

Cerebral Venous Sinus Thrombosis May Follow a Seasonal Pattern

Golshan Salehi, MD,* Payam Sarraf, MD,† and Farzad Fatehi, MD, MSc‡

Background: Several studies have demonstrated seasonal and temporal variations in the incidence of arterial stroke; however, for cerebral venous sinus thrombosis (CVST), such study seems lacking. The main aim of this study was to investigate whether there is any seasonal variation for CVST, and association between CVST occurrence and temperature. *Methods:* This retrospective study was conducted from January 2004 to July 2015 in 2 referral centers for the patients with cerebrovascular disorders. One hundred and sixty-six consecutive patients with a hospital admission or discharge diagnosis of definite CVST were included. The incidence of CVST was compared between high-temperature and low-temperature months. *Results:* The mean age of patients was 36.71 ± 12.44 and 130 (78.31%) subjects were female. The highest frequency of CVST was seen in 3 months of July to September (1.69/month per year); and the lowest frequency of CVST was seen from December to April (.83/month per year). Additionally, there was a significant correlation between the mean average of temperature in each month and the frequency of CVST occurrence ($r = .60$, $P = .03$). Moreover, we found a cluster of patients, mostly females, in whom CVST occurred in cold months and accompanied visible cerebral infarct with higher occurrence of seizure, focal neurological deficit, and loss of consciousness. *Conclusions:* It seems that the incidence of CVST increases in high-temperature months of the year and dehydration and ensuing consequences may play an important role in such augmentation; however, the visible cerebral infarct is again more observed in low-temperature months. **Key Words:** Association—cerebral venous sinus thrombosis—incidence—Iran—season—stroke—temperature.

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Introduction

Cerebral venous sinus thrombosis (CVST) is a rare kind of stroke, representing roughly .5-3% of all strokes, marked by clotting of blood in cerebral venous or dural sinuses,

From the *Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran; †Iranian Center of Neurological Research, Imam Hospital, Tehran University of Medical Sciences, Tehran, Iran; and ‡Iranian Center of Neurological Research, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran.

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Address correspondence to Farzad Fatehi, MD, MSc, Iranian Center of Neurological Research, Shariati Hospital, Tehran University of Medical Sciences, North Kargar Street, Tehran 14117-13135, Iran. E-mail: f-fatehi@tums.ac.ir.

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and in rare cases, cortical veins.^{1,2} The annual incidence rate of CVST has been reported as 3 to 4 cases per million in adults and 7 cases per million in children.³ In spite of being rare, CVST has substantial neurological sequel and a high mortality rate within the first month.^{3,4} As compared with the mid-1970s, before the advent of magnetic resonance imaging (MRI), CVST has been diagnosed more frequently over the past decade, and with time, more associated etiologies will be described.^{2,4}

In the past, before the introduction of antibiotics, infection was the main cause of CVST, but currently the main cause has shifted to a hypercoagulable state.⁵ Venous thrombosis can be elicited by either inequity of the body's homeostasis or reduced action of the intrinsic antithrombotic mechanism. Factors influencing this change include infection, brain tumor, inflammatory conditions, genetic thrombophilias, head trauma that causes intracranial bleeding, and certain medications.^{3,4}

Dehydration may play an important role for venous thrombosis especially in neonates and infants.⁶ It is noticeable that for arterial stroke, several studies have demonstrated seasonal and temporal variations in the incidence of such events, and a possible association between daily temperature and incidence of stroke⁷⁻¹⁶; however, for cerebral venous thrombosis, to the best of our knowledge, such study has not been conducted. The main aim of this study was to see whether there is any association between CVST occurrence and temperature; in other words, whether there is seasonal variation for CVST.

Methods

This retrospective study was conducted from January 2004 to July 2015 in 2 main hospitals of the Tehran University of Medical Sciences (Dr. Shariati Hospital and Imam Khomeini Hospital) that are referral centers for the patients with cerebrovascular disorders. One hundred and sixty-six consecutive patients with a hospital admission or discharge diagnosis of definite CVST were included. To include all admissions for CVST to these medical centers, we also searched the emergency, imaging, intensive care, and other hospital departments' databases for CVST cases.

Study Area

This study was conducted in Tehran. Tehran is the largest city and urban area of Iran, the second largest city in Western Asia. This city has a semi-arid climate with continental climate characteristics and a Mediterranean climate precipitation pattern with a typical 4-season pattern. Summer is lengthy, hot and dry, with approximately no rain, and relative humidity is usually little. Average high temperatures are between 35 and 40°C. The hottest month is July, with a mean minimum temperature of 26°C and a mean maximum temperature of 36°C, and the coldest is January, with a mean minimum temperature of -1°C and a mean maximum temperature of 8°C.

CVST Diagnosis

CVST was diagnosed in all patients based on clinical setting (the presentation of headache, seizure, focal neurological deficit [FND], loss of consciousness [LOC]) and accepted definitions according to MRI, magnetic resonance venography, conventional angiography, and computed tomography venography, and only those patients with a definitive diagnosis of CVST were included in the study.

The neurologists had assessed all cases and hospital admission diagnosis was reconfirmed at discharge. The patients with history of head and neck trauma or malignancy, or those younger than 15 years were excluded. Furthermore, patients with identified primary hypercoagulable states (such as protein C and protein S deficiencies

and antiphospholipid antibody and similar states) before or after CVST diagnosis were not included.

The data included the patients' age, gender, medical history, neurological complaints, sign and symptoms during admission and hospitalization (main manifestations of headache, seizure, FND, and LOC), and sinus and venous involvement, venous infarct, and functional score during the first days of admission with modified Rankin scale (mRS).

All patients had received anticoagulants for treatment.

Temperature Extraction

We extracted mean temperature each month (from January 2004) from Iran's meteorological organization. The temperature units are in centigrade.

Statistical Analysis

Data analysis was performed using RStudio (R version 3.2.2) and we used Shapiro-Wilk test to check whether the variables fit the normal distribution. For categorical data, χ^2 test was used. We categorized the months to high-temperature months (June, July, August, September) and low-temperature months (other months) according to temperature calendar and made the comparisons between these 2 categories. In addition, we used Spearman correlation analysis to find the association between mean of temperature in each month and the frequency of CVST occurrence at the same month.

Moreover, we performed cluster analysis to identify different subgroups of patients regarding the 4 main variables of age, sex, the time of CVST occurrence (high-temperature months versus high-temperature months), and the presence of visible venous infarct on brain MRI.

The P value $< .05$ was considered significant.

This study was approved by the ethical committee of Tehran University of Medical Sciences.

Results

In total, 166 patients from 2004 to 2015 were included. The mean age of patients was 36.71 ± 12.44 , and 130 (78.31%) subjects were female. In females, 57 (43.85%) had a history of combined oral contraceptives consumption before the event and 15 (11.54%) were pregnant during the event. The mean temperature on day of admission was 20.27 ± 10.24 ; 1 day before it was 20.46 ± 10.22 , 2 days before it was 20.27 ± 9.97 , and 3 days before it was 20.33 ± 9.97 . The mean temperature from 3 days before admission to the day of admission was 20.31 ± 9.96 . In total, 12 (7.2%) had hypertension, 6 (3.6%) had diabetes mellitus, and 3 (1.8%) had hyperlipidemia. On the other hand, 159 (95.8%) patients had headache, 44 (26.5%) had seizure, 83 (50.0%) had FNDs, and 37 (22.3%) had LOC. The comparison of clinical manifestations between high-temperature and low-temperature months is shown in

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