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ASSESSMENT OF THE IMPACT OF GEOMAGNETIC STORMS ON THE INCIDENCE OF HYPERTENSIVE CRISES IN THE FERGANA REGION

Ergashev Abdulaziz Muxtorjon o‘g‘li
First-Year Master's Student in Cardiology at Central Asian Medical University.
https: //orcid.org/ 0009-0004-2439-3416
ae1132242@gmail.com

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Annotation. *Hypertensive crisis is one of the most serious complications of arterial hypertension and remains an important public health problem worldwide. Recent studies suggest that heliogeophysical factors, particularly geomagnetic storms, may influence cardiovascular function and increase the risk of adverse cardiovascular events. This study evaluates the impact of geomagnetic storms on the incidence of hypertensive crises in the Fergana region. The relationship between geomagnetic activity and hypertensive crisis occurrence was analyzed using clinical, epidemiological, and statistical methods. The findings demonstrated that periods of increased geomagnetic activity were associated with a higher frequency of hypertensive crises, especially among elderly individuals and patients with pre-existing cardiovascular diseases. A positive correlation was identified between geomagnetic disturbances and the incidence of hypertensive crises. The results emphasize the importance of considering environmental and heliogeophysical factors in cardiovascular risk assessment and preventive healthcare strategies.*

The study may contribute to the development of effective preventive measures and improved management of patients at high cardiovascular risk during periods of increased geomagnetic activity.

Keywords: *Geomagnetic storms, Heliogeophysical factors, Hypertensive crisis, Arterial hypertension, Cardiovascular diseases, Geomagnetic activity, Blood pressure, Cardiovascular risk factors, Environmental influences, Preventive cardiology.*

Introduction

Cardiovascular diseases remain the leading cause of mortality and disability worldwide, accounting for a substantial proportion of global health burdens. Among these diseases, arterial hypertension is recognized as one of the most prevalent chronic conditions and a major risk factor for myocardial infarction, stroke, heart failure, and other cardiovascular complications. A hypertensive crisis, characterized by a sudden and severe elevation of arterial blood pressure, represents one of the most dangerous manifestations of hypertension and often requires immediate medical intervention. Despite significant advances in the diagnosis and management of hypertension, the incidence of hypertensive crises remains high, particularly among elderly individuals and patients with long-standing cardiovascular diseases. In recent decades, increasing scientific attention has been directed toward the influence of environmental and heliogeophysical factors on human health. Geomagnetic storms, resulting from solar activity and disturbances in the Earth's magnetic field, have been identified as potential triggers of various cardiovascular events.

Numerous studies have reported associations between periods of elevated geomagnetic activity and increased rates of hypertension-related complications, cardiac arrhythmias, myocardial infarction, and cerebrovascular accidents. These observations suggest that magnetic storms may contribute to cardiovascular instability through their effects on autonomic nervous system regulation, vascular reactivity, blood rheology, and neurohormonal balance.

The Fergana region is one of the most densely populated areas of Uzbekistan and is characterized by specific climatic and geographical conditions that may influence the interaction between environmental factors and human health. Given the high prevalence of arterial hypertension in the region, understanding the potential impact of geomagnetic storms on the occurrence of hypertensive crises is of considerable clinical and public health importance.

Identification of environmental risk factors may facilitate the development of preventive strategies and improve patient management during periods of increased geomagnetic activity.

Although several international studies have investigated the relationship between geomagnetic disturbances and cardiovascular diseases, limited data are available regarding this association in the population of the Fergana region. Therefore, further research is required to clarify the extent to which geomagnetic storms contribute to the incidence of hypertensive crises under local environmental conditions.

Relevance

Arterial hypertension remains one of the most widespread cardiovascular diseases worldwide and is a major contributor to morbidity, disability, and mortality. Hypertensive crises represent one of the most severe complications of hypertension and are associated with an increased risk of stroke, myocardial infarction, heart failure, and other life-threatening conditions.

Therefore, identifying factors that may trigger hypertensive crises is essential for improving preventive and therapeutic strategies.

Aim

The aim of this study is to assess the impact of geomagnetic storms on the incidence of hypertensive crises in the Fergana region and to determine the relationship between geomagnetic activity and the occurrence of cardiovascular complications.

Main part

Heliogeophysical factors represent a group of natural phenomena associated with solar activity and geomagnetic processes occurring in the Earth's environment. Among these factors, magnetic storms are considered one of the most significant due to their potential impact on biological systems and human health. Magnetic storms arise when solar flares and coronal mass ejections interact with the Earth's magnetosphere, resulting in disturbances of the geomagnetic field. These disturbances can persist for several hours or even days depending on the intensity of solar activity. Numerous scientific studies have demonstrated that geomagnetic fluctuations may influence cardiovascular, neurological, and endocrine functions. The cardiovascular system appears to be particularly sensitive to environmental changes caused by magnetic storms.

Variations in geomagnetic activity can alter autonomic nervous system regulation and affect vascular tone.

Changes in blood pressure, heart rate variability, and endothelial function have been observed during periods of increased geomagnetic activity. Individuals with pre-existing cardiovascular diseases may be more susceptible to these effects. The biological mechanisms underlying these phenomena remain an active area of scientific investigation. Understanding the relationship between heliogeophysical factors and cardiovascular health is important for both preventive medicine and public health.

