The Influence Of The Weather Condition On Frequency And Patient's Subjective Perception Of Epileptic Seizure

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Abstract

The purpose of this study was to determine the air temperature effect and atmospheric pressure on the frequency of certain types of epileptic seizures as well as on patient's subjective perception of the seizure "severity".

Subjects and methods: The study was conducted for one period of year. Included were patients with epilepsy without cognitive impairment or with mild cognitive impairment (a score of mini mental status MMS> 23), who regularly take antiepileptics. Daily personal epileptic seizure calendar of all subjects was monitored for twelve months, and air temperature and atmospheric pressure value was monitored using biometeorological calendar. The calendar recorded the date, the time of seizure, with the assessment of the seizure "severity" (from 1 to 5), based on autoanamnestic and heteroanamnestic data.

Results: Of the 150 subjects included in the study, 74 (49.3%) were male, while 76 (50.7%) were female. There was no statistically significant difference in age between male and female subjects, with a probability of p = 0.082 (t = -1.751). There were 58 patients with generalized tonic-clonic seizures, (total 58), 56 patients with simple focal seizures, and 36 with complex focal seizures. The seizure frequency in both male and female subjects did not depend on the atmospheric pressure value. However, the seizure frequency is statistically significantly more frequent in days of changing in atmospheric pressure (either decrease or increase) in both men and women. Pearson correlation revealed only statistically significant (p <0.031) negative correlation of the seizure severity with the difference (change) in atmospheric pressure in male subjects, and where the correlation was extremely weak with the coefficient of correlation of r = -0,201. Association of seizure type with atmospheric pressure and its changes did not reach statistical significance.

Conclusion: These results certainly require further monitoring of associated biometherological parameters and their effects on seizure onset.

Keywords: epileptic seizures, air temperature, atmospheric pressure

Conflict of interest

The authors declare that they have no conflict of interest.

Introduction

Epilepsy is a paroxysmal cerebral dysrhythmia defined by three important characteristics: the suddenness of the process, its brain origin and the disorder of the rhythm of the electrical brain activity (1). Seizures are common to all types of epilepsies and they include a variety of clinical manifestations or sudden episodes of disturbance of motor, sensibility, behaviour, perception, awareness or other psychic functions, autonomic and other regulations.

The classification of seizures and epilepsy syndrome takes the central place in modern epileptology, although the classification process itself is as old as the study of epilepsy. The international classification, based mainly on the clinical form of seizure and the electroencephalographic findings, was adopted in 1981 and has been further modified. In 1989, ILAE (International League Against Epilepsy) adopted the International classification of epilepsies, epilepsy syndromes and disorders, which highlights the symptoms and signs that show the localization of initial cerebral dysfunction and its spread (2). In 2017, the ILAE released a new classification of seizure types, based upon the existing classification formulated in 1981. and its extension from 2010. The differences include the following: "partial seizures" become "focal"; consciousness is used as a classifier of focal seizures; terms such as „dyscognitive", „simple partial", „complex partial", „psychic" and „secondary generalized" are eliminated; new focal seizures include automatisms, behavioural changes, hyperkinetic, autonomic, cognitive and emotional; atonic, clonic, epileptic spasms, myoclonic, and tonic seizures can be either focal or generalized phenomena; „focal seizure evolving to a bilateral tonic-clonic seizure" replace the term „secondary generalized seizure"; new generalized types of attack are absence with eyelid myoclonia, myoclonic absence, myoclonic-atonic and myoclonic-tonic-clonic and seizures of unknown onset (3).

Biometeorology is an interdisciplinary science that studies the interaction system between living organisms and the environment. The biometerological warning, bioforecast, contain a description of the meteorological situation and announces the arrival of those weather conditions which may adversely affect human health in the next days. The goal of bioprognosis is the organization of preventive measures for the protection of the vulnerable groups (4).

Variations in biometeorological factors have an influence on the overall balance of the human body, as well as to changes in the condition of patients, primarily those ones with chronic diseases. Le Blanc and Mills (1932) stated that one of the oldest diseases whose association with climatic factors is mentioned, is epilepsy (5). Fluctuation in some climatic factors, e.g. air pressure, air temperature might influence one or more of the mentioned factors, and thus lead to seizure.

