



ORIGINAL RESEARCH PAPER

Neurology

ETIOLOGICAL AND RISK FACTOR PROFILE OF STROKE IN YOUNG SERVING SOLDIERS AT HIGH ALTITUDE

KEY WORDS:

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ABSTRACT

**Background / Introduction:** Stroke is major cause of morbidity and mortality and its affliction of young serving soldiers posted at high altitude merits special attention in diagnostic, therapeutic and preventive care. Besides, it leaves these patients with residual disabilities like physical dependence, cognitive decline, depression and seizures and enormous socio – economic burden to meet the costs of rehabilitation of “stroke victims”. Cerebral venous thrombosis and rheumatic heart disease are, in general, the leading causes of stroke in the young besides other conditions like tubercular meningitis, autoimmune angitis, coagulopathy, elevated lipoprotein (a), homocysteine, and elevated anti cardiolipin antibodies. Cerebral venous thrombosis in peripheral and splanchnic veins and arterial thrombosis in coronary, mesenteric and cerebral vessels can occur in troops, weeks after their arrival at high altitudes suggesting role of increased viscosity, secondary to raised hematocrit and dehydration and hypoxia in causation of strokes in young previously healthy serving soldiers.

**Aim of the Study:** This study aims to analyse the etiology and risk factor profile of young serving soldiers with stroke referred to tertiary care hospital.

**Methods:** This is an analysis of young apparently healthy serving soldiers (n = 33) who had suffered a Stroke at high altitude over a period of observation of 3 years. They underwent a detailed general and neurological examination following which underwent the following investigations: complete hemogram, blood sugar levels (fasting and post prandial), lipid profile (12-hour fasting state), and other metabolic parameters. All patients were subjected to chest radiography (for any evidence of cardiomegaly), 12 lead ECG, and 2D echocardiography to detect cardiac abnormalities. Neuroimaging (non-contrast CT head) was performed in all and CT Angiography was done in selected cases. They were further screened for procoagulant profile, encompassing protein C, protein S, antithrombin III assays, factor V leiden, and antiphospholipid antibodies. Serum homocysteine levels were also evaluated, along with vasculitic screening and trans oesophageal echocardiography.

**Results:** The most common etiological cause for Stroke in young apparently healthy soldiers at high altitude was found to be venous infarction followed by cardio embolic stroke. 12 patients (36.36%) had arterial infarcts, 19 patients (57.57%) had venous infarcts, while 2 patients (6.06%) had ICH. Our study showed protein S deficiency to be the most common cause of venous infarction (26.82%) followed by protein C deficiency (21.95%) possibly contributed by hypobaric hypoxia with sedentary lifestyle and dehydration increasing risk of venous thrombus.

**Conclusions:** Stroke in young serving soldiers is caused mostly by venous infarction secondary to an underlying procoagulant state with Protein C and S deficiency being the most common cause.

INTRODUCTION

Stroke is a huge public health concern because of its high morbidity and disability. The World Health Organization (WHO) defines the Stroke in an adult as “rapidly developing clinical symptoms and signs of focal (at times global) disturbance of cerebral function, lasting for more than 24 hours or leading to death with no apparent cause other than that of vascular origin”[1].

Stroke is major cause of morbidity and mortality and its affliction of young serving soldiers posted at high altitude merits special attention in diagnostic, therapeutic and preventive care. Besides, it leaves these patients with residual disabilities like physical dependence, cognitive decline, depression and seizures and enormous socio – economic burden to meet the costs of rehabilitation of “stroke victims” [2]. However, for stroke – prevention planning, reliable epidemiological information on pattern disease and exposure to major risk factors and morbidity or mortality trends for cerebrovascular disease especially in younger populations is not available.

Most studies carried out in India show that about 10% to 15% of strokes occur in the population below 40 years, which is a higher proportion compared with other countries. Age has been shown to have a strong association with the incidence of stroke. While the peak age of stroke occurrence is 55 to 65 years, events occurring at a younger age assume importance as they may have causative factors which are different from the conventional ones. Many years ago, causes contributing to stroke in the young were reported as meningo-vascular syphilis in men, puerperal cerebral venous thrombosis in women, and rheumatic heart disease in both sexes. Diabetes, hypertension, heart disease, current smoking, and long-term heavy alcohol consumption are major risk factors for stroke in young adults as in older population [3]. Cerebral venous

thrombosis and rheumatic heart disease are, in general, the leading causes of stroke in the young besides other conditions like tubercular meningitis, autoimmune angitis, coagulopathy, elevated lipoprotein (a), homocysteine, and elevated anti cardiolipin antibodies [4].

