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*Afr. J. Biomed. Res. Vol. 23 (Special Edition, July, 2020); 59- 63*

*Research Article*

# **Electrolyte Derangements and Its Association with Mortality in Stroke Patients in the University College Hospital, Ibadan, Nigeria**

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## **ABSTRACT**

Stroke is a leading cause of morbidity and mortality worldwide, and it is likely to worsen in developing countries over the next two decades based on the projections by the World Health Organization (WHO 2005). A high level of mortality and morbidity in stroke patients has been recorded with coexisting comorbidities like Infections, cerebral oedema, hyperglycemia and electrolyte derangements. Data on electrolyte derangements in stroke patients still remain somewhat scanty till date. The study was aimed at determining whether complications of stroke include electrolyte derangements, and what relationship it has with mortality of stroke patients. A total of 98 stroke patients were enrolled in this observational study after considering all relevant inclusion and exclusion criteria, A detailed history and examination was performed on patients, samples for Electrolyte, Urea and Creatinine were taken from patients, Patients were followed for a period of one month and those discharged before a month were followed up on phone to determine their current status at home. There was a greater incidence of stroke in males as compared to females with a male: female ratio of 4.39:1, A higher mortality was also seen in males of which the older age group accounted for more than half of the cases. Azotaemia and Hypercreatinemia accounted for the most frequent electrolyte derangements. There was no statistically significant difference between proportion of those who died with abnormal electrolyte and proportion of those with abnormal electrolyte that survived. The high level of electrolyte derangements in stroke patients is a call for more studies to determine the role of electrolytes in the mortality of stroke patients.

**Keywords:** *Stroke, Mortality, Electrolyte derangements, Azotaemia, hypercreatinemia*

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*Received: September, 2019; Accepted: March, 2020; Published: July 2020*

## **Abstracted by:**

*Bioline International, African Journals online (AJOL), Index Copernicus, African Index Medicus (WHO), Excerpta medica (EMBASE), CAB Abstracts, SCOPUS, Global Health Abstracts, Asian Science Index, Index Veterinarius*

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## **INTRODUCTION**

Stroke is defined as any neurologic deficit caused by an acute focal injury of the Central Nervous System from a vascular origin which includes cerebral infarction, intracerebral haemorrhage and subarachnoid haemorrhage (Sacco *et al.* 2013). Stroke and Cardiovascular diseases are the leading causes of death and disability worldwide with stroke having a prevalence of 1.14 per 1000 of admissions increasing to 24.14 per 1000 in those above 65 years of age (Jacob *et al.* 1971). Almost a third of stroke patients die within the first 3 weeks and about 48% die within the first one year. (Harrison)

It's been reported that African Countries have transitioned to a lifestyle that support risk factors for stroke, this transition has been implicated in the increasing burden of cardiovascular diseases and stroke globally (Owolabi *et al.* 2014).

Currently, there is paucity of information on the current epidemiology of stroke in African countries. The causes of stroke in Africa are very peculiar with Hypertension being the leading cause. Stroke is the leading cause of hospital admissions in most neurology units in Africa (Wahab *et al.* 2008).

There has been dearth of information on electrolyte derangements and associated risk factors amongst stroke patients in Africa. Studies have shown that one of the major contributors to poor survival of patients after a stroke event is electrolyte derangements (Hasan *et al.* 2013). Controversies still arise whether or not stroke causes these electrolyte derangements or the electrolyte derangements cause stroke. It has been reported that either ways the presence of one in association with the other worsens and reduces chances of survival of stroke patients (Hasan *et al.* 2013).

