

Serum Electrolytes in Cerebro-Vascular Accidents



BIOCHEMISTRY

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ABSTRACT

Cerebro-vascular accidents cause significant impairments particularly in older age and are amongst the major health issues in several countries. Limited evidence is available about the association between electrolytes and cerebro-vascular accidents in the general population. In view of this, the present study was conducted to analyse serum electrolytes in patients with cerebro-vascular accidents. 40 patients with cerebro-vascular accidents and 40 sex matched healthy controls aged 45 to 85 years were enrolled for this study and serum electrolytes were measured via standard laboratory methods. Patients with cerebro-vascular accidents had higher serum sodium and chloride levels with lower serum potassium levels compared to the controls which were statistically significant. Therefore, the findings of this study confirm the strong association between serum electrolytes and incidence of cerebro-vascular accidents.

INTRODUCTION

Stroke or a Cerebrovascular Accident (CVA) is defined as the "Abrupt onset of a neurological deficit that is attributable to a focal vascular cause" (1). If the neurological signs and symptoms last for < 24 hours, it is called as a Transient Ischaemic Attack (TIA) and if they exceed 24 hours, then it is called as stroke (2). A stroke or "brain attack" occurs when a blood clot blocks the blood flow in a vessel or artery (Ischemia) or when a blood vessel breaks (Haemorrhage), interrupting blood flow to an area of the brain. When either of these things happens, brain cells begin to die and abilities controlled by that area of the brain are lost.

"Little stroke, big trouble" the theme of the World Health Day, 2008, speaks about the importance of Stroke as a critical warning sign of further more debilitating vascular events or death(3). Due to the consequent high mortality and morbidity rates, stroke has become a major community health problem worldwide and it is the third leading cause of death and long term morbidity in developed and developing countries (4,5).

High mortality in stroke is due to some complications like cerebral oedema and brainstem herniation; infection, electrolyte imbalance and associated heart disease and metabolic disorder(6). Hypo and hypernatremia are reported to be the most common electrolyte abnormality in hospitalized sick adults. In a state of hyponatremia- hypoxia causes further damage to the brain in a stroke patient. Further, convulsion due to hyponatremia may aggravate the intracerebral oedema in a stroke patient to worsen the situation(6).

Mild hypo or hypernatremia may be auto reversible, but when it becomes severe and develops all on a sudden, it itself can cause death of a patient(6). It has been shown that high dietary sodium intake is associated with increased risk and mortality of different types of cerebral vascular events(7,8). Patients with intracerebral disorders are prone to develop a state of hypernatremia and are unable to prevent loss of sodium in urine (6).

Experimental studies on hypertensive animal models are suggestive of a protective role of potassium intake on vascular events (9) and higher potassium excretion has been associated with a lower risk of CVA(10, 11). Some of the proposed mechanisms for potassium induced CVA reduction include improved endothelial dysfunction with vasodilation, increased vascular nitric oxide, reduction in asymmetric dimethyl arginine, decreased vascular intracellular calcium and sodium, alteration in DNA synthesis and proliferation in the cerebral vascular smooth muscle, decrease in vascular neointimal formation, lower thrombosis risk, reduction in oxidative stress and NADPH oxidase, and decrease in vascular inflammation (12).

The studies available at present regarding serum electrolytes in cerebro-vascular events are scarce and their associations are not well studied. Further, none of the studies have demonstrated

chloride levels in stroke patients. This study is therefore designed to document the changes in serum electrolytes in stroke patients and compare with controls.

MATERIALS AND METHODS

Type of study: Observational study

Study Design: Case Control study

Study Population

The study was conducted in Shri Sathya Sai Medical College and Research Institute from September 2013 to January 2014. A case group of 40 patients with Cerebro-Vascular Accidents aged more than 45 years were registered. CVA in participants was diagnosed according to clinical presentations suggestive of such events and was confirmed by brain computed tomography. Patients with Diabetes, Hypertension or with serious comorbidities such as Congestive Heart Disease, Kidney or Liver Failure, Hypernatremia or Hyponatremia, Hyperkalemia or Hypokalemia were excluded from the study. Furthermore, patients who were using medications with an effect on Na⁺ or K⁺ metabolism including diuretics were also excluded. The control group consisted of 40 age and sex matched healthy controls admitted with some other ailment other than CVA and not suffering from conditions known to produce hyponatremia or hypernatremia. The study protocol was explained to the participants in the appropriate languages, best understood by them. A full medical history was obtained from these participants and informed consent was signed by each of them.

