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A comparative study to assess biochemical parameters in acute ischaemic and hemorrhagic stroke

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Abstract
IntroductionThe incidence of Cerebrovascular accidents (CVA) is on the rise. Early diagnosis of electrolyte and other biochemical imbalances can reduce mortality. The comparison in these biochemical parameters in different types of stroke i.e. ischaemic and hemorrhagic is necessary to guide therapy but the studies are limited. **Aim:** This study will be conducted to assess and compare biochemical parameters like blood sugar level, urea, serum creatinine, Cr, Na, K, Ca, Mg, Phosphorus, lipid profile, CPK-MB, and Trop-I in patients of ischaemic and hemorrhagic stroke. Our study will build on the existing evidence and also give region-specific insights. **Materials and methods:**This retrospective study was conducted on the data of 100 patients, 50 of whom presented with acute ischaemic stroke and the rest 50 patients with hemorrhagic stroke in the emergency department of a tertiary care institute. **Result**: The mean urea and creatinine levels were within the normal range in patients of hemorrhagic stroke as well as ischaemic stroke and no significant difference was present between both groups.The mean sodium levels were decreased in both groups with no significant difference between groups. The mean potassium levels were decreased in patients of hemorrhagic stroke. The difference was significant (p=0.003). Hypocalcemia was present in patients of both groups. Magnesium and phosphorus levels were normal in both groups.Significant difference in calcium, magnesium, and phosphorus levels in both groups are missing. **Conclusion**: To conclude, we found that, blood sugar levels are raised in stroke patients. Diabetes Mellitus type II, Hypertension, Ischaemic heart disease, past history of CVA are some of the common risk factors.

Keywords: Cerebrovascular accidents, biochemical parameters, ischaemic, hemorrhagic

Introduction

The incidence of Cerebrovascular accidents (CVA) is on the rise which is evident from the fact that it has become second most common reason for the death.[1,2] Between 1970 to 2008 the incidence of stroke has decreased by 42% in high-income countries, but it has increased by 100% in low to middle-income countries.[3] The mortality is high among patients with nearly 48% of them dying within one year. [4] The cause of death can be due to cerebral edema infection, pulmonary embolism, deep vein thrombosis, electrolyte imbalance, a metabolic disorder, etc.[5]
Early diagnosis of electrolyte and other biochemical imbalances can reduce mortality. Sodium, potassium, and calcium electrolyte abnormalities are commonly found in stroke patients. [6,7] Sodium abnormalities are common in the acute phase of stroke which leads to an increase in brain natriuretic peptide and atrial natriuretic peptide. [6,8] Serum lipid levels are also related to CVA. Studies have shown that high serum lipid levels are associated with ischaemic stroke. They cause brain ischemia by blockage of the artery with free radicals and lipid molecules. [5,9–11]

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Materials and methods

This retrospective study was conducted on the data of 100 patients, 50 of whom presented with acute ischaemic stroke and the rest 50 patients with hemorrhagic stroke in the emergency department of a tertiary care institute. The records were made available from the medical records section. Demographic details like age, sex, and details of biochemical parameters like blood sugar level, urea, serum creatinine, Cr, Na, K, Ca, Mg, Phosphorus, lipid profile, CPK-MB, and Trop-I were obtained. The facility for these is available at the institute. Data entry and analysis was done using SPSS 21.0. Continuous variables were expressed as mean± standard deviation. T-test was used to study the difference between continuous variables in both groups. Statistical significance was considered with a $p < 0.05$.

Results

This study conducted on data of 50 patients of acute ischaemic stroke and 50 patients of hemorrhagic stroke yielded the following results. The mean age of patients was 59.33 ± 14.70 years (range 19-90).

Table 1: Demographic characteristics of the patients(N=100)

Variable	Ischaemic (N=50)	Hemorrhagic (N=50)
Age (years)	61.02 ± 12.61	57.64 ± 16.49
Male	24 (48%)	26 (52%)
Female	26 (52%)	24 (48%)
Risk factors		
Diabetes	13 (26%)	7 (14%)
Hypertension	37 (74%)	36 (72%)
IHD	4 (8%)	2 (4%)
COPD	1 (2%)	1 (2%)
ACS	3 (6%)	2 (4%)
Old CVA	3 (6%)	5 (10%)
CKD	0	1 (2%)
Nil	7 (14%)	9 (18%)

Table 1 shows the demographic data of these patients. The mean age of patients with ischaemic stroke was 61.02 ± 12.61 years and hemorrhagic stroke was 57.64 ± 16.49 years. Significant difference in age and sex in both groups is not evident. Hypertension was the most common risk factor present in 73% of patients followed by diabetes (20%), history of CVA (8%), and IHD (6%). **(Figure 1)** Significant difference in the distribution of risk factors in both groups is not evident.