This study therefore seeks to carefully investigate the role of electrolyte derangement in determining mortality among people who have suffered from stroke previously. The present study aims at determining electrolyte derangement and its associated risk factors amongst stroke patients receiving care in UCH, Ibadan. Previous studies have shown common complications after stroke include neurological complications like recurrent stroke, seizures and medical complications like chest infection, Urinary tract infection, bowel or bladder dysfunction, Deep venous thromboembolism, Upper Gastrointestinal bleeding, aspiration pneumonia, bedsores, malnutrition (Hasan et al. 2013). A related study done in Bangladesh revealed 70% of all patients with acute stroke had electrolyte disturbances. Of which 60.57% of ischaemic stroke, 54.16% of haemorrhagic stroke and 60% of SAH patients had electrolyte abnormalities. Electrolyte disturbances such as hyponatremia, hypernatremia resulting from inappropriate secretion of Anti diuretic hormone (ADH), increase in Brain Natriuretic Peptide (BNP), and Atrial Natriuretic Peptide (ANP), inappropriate fluid intake and loss can lead to complications like seizure and death (Chad et al. 2004). Known associations from studies include intake of sodium of which higher levels have been shown to increase the risk of cerebral events (Gardener et al. 2012; O'Donnell et al. 2011). There is likelihood high level of sodium increases mortality in stroke patients (Umesawa et al. 2008). A closely studied electrolyte is potassium; increased excretion has been shown to lower the risk of a stroke (Umesawa et al. 2008; He et al. 2002).

## **MATERIALS AND METHODS**

**Study design, population and location:** The study was an observational study carried out at the University College Hospital, Ibadan. The study population was all consenting stroke patients admitted to the Neurology unit of the University College Hospital, Ibadan. Non consenting stroke patients and other patients without stroke were excluded from study. The study areas were the Neurology Ward and Clinic, General Medical wards of the University College Hospital (UCH), Ibadan in Southwest Nigeria.

**Sample size:** There are no locally published papers on this subject, hence the sample size was determined using the Leslie Kish formula with an assumed prevalence of 50%, and the result amounted to 107 patients (Kasiulevicus et al. 2008).

**Data collection, instrument and quality controls:** Patients were identified and the whole research was explained to participants and caregivers informed consent was obtained. The necessary vessels were identified and blood withdrawn and put into laboratory bottles. A general systems examination was done, Blood pressure at time of admission and at time of contact were both recorded. All findings were documented by filling of questionnaires. 5mls of Blood was sent to the laboratory for analysis of electrolytes in Lithium Heparin bottles using the Semi-automatic method which included Potassium, Sodium, Chloride, Bicarbonate, Urea and Creatinine and also documented.

Patients were followed up on the ward to determine physical status and response to treatment over a period of one month. Most deaths which occur after stroke usually do so within the first one month (Bonita et al. 1988). The patients were visited every week for a period of one month during the period of admission; they were examined and their status determined, Mortality that occurred was recorded. Those discharged within one month of admission were followed up on phone to determine their current health status at home, Mortality was also recorded.

Normal reference ranges included Sodium (135-145mmol/L), Potassium (3.5-5.0mmol/L), Chloride (95-110mmol/L), Urea (15-45mg/dl) Creatinine (0.5-1.5mg/dl), Bicarbonate (20-30mmol/L). For sodium levels values below 135 and above 145 were classified as abnormal, For Potassium values less than 3.5 and greater than 5.5 were classified as abnormal, For Chloride values less than 95 and greater than 110 were classified as abnormal, For Urea values less than 15 and greater than 45 are classified as abnormal, Creatinine levels less than 0.5 or greater than 1.5 were classified as abnormal, Bicarbonate levels less than 20 or greater than 30 was classified as abnormal.

Normal values of blood pressure included systolic less than 140 mmHg and diastolic less than 80mmhg. Abnormal values of blood pressure ranged from systolic values within 140-150mmhg were classified as mild, Values of 150-160mmhg were classified as moderate, 160-170mmhg were classified as severe and values greater than 170 was classified as very severe. Systolic values below 90 were also termed abnormal.

**Data Analysis:** Data obtained was coded and entered into spreadsheet. Analysis was done using IBM SPSS 20 (Statistical Package for the Social Sciences version), New York. Descriptive statistics such as: frequency count, percentages, mean with or without Standard deviation was used to summarize and present the results. Chi Square test was used to determine whether the association between electrolytes imbalance and mortality of stroke patients is statistically significant at  $p < 0.05$

**Ethical consideration:** Ethical approval was gotten from the UI/UCH Review Board on the 20<sup>th</sup> of December, 2016. A letter was written to the Head of Department of the Neurology Unit for approval to carry out research. It was approved and research commenced immediately after approval was obtained.

