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Effects of meteorological factors on the onset of Bell's palsy

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ABSTRACT

Objective: The etiology of Bell's palsy (BP) has not yet been clarified, although viral infection or reactivation is probably a major cause. The objective of this study was to evaluate the effects of meteorological factors on the onset and incidence of BP.
Methods: Meteorological data from 2007 to 2011 were obtained from the Web-based 'Monthly Weather Reports of the Meteorological Administration' database. Patients with BP who attended Incheon St Mary's Hospital during the same period, presenting on the precise day that their symptoms appeared, were included in this retrospective chart review. Twelve meteorological factors were compared for days on which BP onset was and was not observed. The weather conditions occurring 1–7 days before BP onset (D_{-1}–D_{-7}) were included to assess any possible delayed effects of meteorological factors on the onset of BP. The seasonal and monthly distributions of BP were evaluated.
Results and conclusion: The mean values for the meteorological parameters did not differ significantly between the days when BP onset did and did not occur. However, the maximum wind speed on day −1 (D_{-1}) was significantly higher for BP onset days than for days with no BP onset. The seasonal and monthly distributions of BP did not differ significantly. It is suggested that stronger wind speed of preceding day may be related to the occurrence of BP.

1. Introduction

Idiopathic peripheral facial nerve paralysis or Bell's palsy (BP) is the most common cause of facial nerve palsy. BP accounts for approximately 49–51% of all cases of facial nerve palsy, with an estimated incidence of 13–34 cases per 100,000 people per year [1]. A variety of theories have been proposed regarding its etiology, which include viral infection or reactivation, vascular dysfunction, disorders of autonomic regulation, and inflammation. Of these, viral neuropathology is considered to be one of the main pathogenic mechanisms of BP.

Recent studies have suggested, however, that a meticulous study of a "combination of changing factors" may illuminate the underlying pathophysiology of BP. Weather conditions that affect BP have been frequently studied to identify whether they are involved in triggering its pathogenic mechanism. Unfavorable weather conditions such as wide temperature range and cloudy days have been thought to be related with the occurrence of BP [2]. It is generally agreed that that BP was less likely developed in warm temperature or in summer, whereas the occurrence of BP was increased in cold and dry weather or in winter [3–5].

As for the effect of meteorological factors on the onset of BP, no consensus has been reached. There was a report that the incidence of BP increased on days with low barometric pressure in Germany [6]. On the contrary, de Diego et al. [5] reported that lower temperature was associated with a higher incidence of BP, but no relationship was found between atmospheric pressure and BP in Spain. Danielides et al. [7] found no significant correlation between the onset of BP and several meteorological parameters including temperature, atmospheric pressure, and humidity at the onset days. The controversy over the effect of meteorological factors on the onset of BP might be resulted from time lag effect. There will be several days of delay until weather condition affect a human body with a development of BP. Hence, we analyzed the influence of several meteorological factors on the occurrence of BP including meteorological data of the preceding 7 days from the onset of BP days as well as those of onset days.

2. Materials and methods

The study protocol was performed in accord with the principles of the Declaration of Helsinki and approved by the Institutional Review Board of the Catholic University of Korea. The medical

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charts of patients who had been diagnosed with BP at Incheon St Mary's Hospital over a period of four years (from September 2007 to August 2011), with the code 'Bell's palsy' or 'idiopathic facial palsy', were selected from a database. A retrospective chart review of the selected patients was conducted, and only those who presented exactly on the day of disease onset, resided only in Incheon and fulfilled the diagnostic criteria for BP were selected for this study. The inclusion criteria were: (1) sudden weakness on one side of the face; (2) presentation on the exact day of onset; (3) absence of tumors, trauma, and other infections, such as meningitis, otitis media, and Ramsay–Hunt syndrome.

The meteorological data for Incheon city for the same period were available from the database at the Korean Meteorological Administration website (http://www.kma.go.kr/weather/observation/data_monthly.jsp). Information was obtained from the database for the seven parameters examined in the analysis: mean atmospheric pressure, mean temperature (T), maximum temperature (T_{max}), minimum temperature (T_{min}), mean relative humidity, mean wind speed, and maximum wind speed. Day-to-day differences in the mean value of each parameter were calculated from the data. The daily temperature range was defined as the difference between T_{max} and T_{min}. The days on which BP onset was reported over the whole 5 years of the study were defined as BP (+) days, and the days on which no BP onset was reported were defined as BP (−) days. Each weather parameter was compared between the BP (+) and BP (−) days. Delayed effects of meteorological factors on the development of BP were expected and time lags of up to seven days were accommodated within the analysis. Thus, the data for meteorological parameters recorded 1–7 days before the onset of BP were also compared between the BP (+) and BP (−) days. Seasonal and monthly changes in the incidence of BP were also analyzed, together with changes in weather patterns. Each meteorological parameter was compared between the BP (+) and BP (−) days with Student's t test and the χ^2 test. Statistical significance was defined as $P < 0.05$.

Table 1
Comparison of the meteorological parameters on days with and without BP onset.

