range	β	0.0011	−0.0235	0.0511	−0.0423
	p-value	0.9672	0.4078	0.1810	0.1460
Relative humidity	β	0.0034	−0.0013	−0.0007	−0.0047
	p-value	0.5989	0.8284	0.9148	0.4314
Atmospheric pressure	β	0.0264	0.0002	−0.0002	−0.0002
	p-value	0.7370	0.0646	0.7784	0.7773

†lowest *p*-value; *p*-value<0.05 was considered statistically significant. β: regression coefficient, ED: emergency department

ing correlation and causation remains challenging. To date, research on the impact of climate factors on epistaxis incidence are insufficient.

Earlier work evaluating seasonal variation of epistaxis showed the highest incidences in February, June, July, and November.[3,8] In our study, epistaxis also showed seasonal patterns with higher incidence in the winter months (February and November) and the lowest incidence in the summer (July and August). These results may be evidence that climate variation could influence the occurrence of epistaxis. We speculated that the finding of decreased epistaxis in the summer was particularly meaningful as the total number of ED visits at our hospital for all causes increases during that same time-period due to the Korean tourism season.

In our analysis of epistaxis and short-term meteorological factors, we found that lower average temperature 2 days before ED presentation resulted in an increased incidence of epistaxis. This does not mean the absolute value of the lower temperature, but it means that the greater changes from the cold temperature cause more occurrence of epistaxis. This result might coincide with our finding of highest epistaxis incidence in seasonal pattern that February and November are between seasons-winter to spring and autumn to winter, because the changes of the temperature are most pronounced in this periods compared to the other seasons. In addition, average temperature did not have statistical significance in age-specific analyses, but it showed a trend towards significance in both adults and elderly patients. We estimated the reasons that because of reduced the number of population in age-specific analyses.

While previous studies correlating meteorological factors and epistaxis have mostly offered inconsistent findings, several reports have demonstrated inverse correlations between temperature and epistaxis incidence.[5-7] In particular, Reddy, et al.[7] proposed that cold temperatures led to an increase in admission rates for epistaxis. These authors further hypothesized that upper respiratory infections impaired nasal mucosal defense mechanisms at lower temperatures resulting in hypothermic coagulopathy, and together, such impairments led to an increased incidence of epistaxis. Cold temperatures have also been associated with higher blood pressures, and blood pressure changes were most evident in older patients.[14]

Our study showed age-specific differences between meteorological factors and epistaxis. Incidence of epistaxis in children was highest in April whereas adults and elderly both had highest incidences in February and November. Perhaps pediatric epistaxis was more common in the spring due to more frequent allergies that may subsequently cause intranasal mucosal irritation via increased coughing or sneezing. Murray and Milner.[15] showed that allergic rhinitis was associated with

recurrent epistaxis, and children with both nasal symptoms and positive allergy skin testing were found to have recurrent nosebleeds more frequent than those children with either one or neither of such clinical findings. Of note, allergic rhinitis is the most common, chronic disease in childhood with prevalence in some geographic regions of up to 40%.[16]

Additionally, higher atmospheric pressure changes 2 days and 3 days prior to ED visits showed statistically significant correlations with epistaxis, but only in children. Migratory anticyclones arise most frequently in Korea in April at a time that coincides with the increased incidence of pediatric epistaxis seen in our data. Children are thought to be more affected as blood vessel and nasal mucosa are particularly vulnerable at that age as compared to adults. Some data have demonstrated that abrupt changes in barometric pressure were associated with subarachnoid hemorrhages (SAH).[17,18] Setzer, et al.[19] described that decreases in atmospheric pressure were significantly associated with SAH. Abrupt changes in atmospheric pressure may increase systemic blood pressure, thereby leading to increased transmural pressure at weak vessel walls like an aneurysm or in pediatric patients. However, precise pathophysiologic mechanisms explaining the relationship between atmosphere pressure and epistaxis are still unclear.

Some previous investigations had reported that the relative humidity had affected occurrence of epistaxis,[4,20] but our study didn't show any statistically significant correlation between relative humidity and occurrence of epistaxis. Other recent studies by Reddy, et al.[7] and Danielides, et al.[9] comparing the water vapour pressure also showed different results. Many researchers considered the effect of humidity on epistaxis, but the studies showed various results and there are only a few reports in the literatures until now.

Our study has several limitations due to its retrospective design. We did not control for clinical comorbidities except for bleeding risk, trauma, and prior nasal surgery. We were unable to collect data on allergies or viral infections that may impact nasal mucosa. In addition, life styles or personal habits could influence epistaxis-related ED visits.

Despite these limitations, our findings offer significant associations between meteorological factors and epistaxis. We also demonstrated that weather changes impact patients differently based on age. Taken together, our study is the first attempt to survey the seasonality differences in epistaxis incidence and to study the influence of meteorological factors on epistaxis between age groups.

Conclusively, in adults and elderly patients, epistaxis occurred most frequently in the winter months and less commonly in the summer. However, in children, epistaxis incidence was highest in the spring. Cold temperatures 2 days prior to ED presentation led to increased incidence of epistaxis. Fluctuations in barometric pressure appeared to influence the number of pediatric epistaxis visits.

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