The purpose of this study was to determine the effect of air temperature and atmospheric pressure on the specific seizure types frequency as well as on patient's subjective perception of the seizure "severity".

Subjects and methods

The study was conducted prospectively from a period of one year (April 2012 – April 2013). In this study were included patients with epilepsy who were admitted to the Epileptology unit of the Clinic for Neurology of the University Clinical Centre Tuzla, as well as patients in Health Centres of Tuzla Canton. Only patients without cognitive impairment or with mild cognitive impairment (a score of mini mental status MMS> 23), who regularly take antiepileptics are included in the study (6). Excluded are all patients whose cause of seizure might be associated with a febrile condition or some other diseases.

Patients with epilepsy were divided into three groups based of seizure type: In the first group were patients that had generalized tonic-clonic seizures, second group had simple focal seizures, and third group had complex focal seizures. Classification of epilepsy used for this study is the one released by ILAE in 1989 (2).

In the study period, daily personal epileptic seizure calendar of all patients was monitored. The calendar recorded the date, the time of seizure, with the assessment of the seizure "severity" (from 1 to 5) and based on anamnestic and history taken data. Assessment of the seizure severity was the patient subjective experience rated on the five-point scale, ranging from 1 **(**slight seizure**)** to 5 (the most severe seizure) and according to the modified VAS pain scale (7). Temperature and atmospheric pressure values are monitored using biometeorological calendar. Daily biometeorological data from the Hydrometeorological Institute of the Federation of Bosnia and Herzegovina were used.

Results and discussion

Of the 150 subjects included in the study, 74 (49.3%) were male, while 76 (50.7%) were female. The average age of male subjects was 26.72 (± 2.52), with an average deviation from the average for 11.05 years, while the average age of female subjects was 29.99 (± 2.65) with a standard deviation of 11.81 years. There is no statistically significant difference in the age between male and female subjects, with a probability of p = 0.082 (t = -1.751).

The subjects were divided into three groups on the basis of seizure type. In the group of patients with generalized tonic-clonic seizures (total 58), 30 (51.7%) were males and 28 (48.3%) were females (p = 0.793, X = 0.069). The second group consisted of 56 subjects with simple focal seizures, 29 or 51.8% were males and 27 or 48.2% were females (p = 0.789, X = 0.071). The third group consisted of 36 subjects, 15 (41.7%) males and 21 (58.3%) females (p = 0.317, X = 1.00) (Table 1. Figure 1)

The seizure frequency in both male and female was statistically significantly more frequent on days when the air temperature was 0˚C and higher than on days when the air temperature was less than 0˚C (Table 2 and Table 3).

The results also show that the seizure frequency is statistically significantly more frequent in days of air temperature change (either decrease or increase) in both men and women (Table 4 and 5).

The seizure frequency in both male and female subjects did not depend on the atmospheric pressure value. (Table 6 and 7).

The seizure frequency is statistically significantly more frequent in days of atmospheric pressure change (either decrease or increase) in both men and women (Table 8 and 9).

Analysing the biometeorological variable - atmospheric pressure and the variable of experiencing the „severity“of epileptic seizures, the results show that male subjects had „severe“epileptic seizures in days of decrease in atmospheric pressure of 3.11 hPa recorded. On days when they had a slight seizure, there was a decrease in atmospheric pressure by 0.67%.

Female subjects had severe seizures in days of the increase in atmospheric pressure on average 0.78 hPa was recorded. In the days when they had an slight seizure an average decrease in atmospheric pressure of 0.29 hPa was recorded.

Pearson correlation revealed only statistically significant (p <0.031) negative correlation of the seizure severity with the difference (change) in atmospheric pressure in male subjects, and where the correlation was extremely weak with the coefficient of correlation of r = -0,201, as shown on the diagram of scattering, figure 2.

One-way analysis of variance (ANOVA) revealed that the epileptic seizure type is associated with atmospheric pressure and its changes, both in male and female subjects.

