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# To study serum zinc levels in ischemic stroke patients

**Sushree S Rautaray[1]* and Purnima Dey Sarkar[2]**

[1]Department of Biochemistry, Army College of Medical Sciences, Delhi, India

[2]Department of Biochemistry, M.G.M Medical College, Indore, India

## Abstract

Stroke is the leading cause of mortality and morbidity worldwide, particularly in the elderly. Zinc is essential for the structure and function of regulatory, structural and enzymatic proteins and mediates various cellular and physiological functions. The aim of this study was to investigate the relationship between serum zinc and stroke outcome. Our study included 200 patients of ischemic stroke and 200 controls. Low serum zinc levels were reported in ischemic stroke patients compared to controls and a poor functional status at discharge.

## Introduction

Stroke is the leading cause of disability worldwide and a serious neurological disease [1]. Ischemic strokes constitute 80-90% of all cases. The term stroke defines rapidly developing clinical symptoms and signs of focal loss of cerebral function lasting for more than 24 hours leading to death with no apparent cause other than vascular origin [2]. The increasing incidence of stroke in Indian patients (>65 years) is possibly due to industrialization, stress of life, less exercise, increasing incidence of smoking, hypertension and other factors. Zinc is one of the most abundant trace elements in the body. It mediates several vital physiological processes and functions and is essential for maintaining a healthy immune system and meeting metabolic demands [3]. However, whether zinc exerts neuroprotective effect during ischemic stroke is still unclear. Zinc is essential for the structure and function of regulatory, structural and enzymatic proteins. Zinc with calcium, potassium and sodium acts as a key modulator of neuronal excitability. The glutaminergic synapse is the most abundant synapse in the cerebral cortex and plays a pivotal role in cortical communications. Mean zinc levels in healthy cohorts range from 70 $\pm$ 32 mcg/dl [4] to 105.2 mcg/dl [5,6]. These levels tend to decrease with age. We studied serum zinc levels in ischemic stroke patients and whether low zinc levels ($\leq$65 mcg/dl) are associated with higher stroke severity and poor functional status at discharge.

The study was case controlled in design. We have selected the patients as they have presented. Patients included in the present study were all admitted to the Intensive Care Unit (ICU) or attending the outpatient department of Medicine of Maharaja Yashvantrao Hospital attached to Mahatma Gandhi Memorial College, Indore (M.P). The study group consisted of 200 patients with ischemic stroke between 60-75 years of age and they were undergoing admission to hospital and 200 age and sex matched controls were taken with no family history of stroke. Brief clinical history covering the signs and symptoms, past, personal and family history of concerned risk factors were taken. All participants gave written informed consent and this protocol was approved by ethical and research committee of Mahatma Gandhi Memorial Medical College, Indore. Table 1 gives the details of the profiles of the subjects. The study was case controlled in design. We have selected the patients as they have presented. Patients included in the present study were all admitted to the Intensive Care Unit (ICU) or attending the outpatient department of Medicine of Maharaja Yashvantrao Hospital attached to Mahatma Gandhi Memorial College, Indore (M.P), India.

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M.K. Chooi *et al.,* studied low zinc levels to be defined as $\leq$65 mcg/dl. We divided zinc levels into two groups: low levels ($\leq$65 mcg/dl) and normal levels ($\geq$65 mcg/dl) [4-6].

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Statistical Analysis All values are presented as mean $\pm$ s.d. Statistical significance was analysed by student 't' test and correlation between

***Correspondence to:*** Sushree S Rautaray, Department of Biochemistry, Army College of Medical Sciences, Delhi, India, E-mail: sambit.nayak77@gmail.com

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variables were studied by using Pearson's correlation coefficient test. The level of significance was set at $p<0.05$.

## Results

The clinical characteristics of Ischemic stroke patients and control subjects are presented in Table 1. Among 200 Ischemic stroke patients, 130 were males and 70 were females. Among 200 controls 125 were males and 75 were females.

The clinical and biochemical characteristics of the patients and controls is described in Table 2.

## Discussion

The study was conducted on 200 confirmed cases of ischemic stroke patients and 200 age and sex matched controls. Our study showed that lower zinc levels (≤65mcg/dl) are associated with ischemic strokes with poor functional status at discharge. It is still unclear that whether zinc is neuroprotective or neurotoxic or both [3]. Several studies have demonstrated that increased intracellular zinc levels [7,8] during ischemic stroke may enhance neuronal death [7]. Preclinical studies have demonstrated the role of zinc in cerebral ischemia and stroke. Animal based studies have shown that zinc supplementation reduces infarct size [9], while zinc chelation is neurotoxic.

Bhatt *et al.,* studied low serum zinc levels in 35.7% patients of ischemic stroke and poor functional staus discharge [10]. Munshi *et al.,* reported that low zinc levels is an independent risk factor for stroke [11]. Sorensen *et al.,* reported the disappearance of zinc positive neuronal terminals in the ischemic neocortex and related areas,most likely due to a neuronal release of vesicular zinc in response to hypoxia,and concluded that the high extracellular concentration of zinc is thought to be neuroprotective by blocking the receptors [12]. Alteration of zinc levels in brain may influence neurotransmission in zinc containing glutaminergic synapses. Therefore dietary zinc deficiency may influence zinc homeostasis in the brain, resulting in brain dysfunction such as stroke. A Munshi *et al.,* reported low zinc levels may be in fact a risk for stroke [12].

The results of this study show that zinc is found to be deficient in patients with ischemic stroke. The development of new treatment and preventive strategies need to be taken into account for the role of zinc in neuronal function, damage and repair. Further studies are required to delineate the importance of serum zinc levels in patients with ischemic stroke and to investigate whether low zinc levels are associated with long term outcomes.

**Table 1.** Baseline characteristics of study subjects.

| Particulars | Patients (n=200) | Controls (n=200) |
|---|---|---|
| Age (years) | 70.2 ± 19 | 68.2 ± 16 |
| Male/ Female | 130/ 70 | 125/ 75 |
| HTN (%)* | 116% | 52% |

*HTN= Hypertension

**Table 2.** Characteristics of patients with Ischemic Stroke and association with low Zinc levels (≤ 65 mcg/dl).

| | Total N = 200 | Zinc level N=100 (≤ 65 mcg/dl) | Zinc level N=100 (≥ 65 mcg/dl) | P value |
|---|---|---|---|---|
| Mean age yrs (mean ± SD) | 66.2 ± 19 | 70.2 ± 20 | 68.2 ± 16 | P < .05* |
| Males (N) | 100 | 50 | 50 | P < .05* |
| Hypertension (N) | 40 | 30 | 30 | P < .001** |
| Smoking (N) | 40 | 20 | 20 | P < .001** |

*P – value < .05 = Significant
**P- Value < .001 = Highly Significant

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