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ORIGINAL ARTICLES

Serum Creatine Kinase Concentration & Its Association with Severity in Acute Ischemic Stroke Patients: A Cross-Sectional Analytical Study

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Abstract:

Background: *The diagnosis of ischemic stroke remains a clinical one, with confirmatory evidence obtained through neuroimaging. Analogous to the role that the creatine kinase (CK), a biochemical test may be useful in diagnosis as well as detect severity which ultimately helps in the management of acute ischemic stroke.*

Objective: *To evaluate serum creatine kinase level and its association with severity in acute ischemic stroke patients.*

Methods: *This cross-sectional analytic study was carried out in the Department of Neurology, BSMMU, Dhaka from January 2014 to December 2014.In this study 50 acute ischemic stroke patients were enrolled as cases.*

Result: *In this study, 42.0% patients were female and 58% were male and their mean age was 55.96±10.93 years. According to classification by NIH Stroke score, 32% patients was found in minor stroke, 28% in moderate stroke, 26% in moderate to severe stroke and 14% in severe stroke. 80.0% patients had increased level of serum creatine kinase. In this study there is a positive correlation between NIH Stroke Score and Serum creatine kinase level ($r= 0.869$, $p < 0.0001$).*

Conclusion: *Increase severity of acute ischaemic stroke causes increased level of serum creatine kinase.*

Keywords: *Acute ischemic stroke, Serum creatine kinase; NIH stroke score; Bangladesh.*

Introduction:

Acute stroke is characterized by the rapid appearance (usually over minutes) of a non-convulsive, non-traumatic focal deficit of brain function, most commonly a hemiplegia with or without signs of focal higher cerebral dysfunction (such as aphasia), hemi sensory loss, and visual field defect or brain-stem deficit.[1] The neurovascular syndromes enable the physician to localize the lesion—sometimes so precisely that even the affected arterial branch can be specified[1-]3. Most embolic strokes characteristically occur suddenly, and the deficit reaches its peak almost at once. Thrombotic strokes may have an abrupt onset, but they evolve somewhat more slowly over a period of several minutes or hours and occasionally days; in the latter case, the stroke usually progresses in a series of steps rather than smoothly. In hypertensive cerebral hemorrhage the deficit may be virtually static or steadily progressive over a period of minutes or hours, while subarachnoid hemorrhage is almost instantaneous[1-3].

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An analogous example would be cerebrovascular thrombosis. About two thirds of patients with cerebrovascular thrombosis develop increase in serum creatine phosphokinase(CPK) levels, maximum at 48 to 72 hours after the stroke. Values as high as 2,900 units per ml. have been reported. The CPK slowly returns to normal over a two week period[4,5]. The level of CPK activity in the serum and spinal fluid are quite independent of each other, since neither isoenzyme crosses the blood brain barrier in significant amounts[6].

Creatine kinase(CK) is a dimeric globular protein consisting of two subunits with a molecular mass of 43 kDa. It buffers cellular ATP and ADP concentrations by catalysing the reversible exchange of high-energy phosphate bonds between phosphocreatine and ADP produced during contraction. At least five isoforms of CK exist: three isoenzymes in cytoplasm (CK-MM, CK-MB and CK-BB) and two isoenzymes (non-sarcomeric and sarcomeric) in mitochondria[7].

CK-MM is found in several domains of the myofibre where ATP consumption is high and is a marker of muscle disease[8]. CK-MB increases in acute myocardial infarction[9] and CK-BB increases in brain damage[10]. Patients with neurological conditions such as acute cerebrovascular accidents[11]and proximal spinal muscular atrophy[12] show marked elevation of CK-BB. Brain is a rich source of a variety of enzymes and any injury (e.g. stroke) to brain tissue could similarly result in an increase in activity of these enzymes in cerebrospinal fluid. A simultaneous increase in serum levels will probably depend on integrity of blood brain barrier. If injury is severe enough to disrupt the blood brain barrier there might be some rise in enzymatic activity in serum. As the stroke syndrome is usually clearly delineated clinically but in some patients laboratory evidence of the presence of cerebral infarction may provide additional diagnostic and prognostic information. Determinations of serum enzyme activity have the advantage of permitting repeated sampling without danger or inconvenience to the patient. The objective of the present study was to determine the variations in serum creatine kinase (CK) activity in patients presenting with acute ischemic stroke and to correlate these findings with the severity of disease.

Method:

This cross-sectional analytical study was conducted in the Department of Neurology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka over a period of one year from January 2014 to December 2014. Fifty diagnosed patients of acute ischaemic stroke within first 2 weeks of presentation age 18 years and above of any sexes were included in this study. The demographic information, relevant history, examination findings and investigation reports of all the study subjects were recorded in the data collection sheet. Any complication during the procedure and hospital admission if required was also recorded. All data were recorded systematically in preformed data collection form (questionnaire). Quantitative data were expressed as mean and standard deviation and qualitative data were expressed as frequency distribution and percentage. Statistical analysis was performed by using windows based computer software "Statistical Packages for Social Sciences" (SPSS-12). Associations between continuous variables were analyzed by Kruskal-Wallis test. Correlation was done by Spearman correlation coefficient test. For all statistical tests, it was considered p value <0.05 as statistically significant.