Table 10 shows obtained atmospheric pressure parameters with respect to seizure types in male subjects. Differences in average atmospheric pressure values between 3 seizure types in male subjects did not reach statistical significance, as shown by p-values of variance analysis greater than 0.05, (Table 11).

When it comes to analysing the correlation between atmospheric pressure and its changes with a particular seizure type in female subjects, one-way variance analysis did not reveal that average atmospheric pressure values were statistically significantly greater/ less in particular seizure type. The results obtained are shown in Tables 12 and 13.

Discussion

Various environmental conditions have been studied extensively for their role as precipitating or modifying factors related to human health. Particularly, meteorological and climate factors, both short and long-term, have been a subject of interest for health professionals for years, without unequivocal consensus about their role, be it a direct, or an indirect role, such as a predisposition for the propagation of infectious diseases. Results of one study suggest that temperature is the only meteorological factor among observed which affects seizure occurrence. Humidity, atmospheric pressure, precipitation, and number of hours of sunshine were not correlated to seizure incidence. Chiang et al. also showed that ambient temperature affects seizure occurrence. Moreover, they noted that some air pollutants, including CH_4 and NO, are positively correlated with seizure incidence. In our study, the seizure frequency in both male and female was statistically significantly more frequent on days when the air temperature was 0˚C and higher than on days when the air temperature was less than 0˚C. The results also show that the seizure frequency is statistically significantly more frequent in days of air temperature change (either decrease or increase) in both men and women.

Our results show that the value of atmospheric pressure did not affect the frequency of epileptic seizures in neither male nor female subjects. However, when atmospheric pressure change (either decrease or increase), statistically significantly more frequent epileptic seizures were recorded in both male and female subjects. Similar results were demonstrated in Doherty et al. study (8) that showed that in patients with known epilepsy increased seizure frequency occurred with changes in barometric pressure, particularly over 5.5 mBar range per day. The authors state that mechanisms of atmospheric pressure change on seizure susceptibility are speculative. Patients with pseudoseizures or seizures of some other type did not show an increased frequency in the days of atmospheric pressure change.

One-way variance analysis of male and female subjects was applied to analyse the effects of atmospheric pressure change on specific seizure types (generalized, simple focal and complex focal) and the results did not show any statistical significance for any seizure. Similar results are also shown by other authors (9). In the study of Mott et al., the authors could not find evidence that atmospheric pressure changes significantly effect on frequency of any seizure type (focal, generalized or nonepileptic). However, they conclude that unstable weather conditions in spring, autumn and winter cause an increase in the frequency of seizures in in almost half of the epileptic patients but only in 7% in summer. The increase in frequency of seizures in unstable weather conditions did not correspond in all patients with increase of changes in EEG. However, such results suggest an impact of these conditions on subclinical seizures (10).

In the study of Rakers et al. (11), the authors report a linear negative correlation between atmospheric pressure and risk of seizure. The authors conclude that low air pressure and high relative humidity are associated with an increased risk for epileptic seizures, whereas high ambient temperatures seem to decrease seizure risk. They note that these results require further replication across different climate regions and cohorts before reliable clinical recommendations can be made. Our results show only a statistically significant negative correlation between subjective sensation of the severity of seizures and atmospheric pressure changes in male subjects. This significance is not evident in female subjects.

Conclusion

The seizure frequency in both male and female subjects depended on the air temperature value but did not depend on the atmospheric pressure value. The frequency was statistically significantly higher in days when the atmospheric pressure change (increase or decrease) comparing to days when these changes did not occur. The frequency was statistically significantly higher in days when the air temperature was above 0 degree. On days of change in air temperature (either fall or rise), the frequency of epileptic seizures of any kind in both men and women

is statistically significantly higher compared to days when there was no change in temperature. There is no significant correlation between seizure type and atmospheric pressure and its changes. In male subjects there is a statistically significant negative correlation between severity of seizure and atmospheric pressure change, with the atmospheric pressure increase the sensation of seizure "severity" was decreased. There is no clear correlation between severity of seizure and atmospheric pressure change in female subjects. These results certainly require further monitoring of associated biometherological parameters and their effects on seizure onset.

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