The apparent association between atmospheric conditions and the incidence of aneurysmal SAH and other cerebrovascular disorders is controversial, with various publications confirming 10–12,14,17 and others refuting these findings.9,14 In our center a prospectively acquired database of all patients with aneurysmal SAH who were treated at the regional neurosurgical unit has been kept since 1990. Using this information and local atmospheric pressure readings obtained from the Meteorological Office, we have attempted to determine the relationship between aneurysmal SAH and atmospheric pressure in a prospective fashion.

Our hypothesis was that a rise in SAH referrals occurs when the weather conditions change, specifically after an increase in atmospheric pressure. Our aim in this study was to explore the phenomenon and to add to the evidence in the literature on this association.

Clinical Material and Methods

Information about all patients with angiographically proven aneurysmal SAH who were treated in the regional neurosurgical unit is recorded in a database that is updated prospectively. The cases for calendar year 1998 were chosen. These referrals were allocated on the basis of their postal codes to the areas covered by two Meteorological Office stations, one designated WIT and one referred to as WAT, in the northern and southern halves of our catchment area, respectively. No attempt was made to survey those cases of SAH not treated at our center because they had not been proven to be aneurysmal and they would, therefore, not qualify to be in our database. Daily atmospheric pressure readings were obtained from both weather stations through the Meteorological Office. Both sets of readings were combined as one data set for the study. The daily change in atmospheric pressure was calculated by subtracting the previous day’s measurement.

Nonparametric statistics were used for data analysis. Correlations between variables were calculated using the Spearman rank correlation. Comparisons across groups were made using the Mann–Whitney U-test. The Yates corrected chi-square test was used to investigate subgroup distributions.

Results

One hundred nine patients with aneurysmal SAH were included, 34 from the WIT and 75 from the WAT catchment areas. Analysis of the data revealed that one case occurred on each of 81 days (26 WIT days and 55 WAT days), two patients suffered from aneurysmal SAH on each of 11 days (4 WIT days and 7 WAT days), and three events took place on each of 2 days (both WAT days). The median atmospheric pressure was 1014.5 Mb (interquartile range 1006.7–1022.3 Mb) and the median daily change was 0 Mb (interquartile range −4.8 to 5 Mb).
Using the complete data set, we noted that the atmospheric pressure was modestly correlated with the number of events per day (Spearman rank test, r = 0.33, p < 0.0001), and daily change in atmospheric pressure also correlated modestly with the number of cases (r = 0.34, p < 0.0001). The proportion of days with decreasing (δMb ≤ 0: 50.1%) and increasing (δMb > 0: 49.9%) atmospheric pressure was similar, and there was no statistical difference in the number of days with or without events (δMb ≤ 0: 12.6% of days had events; δMb > 0: 13.8% of days had events; p = 0.729). Comparing the days on which occurred aneurysmal SAH with days free of incidents, we noted that neither the atmospheric pressure (median value on days with events = 1016.5 Mb; on days without events = 1014.5 Mb; p = 0.886) nor the daily change in pressure (median value on days with events = 0.5 δMb; on days without events = 0 δMb; p = 0.42) showed significant differences.

If analysis was restricted to the days on which aneurysmal SAH occurred, the atmospheric pressure still correlated with events (r = 0.3, p = 0.004), whereas a statistical trend was found correlating daily change in pressure with events (r = 0.19, p = 0.065). An analysis in which the chi-square dispersion test was used demonstrated no statistically significant relationship between the numbers of aneurysmal SAH events and time of year.

Discussion

This study of prospectively acquired data in 109 patients with angiographically proven aneurysmal SAH shows that the greater the atmospheric pressure, the higher the frequency of SAH, and that increasing pressure leads to more events. After restricting this analysis to only those days on which aneurysmal SAH occurred, a similar statistical relationship has been found.

The hypothesis that more patients suffer aneurysmal SAH after increases in atmospheric pressure appears to be supported in this study. This also agrees with the findings of an increase in stroke events following increases in atmospheric pressure, and also of higher numbers of aneurysmal SAH events on days in which changes in pressure occur, which have been reported in other series. A similar statistical relationship has been found.

Many researchers have found that hemorrhagic stroke is more common in the winter; and decreased clotting capability occur in colder weather, it is not surprising that intracerebral hemorrhagic events appear to occur more in winter than in summer. This indicates that atmospheric pressure alone is not the only meteorological factor precipitating aneurysmal SAH.

From our study, however, the association between atmospheric pressure and aneurysmal SAH appears to be strong. The need for further prospective data acquisition on a multicenter basis is obvious. The cause of aneurysmal SAH is multifactorial, and the reason for the association between rupture and atmospheric pressure may never be fully elucidated; it may be due to rising atmospheric pressure causing greater peripheral resistance, which leads to increased venous return and cardiac output, thus elevating blood pressure, and finally precipitating the aneurysmal SAH. Animal models in which barometric chambers are used may help to answer this question.

References


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