Sample Collection and Biochemical Analysis

5 ml of venous blood was collected from each patient with cerebro-vascular accident as per the ICMR guidelines and serum samples were analysed for electrolytes on the same day of collection by Ion Selective Electrode Technology using Ilyte Analyser.

Statistical Analysis

- ✓ Data was presented as Mean ± SD.
- ✓ The findings were analysed by student "t" test.
- ✓ P value of less than 0.05 was considered significant.
- ✓ All statistical calculations were performed using SPSS, version 17.0.

RESULTS

The present study included a total of 80 consented individuals divided into 2 groups. The study group comprised of 40 patients with cerebro-vascular accidents and 40 healthy controls were recruited as control group. The mean age of the participants was 56.5, ranging from 45 to 85 years. No significant differences were observed between patients in CVA group and the control group in terms of age (P = 0.08) and the frequency of gender of the participants (P = 0.07). Both the study group and the control group were evaluated for serum electrolytes and the results obtained were as fol-

lows: Table 1 depicting the resultant value is missing and is to be included. Refer the source document sent earlier.

From the results obtained, it was evident that serum sodium and chloride values were intensely raised together with corresponding deteriorating potassium levels in patients with cerebro-vascular accidents. As evidenced from table 1, there was a significant increase in the levels of serum sodium in stroke patients (141.5 ± 2.77) as compared to controls (137.95 ± 2.48); ($P < 0.0001^{***}$) whereas serum potassium levels were significantly reduced in the study group (3.6 ± 0.39) when compared to the control group (4.42 ± 0.55); ($P < 0.0001^{***}$). Patients with cerebro-vascular accidents also had higher serum chloride levels (106.87 ± 4.29) compared to the controls (104.32 ± 4.52) which were also statistically significant ($P < 0.05^*$). Figure 1 depicting the resultant value is missing and is to be included. Refer to the source document sent earlier

DISCUSSION

The present study showed significant changes in serum electrolytes in cerebro-vascular patients. According to Shervin Farahmand et al(2013), Serum sodium levels were significantly increased with decreased serum potassium levels in stroke patients compared to controls at $P < 0.001^{**}$ (13). Sisir Chakraborty et al (2013) also reported similar results of serum electrolyte concentrations in stroke patients compared to controls at $P < 0.001^{**}$ (6). The findings of this study were in accordance to the above 2 studies at $P < 0.0001^{***}$. In addition, the present study showed higher serum chloride levels in the study group compared to the control group at $P < 0.05^*$. To the best of our knowledge, this is the first study elucidating serum chloride changes

in stroke patients and higher significant changes in serum sodium and potassium in the study group compared to controls.

It has been previously shown that for an actual increase in brain volume to occur, additional fluid must be added to the brain's extracellular space. During permanent ischemia, blood sodium rapidly enters the extracellular fluid of the brain, leading to consequences of brain oedema^(14,15). Therefore, Sisir Chakraborty et al (2013) hypothesized that higher serum sodium levels are associated with higher risk and exacerbation of events following brain ischemia⁽⁶⁾. Evidence derived from studies such as Trials of Hypertension Prevention Collaborative Research Group indicate the association of a reduction in sodium intake with long-term reduction in CVA, suggesting a protective role of limiting dietary sodium intake in primary prevention of vascular events⁽¹⁶⁾. The discussion is incomplete. Both 3rd and 4th paragraph under discussion are missing and ought to be included. Refer the source document sent earlier.

CONCLUSION

The present study suggests higher serum sodium and chloride levels with lower serum potassium levels to be independently associated with higher incidence of CVA confirming the association between serum electrolytes and cerebro-vascular accidents. In order to reduce the risk of cerebro-vascular accidents, physicians must intervene and recommend for reducing dietary sodium chloride with increasing dietary potassium intake and initiate effective therapy to maintain the equilibrium of electrolytes to prevent further recurrence of strokes.

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