Result:

Table-I

Demographic profile of the study population (n=50)

	Frequency (n)	Percentage (%)
Age (years)		
≤50	16	32
51 -60	20	40
>70	14	28
Mean ± SD	55.96± 10.93	
Min - Max	32.00 - 75.00	
Gender		
Male	29	58
Female	21	42
Male: female ratio	1.38 : 1	

Out of 50 acute ischaemic stroke patients, females were 42% and males were 58%. Male and female ratio was 1.38: 1. Mean age of the patients was 55.96±10.93 years with range of 32 to 75 years. The most frequent age group was 51-60 years.

Table-II

Serum creatine kinase level in different groups of acute ischaemic patients (NIH stroke score).

Group	Serum Creatine Kinase (u/L)	P value*
Minor Stroke(16)	194.6 ± 79.0	<0.0001[s]
Moderate Stroke(14)	699.5 ± 250.2	
Moderate to Severe Stroke (13)	1414.3 ± 444.8	Severe (7)
3204.2 ± 753.2		
Total	1074.4 ±1052.6	

The highest increased value of Serum CK was recorded in severe stroke which was 3204.28 (753.23) u/L. It was decreased step by step by moderate to severe stroke accounted 1414.31(444.83) u/L, 699.57 (250.23) u/L in moderate stroke and 194.62 (79.02) u/L in minor stroke.This increasing trend of serum CK level from minor stroke to severe stroke i.e. severity was tested by Kruskal-Wallis test which was statistically highly significant (p value <0.001).

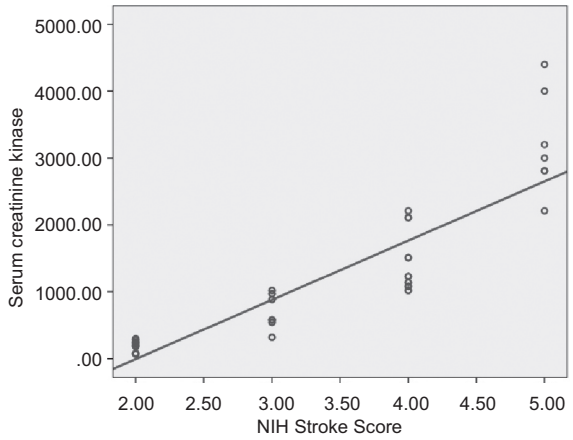

Fig.-1: *Correlation between NIH Stroke Score and Serum creatine kinase level of the study population*

NIH Stroke Score had a positive correlation with serum creatine kinase level of the study population (r= 0.960; p<0.0001).

Discussion:

In this study, male to female ratio was 1.38: 1. Mean age of the patients was 55.96±10.93 years with range of 32 to 75 years. The most frequent age group was 51-60 years. In correspond of these study findings, Elyaset al.[13]also found male predominance in their study (63.33%). A study at Bangabandhu Sheikh Mujib Medical University, Bangladesh revealed male to female ratio 2.75:1. In that same study, it was reported that age range from 35 to 79 years with mean 59.45 years and majority of patients were in 7th decade (n=20, 33%) and 6th decade (n=16, 27%).[14]

According to classification by NIH Stoke score in this study, more patients were found in minor stroke (32%) which was followed by moderate (28%), moderate to severe (26%) and severe stroke (14%).

The mean serum creatine kinase level was found 1074.4±1052.6u/L in the range of minimum 67.0 to maximum 4400.00 u/L. Ay et al.[15] estimated total CK level in 32 patients of stroke. They found elevated CK level among 62.5% patients. Another study done by Norris et al.[16] found 101 patients had raised total CK values among 224 patients with stroke which stands for 46%. Myers et al.[17] found 15 stroke patients out of 100 patients with abnormally high CK values.

The highest increased value of Serum CK was recorded in severe stroke patients which was 3204.2±753.2 u/L. It was decreased step by step, moderate to severe stroke accounted 1414.3±444.8 u/L, 699.5±250.2 u/L in moderate stroke and 194.6±78.0 u/L in minor stroke. Increasing trend of serum CK level from normal to severe stroke i.e. severity was tested by multiple comparison test which was statistically highly significant (p <0.0001). There was a positive correlation between NIH Stroke Score and serum creatine kinase level of the study population (r=0.960; p<0.001), which indicates that increase severity of stroke causes increase level of serum creatine kinase. Capocchiet al.[18] also correlated with severity of brain damage in acute ischemic stroke patients with serum CK-BB level. In stroke patients they found a statistically significant correlation between severity of brain damageand serum values of CK-BB. Eisenet al.[6] also

suggested that the presence of high peak activities and an early rise in serum CPK may indicate increase severity as well as a poor prognosis. All these study findings correspond with this study.

Conclusion:

It can be concluded that serum creatine kinase level has association with severity in acute ischemic stroke patients.Serum creatine kinase in this regard can be an important tool in understanding the severity of acute ischemic stroke.

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