Cerebral venous thrombosis and arterial thrombosis in cerebral vessels can occur in troops, weeks after their arrival at high altitudes suggesting role of increased viscosity, secondary to raised hematocrit and dehydration because of increased physical activity, decreased thirst and consequent to less fluid intake and increased loss through combined effects of ultraviolet rays at high altitude and aggravated further by alcohol intake, use of diuretics which impairs the cerebral blood flow. In addition hypoxia induces capillary damage which may promote intravascular thrombosis [5]. We conducted an observational study, to analyse the etiology and risk factor profile of young serving soldiers posted at high altitude with stroke referred to tertiary care hospital.

AIM OF THE STUDY

This study aims to analyse the etiology and risk factor profile of young serving soldiers posted at high altitude with stroke referred to tertiary care hospital.

MATERIAL AND METHODS

This is an analysis of young serving soldiers (n = 33) who had suffered a Stroke at high altitude over a period of observation of 3 years. Stroke was defined as rapidly developing clinical symptoms and signs of focal (at times global) disturbance of cerebral function, cerebellar or brainstem involvement lasting for more than 24 hours or leading to death, with no apparent cause other than that of vascular origin and were confirmed by CT head. Stroke in young was defined as stroke occurring before 45 years and high altitude was defined as 9000 feet and above.

**Data Collection Technique and Tools**

The patients were included in the study after an informed consent from them or accompanying person. The detailed history was obtained with emphasis on time of onset of symptoms, mode of onset of symptoms, and risk factor details (including history of smoking, hypertension, and any treatment for it, diabetes mellitus, dyslipidemia, alcohol use, heart disease, trauma, or oral anticoagulant use). The details of symptoms were also noted down in form of side of involvement, speech and language disturbances, duration of symptoms, associated symptoms of headache, vomiting, visual disturbances, ataxia, seizures, and altered sensorium at onset. They underwent a detailed general and neurological examination following which underwent the following investigations: complete hemogram, blood sugar levels (fasting and post prandial), lipid profile (12-hour fasting state), and other metabolic parameters. All patients were subjected to chest radiography (for any evidence of cardiomegaly), 12 lead ECG, and 2D echocardiography to detect cardiac abnormalities. Neuroimaging (non-contrast CT head) was performed in all and CT Angiography was done in selected cases. They were further screened for procoagulant profile, encompassing protein C, protein S, antithrombin III assays, factor V leiden, and antiphospholipid antibodies. Serum homocysteine levels were also evaluated, along with vasculitic screening and trans oesophageal echocardiography.

**Data Analysis**

Data were analyzed in a descriptive manner and p-values were calculated using the chi-square test.

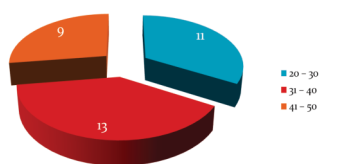
**RESULTS**

The most common etiological cause for Stroke in young soldiers at high altitude was found to be venous infarction followed by cardio embolic stroke.

*Age related incidence of stroke at high altitude area (n = 33)*

Age (in years)	Number of Patients	%
20 - 30	11	33.33
30 - 40	13	39.39
40 - 50	09	27.27

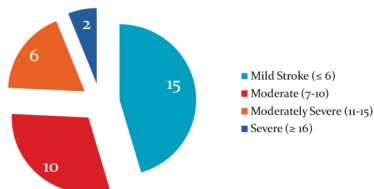
*Age related incidence of stroke at high altitude area (n = 33)*



**Causes of Stroke**



**Severity of stroke based on NIHSS**



The most common etiological cause was found to be venous infarction (57.57%), followed by cardio embolic causes in 12.19%. Cerebral venous thrombosis and rheumatic heart diseases have been reported to be the most common causes of stroke in young in India [6].

Our study showed protein S deficiency to be the most common cause of venous infarction (26.82%) followed by protein C deficiency (21.95%) possibly contributed by hypobaric hypoxia with sedentary lifestyle and dehydration increasing risk of venous thrombus [7].

**DISCUSSION AND CONCLUSIONS**

To best of our knowledge, this is the first such study analyzing the etiology and risk factor profile of young serving soldiers posted at high altitude presenting with stroke. Stroke in young serving soldiers is caused mostly by venous infarction secondary to an underlying procoagulant state with Protein C and S deficiency being the most common cause. The ascent to high altitude represented a pro-thrombotic risk factor in addition to protein S and C deficiency.

Stroke in young patients need to be evaluated more extensively for etiologies other than the common risk factors. We sincerely wish this study will be an important step in understanding risk factors of young serving soldiers posted at high altitude presenting with stroke and sensitize doctors to the need for frequent evaluation and designing preventive strategies as well as future studies on this condition.

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