	BP (−)	BP (+)	*P*
Mean wind speed (m/s)	2.9 ± 0.0	2.9 ± 0.1	0.62
Maximum wind speed (m/s)	5.9 ± 0.1	5.9 ± 0.1	0.98
Mean atmospheric pressure (hPa)	1016.0 ± 0.2	1016.2 ± 0.4	0.57
Day-to-day difference in atmospheric pressure (hPa)	0.0 ± 0.1	−0.1 ± 0.2	0.44
Mean temperature (°C)	12.5 ± 0.3	11.9 ± 0.5	0.33
Day-to-day difference in temperature (°C)	0.0 ± 0.1	−0.1 ± 0.1	0.64
Maximum temperature (°C)	16.2 ± 0.3	15.7 ± 0.5	0.39
Minimum temperature (°C)	9.4 ± 0.3	8.7 ± 0.5	0.29
Daily temperature range (°C)	6.8 ± 0.1	6.9 ± 0.1	0.36
Mean relative humidity (%)	67.5 ± 0.5	67.3 ± 0.8	0.81
Day-to-day difference in humidity (%)	−0.1 ± 0.4	0.3 ± 0.7	0.65
Minimum relative humidity (%)	46.2 ± 0.5	45.7 ± 0.9	0.50

The results presented are mean ± standard errors. BP (−): days when no BP onset was reported; BP (+): days when BP onset was reported.

3. Results

During the study period, 488 patients attended our hospital with a diagnosis of BP. Of these patients, 103 were excluded from the study because another etiology, such as otitis media or herpes zoster infection, was identified in 89 patients and 14 patients did not present on the exact day of disease onset. The remaining 385 patients were enrolled in the study. There were 179 female patients and 206 male patients. The mean age of the patients was 46.7 ± 17.3 years. BP onset was recorded on 344 days of the total 1459 days of the study, including 33 days each with two cases of BP, three days each with three cases of BP, and one day with four cases of BP. In the statistical analysis, the days on which two or more cases of BP were reported were weighted by the number of BP cases reported on that day.

South Korea tends to have a humid continental climate and is affected by the East Asian monsoon, with heavier precipitation in the summer during a short rainy season that extends from the end of June to the end of July. The mean yearly temperature ranges from −4.0 °C in January to 23.9 °C in August. The mean temperature was 12.4 ± 0.3 °C, the mean atmospheric pressure was 1016.0 ± 0.2 hPa, the mean relative humidity was 67.4 ± 0.4%, and the mean wind speed was 2.9 ± 0.0 m/s. During the study period, the temperature ranged between −14.9 °C and 33.6 °C and the relative humidity ranged from 28% to 99%.

When each meteorological parameter was compared between BP (+) and BP (−) days, there were no significant differences in any of the 12 meteorological parameters (Table 1). Assessment of the lag effects of phenomena experienced 1–7 days before BP onset only revealed a significant difference in the maximum wind speed at D_{-1} ($P < 0.05$; Fig. 1B). The mean atmospheric pressure on days D_{-7}–D_0 was higher for BP (+) days, but the difference was not statistically significant. The mean temperature, maximum temperature, and minimum temperature were lower on days D_{-7}–D_0 for BP (+) days, but these differences were also not statistically significant. The distribution of mean humidity did not differ significantly between BP (+) and BP (−) days.

The monthly distribution of BP onset was evaluated, and the BP was most frequently occurred in October (10.3 ± 1.8 cases/month), followed by February (9.0 ± 0.0 cases/month), March (9.0 ± 0.7 cases/month), and April (9.0 ± 2.8 cases/month), although the difference was not significantly different compared to other months. Because the only factor significantly affecting BP onset was the maximum wind speed at D_{-1}, we assessed the monthly maximum wind speeds to identify any tendency in the monthly pattern. The month with the highest maximum wind speed was December (7.1 ± 0.3 m/s), followed by March (7.0 ± 0.2 m/s), which is not consistent with the monthly distribution of BP onset (Fig. 2).

To analyze the seasonal incidence of BP, we divided each year into four conventional seasons: spring (March 1–May 31), summer (June 1–August 31), autumn (September 1–November 30), and winter (December 1–February 28/29). Of the 385 cases of BP, onset occurred most frequently in autumn (26.3 ± 3.0 cases), followed by spring (25.8 ± 4.5 cases), but the difference was not significant among other seasons. We also assessed the seasonal distribution of the maximum wind speed to identify any relationship between maximum wind speed and season. The maximum wind speed was highest in winter (7.1 ± 0.2 m/s), which is not consistent with the seasonal pattern of BP.

4. Discussion

The present study was designed to evaluate the effects of meteorological parameters of onset days as well as preceding 7 days on the onset of BP.

Various diseases such as infectious diseases, rheumatic diseases, and spontaneous pneumothorax have been considered as being affected by weather conditions. The effect of weather conditions on the onset of BP and seasonal pattern of BP occurrence have been studied [3,4,7]. Danielides et al. [7] investigated the relationship between meteorological variables and the incidence of BP in Greece and reported that meteorological conditions have little effect on the incidence of BP. However, they evaluated the effect of meteorological factors of onset day without considering the time lag effect of weather on the development of disease. In this study, maximum wind speed one day before the onset of BP (D_{-1})