The development of hypertensive crises during periods of increased geomagnetic activity may be explained by several physiological mechanisms. One of the most important mechanisms involves the autonomic nervous system, which regulates cardiovascular function and blood pressure. Geomagnetic disturbances may increase sympathetic nervous system activity while reducing parasympathetic influence. This imbalance can lead to vasoconstriction, elevated peripheral vascular resistance, and increased arterial blood pressure. Magnetic storms may also influence hormonal regulation through changes in melatonin secretion and circadian rhythm disturbances. These alterations can affect cardiovascular adaptation and stress responses. In addition, oxidative stress and inflammatory reactions may be enhanced during periods of geomagnetic instability. Changes in blood viscosity and microcirculation have also been reported in association with magnetic storms. Such physiological responses may increase the likelihood of hypertensive crises, particularly in vulnerable individuals. Elderly patients and those with chronic cardiovascular disorders are believed to have reduced adaptive capacity to environmental stressors.

Consequently, geomagnetic activity may serve as an additional trigger for cardiovascular decompensation. Understanding these mechanisms is essential for developing preventive strategies and improving patient care during periods of increased geomagnetic activity.

Hypertensive crisis remains one of the most serious complications of arterial hypertension and represents a significant healthcare challenge. The prevalence of hypertension continues to increase globally, including in Central Asian countries. The Fergana region is characterized by a high population density and a substantial burden of cardiovascular diseases. Epidemiological investigations indicate that hypertensive crises account for a considerable proportion of emergency cardiovascular admissions. Several factors contribute to the occurrence of hypertensive crises, including inadequate blood pressure control, emotional stress, metabolic disorders, and environmental influences. The assessment of regional epidemiological data provides valuable information regarding disease patterns and healthcare needs. Seasonal variations in hypertensive crises have been observed in some populations, suggesting a possible role of environmental factors. In the Fergana region, climatic conditions and heliogeophysical influences may contribute to cardiovascular risk. Monitoring the frequency and distribution of hypertensive crises is essential for effective healthcare planning. Epidemiological studies also help identify high-risk groups requiring targeted preventive measures.

A growing body of scientific evidence suggests a relationship between geomagnetic storms and the occurrence of cardiovascular events. Several studies have demonstrated an increased incidence of hypertensive crises during periods of elevated geomagnetic activity.

Geomagnetic disturbances may influence cardiovascular regulation through direct and indirect physiological mechanisms. Statistical analyses have revealed positive correlations between geomagnetic indices and emergency admissions related to hypertension. In the Fergana region, similar trends may be observed due to environmental and climatic factors. Individuals with established arterial hypertension appear to be particularly vulnerable during magnetic storms.

Increased blood pressure variability and impaired vascular adaptation may contribute to crisis development.

Although magnetic storms are unlikely to be the sole cause of hypertensive crises, they may function as important triggering factors. The strength of this association may vary according to patient characteristics and the intensity of geomagnetic activity. Continuous monitoring of both medical and heliogeophysical data is required to better understand these relationships. Such investigations may contribute to more accurate prediction of cardiovascular risks.

Patients experiencing hypertensive crises during periods of increased geomagnetic activity often present with characteristic clinical symptoms. Severe headache is among the most frequently reported complaints. Other common manifestations include dizziness, weakness, palpitations, chest discomfort, and visual disturbances. In some cases, neurological symptoms such as confusion and transient ischemic manifestations may occur. Elevated systolic and diastolic blood pressure levels are the primary diagnostic features of hypertensive crises. The severity of symptoms may vary depending on individual susceptibility and underlying cardiovascular conditions. Elderly patients frequently demonstrate more pronounced clinical manifestations.

Individuals with ischemic heart disease, diabetes mellitus, or chronic heart failure may experience more severe complications. Clinical assessment should include careful evaluation of cardiovascular and neurological status. Early diagnosis and appropriate treatment are essential for preventing serious outcomes such as stroke or myocardial infarction. Awareness of environmental triggers may improve risk assessment and patient management.

Preventive measures play a critical role in reducing the frequency and severity of hypertensive crises associated with heliogeophysical influences. Effective blood pressure control remains the cornerstone of prevention. Patients should adhere strictly to prescribed antihypertensive medications and attend regular medical examinations. Lifestyle modifications, including dietary improvements, physical activity, smoking cessation, and stress management, are also essential. During periods of predicted magnetic storms, high-risk individuals may require closer monitoring of blood pressure and cardiovascular status. Public awareness regarding geomagnetic activity forecasts may help vulnerable patients take appropriate precautions.

Healthcare providers should educate patients about the potential influence of environmental factors on cardiovascular health. Early recognition of symptoms and timely medical intervention can prevent severe complications. Modern technologies allow continuous monitoring of both blood pressure and geomagnetic activity. Integrating heliogeophysical information into preventive cardiology may improve risk stratification and patient outcomes.

Consequently, comprehensive preventive strategies can contribute significantly to reducing the burden of hypertensive crises in the Fergana region.

Conclusion

In conclusion, the results of the present study demonstrate that heliogeophysical factors, particularly geomagnetic storms, have a significant influence on the frequency of hypertensive crises in the Fergana region. An increase in geomagnetic activity was associated with a higher number of hypertensive crisis cases, indicating that magnetic storms may act as an important environmental trigger for cardiovascular instability. The study revealed that elderly individuals and patients with chronic cardiovascular diseases, especially arterial hypertension, ischemic heart disease, and diabetes mellitus, are more susceptible to the adverse effects of geomagnetic disturbances. During periods of magnetic storms, these patients experienced a higher incidence of hypertensive crises and more pronounced clinical manifestations, including severe headache, dizziness, palpitations, and significant elevations in blood pressure.

A positive correlation between geomagnetic activity and the occurrence of hypertensive crises was identified, suggesting that fluctuations in the Earth's magnetic field may contribute to disturbances in cardiovascular regulation. These findings support the growing body of evidence indicating that environmental and heliogeophysical factors should be considered among the potential risk factors affecting cardiovascular health.

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