## **RESULTS**

A total of 98 stroke patients participated in this study, 79(80.6%) of the respondents were males while 18(18.4%) were females. The age range with 51-70 years among the respondents was the predominant age group that participated with the mean age being  $60.31 \pm 13.68$ .

All respondents were married. 9(17.3%) did not have any form of education as shown in Table 1 below

**Table 1:**

Frequency distribution of the socio demographic characteristics of the respondents

Variable	Number of patients	Percentage
<b>Gender</b>		
Male	79	80.6
Female	18	18.4
<b>Age (Years)</b>		
25-50	18	18.4
51-70	16	61.2
71+	20	20.4
<b>Religion n= 94</b>		
Christianity	71	75.5
Islam	23	24.5
<b>Ethnicity n=90</b>		
Yoruba	85	94.4
Igbo	4	4.4
Others	4	1.1
<b>Marital Status n=91</b>		
Married	90	98.9
Widow	1	1.1
<b>Education Status n=52</b>		
None	9	17.3
Secondary	3	5.8
Tertiary	1	1.9
Educated	39	75.0

On admission 29 (29.6%) patients were normotensive, while 65(66.3%) patients were hypertensive. Follow up Blood pressure check within a week of admission showed that 35 patients (35.7%) were normotensive, 53(54.1%) patients were hypertensive.

**Table 2**

Proportion of Hypertension level among the respondents

Variables	Number of patients	Percentage
<b>Admitting BP n=98</b>		
Normal	29	29.6
Mild	23	23.5
Moderate	23	23.5
Severe	15	15.3
Very severe	4	4.1
No response	4	4.1
<b>Current BP n=98</b>		
Normal	35	35.7
Mild	28	28.6
Moderate	18	18.4
Severe	5	5.1
Very severe	2	2.0
No response	10	10.2

An assay of electrolytes revealed 62(63.3%) respondents had abnormal electrolytes compared to 36(36.7%) with normal electrolytes. Azotaemia accounted for (33%) of patients examined with an average abnormal value of 55mg/dl, and closely followed by Hyercreatinemia which accounted for (20%) with average abnormal value of 1.8mg/dl. At the end of

one month after they were recruited, a mortality of 22 (22.45%) patients was recorded, of which 13(59.1%) had abnormal electrolyte status, 9 patients with normal electrolytes died and 49(79%) with abnormal electrolytes survived. There was no statistically significant difference between proportion of those who died with abnormal electrolyte and proportion of those with abnormal electrolyte that survived, p value was >0.05.

**Table 3:**

Distribution of group electrolyte of the respondents

Variable	Number of patients	Percentage
<b>Serum sodium n=97</b>		
Normal	82	84.5
Abnormal	15	15.5
<b>Serum potassium n=98</b>		
Normal	94	95.9
Abnormal	4	4.1
<b>Serum chloride n=98</b>		
Normal	86	87.8
Abnormal	12	12.2
<b>Serum urea n=98</b>		
Normal	65	66.3
Abnormal	33	33.7
<b>serum bicarbonate n=98</b>		
Normal	96	98.0
Abnormal	2	2.0
<b>Serum creatinine n=98</b>		
Normal	78	79.6
Abnormal	20	20.4

Within a period of one month, a mortality of 22 patients was recorded, of which 13 (59.1%) had abnormal electrolyte status. Out of this number, 18 (81.8%) were hypertensive. Of the 22 that died 14 were males (63.6%).those in the older age group, 51-70 years were 11(50%)

There was a statistically significant relationship between gender and treatment outcome, with Males having a higher rate of mortality (P=0.015).

There was statistically significant relationship between age and treatment outcome, with age of 71 and above having highest mortality. (P = 0.002). The relationship between abnormal blood pressure, electrolyte derangement and mortality as outcome were not found to be significant

## DISCUSSION

The prevalent age of stroke patients was 51-70. This is similar to a study by Hasan *et al*, (2013) In many developed countries, the average age at which occurrence of stroke occurs is usually before 73 years, showing an older age distribution of such countries (Bamford *et al*. 1988) The predominant sex that stroke was seen was the Male, the ratio of Male to female being 4.38 to 1, this was similar to a study done by Meghna *et al* (2016) in India where the ratio was 2.36:1.

**Table 4:**

Association between Blood Pressure, Electrolyte Status, Gender, Age and Treatment Outcome

VARIABLES	OUTCOMES			
	Alive	Dead	X <sup>2</sup>	P value
<b>BLOOD PRESSURE</b>				
Normal	20	4	0.610	0.435
Abnormal	56	18		
<b>ELECTROLYTE STATUS</b>				
Normal	27(75.0%)	9 (25.0%)	0.213	
Abnormal	49(79.0%)	13 (21.0%)		0.645
<b>GENDER</b>				
Male	65 (82.3%)	14 (17.7%)	5.970	0.015
Female	10 (55.6%)	8 (44.4%)		
<b>AGE</b>				
25-50	17(94.4%)	1(5.6%)	12.255	0.002
51-70	49(81.7%)	11(18.3%)		
71+	10(50.0%)	10(50.0%)		

About 70% of patients considered were hypertensive this is similar to a study by Hasan *et al* (2013) this association shows that hypertension has a strong association in the aetiology and complications of stroke. Research has shown that elevated blood pressure is the most important risk factor for stroke (Dunbabin *et al* 1990), Occurrence of a stroke event rises as blood pressure rises and doubles for every 7.5mmhg increase in diastolic blood pressure (Singh *et al*. 2000).

In this study 62% of respondents had abnormal electrolyte values; this is slightly higher than that reported in a study by Siddique *et al* (2012) in which 53% of respondents had abnormal electrolyte values (Siddique *et al* 2012). Our patients who had abnormal sodium levels were 15.5%, this was lower than that reported by Hasan *et al* (2013) with abnormal sodium levels in 38.57% of respondents. Only 4.1% of our patients had abnormal potassium levels this is lower than that reported by Hassan *et al* (2013) with 20%.

Our electrolyte values may have differed from those of similar studies elsewhere possibly because of late presentation of our patients and poor drug compliance in this part of the world. About 12% of the participants had abnormal chloride levels; this is similar to a previous study with values at 10% (Hasan *et al* 2013)

There is paucity of data on values on level of bicarbonate, urea, and creatinine. This is probably because most hospitals don't consider them electrolytes that are deranged in acute phase of stroke patients. This study showed however that derangements in urea (33%) and creatinine (20%) were the commonest, suggesting the presence of renal insufficiency in a number of the participants we studied. some of the observed differences may have been related to late presentation of stroke patients in this part of the world. Patients presented in less than a week after an event of stroke (Hasan *et al* 2013). Most patients in this part of the world presented late due to financial constraints and belief in unorthodox medicinal practices. In the state of reduced conscious level by stroke patients with expected reduced fluid and food intake at home, it is not surprising that renal derangement due to poor fluid balance for protracted periods would result in higher proportion presenting with abnormal creatinine and urea

levels. Our study observed that 59.1% % of patients that died had abnormal electrolyte values.

The study also observed that more males than female stroke patients were likely to die within one month of follow up. This was also observed by the study reported by Siddique *MR et. Al*

In conclusion, this study showed that electrolyte derangements are quite common following a stroke event. Azotaemia and hyper-creatinemia were the most commonly observed. This was closely followed by derangements in Sodium, Chloride and Potassium. Electrolyte derangement may be related to renal dysfunction due to poor fluid management while patients were being managed at home or some other unorthodox means.

Further studies are therefore required to explore the role of early hospital presentation and intervention on electrolyte balance and outcome of treatment of stroke patients. Although this study found no statistically significance of association between electrolyte derangement and mortality of stroke patients, more than half of those who died (59.1%) had abnormal electrolyte derangement therefore the need for further studies on the effect of stroke on mortality of stroke patients. Adequate monitoring and control of electrolyte in stroke patients cannot also be over emphasized.

It is recommended that stroke patients have adequate monitoring of their fluid and electrolyte to prevent the deleterious effect of fluid and electrolyte balance on renal function. This may help to reduce mortality in stroke patients.

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