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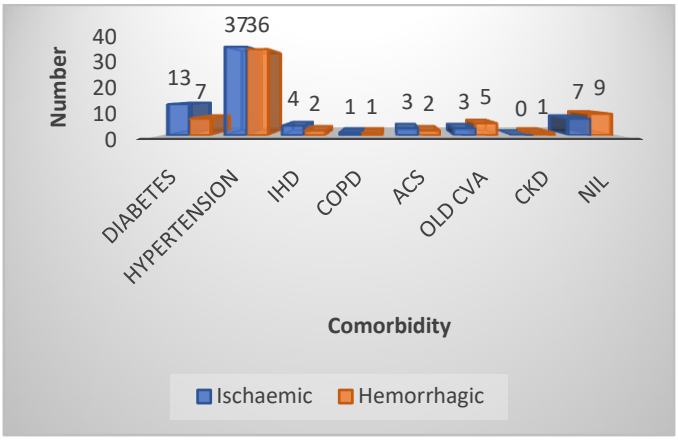

Figure 1: Risk factors present in patients of Ischaemic and Haemorrhagic stroke (N=100)

Biochemical parameters were compared in both the groups. (**Table 2**) The mean blood sugar levels were higher in patients of ischaemic stroke than hemorrhagic stroke but the difference was not significant. The HbA1c levels were significantly higher in patients of ischaemic stroke than hemorrhagic stroke(p=0.028).

Table 2: Biochemical parameters in stroke patients (N=100)

Variable	Ischaemic (N=50)	Hemorrhagic (N=50)	p-value
Blood Sugar level (mg/dl)	200.58 ± 99.39	184.76 ± 78.97	0.380
HbA1c	6.400 ± 1.69	5.782 ± 0.99	**0.028**
Urea	29.38 ± 13.46	30.86 ± 25.70	0.719
Creatinine (mg/dl)	0.91 ± 0.19	1.072 ± 0.79	0.162
Electrolytes			
Sodium (mmol/l)	132.38 ± 5.51	133.86 ± 6.28	0.214
Potassium (mmol/l)	3.52 ± 0.57	3.20 ± 0.48	**0.003**
Calcium (mg/dl)	8.76 ± 0.72	8.83 ± 0.84	0.628
Magnesium (mg/dl)	1.77 ± 0.29	1.83 ± 0.39	0.329
Phosphorus (mg/dl)	3.36 ± 1.04	3.23 ± 1.12	0.549
Lipid profile			
Total Cholesterol (mg/dl)	168.58 ± 47.86	186.46 ± 42.45	**0.051**
Triglyceride (mg/dl)	118.16 ± 53.71	119.24 ± 55.80	0.922
HDL (mg/dl)	45.30 ± 13.23	42.92 ± 14.37	0.391
LDL (mg/dl)	101.16 ± 36.92	117.80 ± 33.03	**0.019**

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VLDL (mg/dl)	23.88 ± 10.88	24.52 ± 10.89	0.770
Cardiac Profile			
CPK-MB	9.15 ± 27.73	5.82 ± 4.27	0.404
Troponin	0.28 ± 1.56	0.11 ± 0.43	0.457

The mean urea and creatinine levels were within the normal range in patients of hemorrhagic stroke as well as ischaemic stroke and no significant difference was present between both groups.

The mean sodium levels were decreased in both groups with no significant difference between groups. The mean potassium levels were decreased in patients of hemorrhagic stroke. The difference was significant (p=0.003). Hypocalcemia was present in patients of both groups. Magnesium and phosphorus levels were normal in both groups.Significant difference in calcium, magnesium, and phosphorus levels in both groups are missing.

Table 3: Sodium and potassium imbalance in stroke patients (N=100)

Parameter		**Ischaemic (N=50)**	**Hemorrhagic (N=50)**	**p-value**
Na^+ levels (135-145 mmol/l)	Hyponatremia	35	26	0.065
	Normal	15	24	
K^+ levels (3.5-5mmol/l)	Hypokalaemia	25	39	**0.004**
	Normal	25	11	
Ca^{2+} levels (3.5-5mmol/l)	Hypocalcemia	33	28	0.305
	Normal	17	22	

The detailed frequency of serum sodium alongwith potassium imbalance in patients who suffered stroke is represented in **Table 3**. Hyponatremia was seen in 61 patients with the majority having an ischaemic stroke. The difference was however just insignificant (p=0.06). Hypokalaemia was seen in 64 patients with the majority having a haemorrhagic stroke. The difference was significant (p=0.004). Hypocalcemia was seen in 61% of patients with no difference in ischaemic and hemorrhagic stroke.

The lipid profile was also compared in patients of both the groups. (**Table 2**) The mean total cholesterol levels were higher in patients of hemorrhagic stroke (186.46 ± 42.45 mg/dl) than ischaemic stroke (168.58 ± 47.86 mg/dl) and this difference was found to be significant. (p=0.05). The mean LDL levels were also higher in patients of hemorrhagic stroke (117.80 ± 33.03 mg/dl) than ischaemic stroke (101.16 ± 36.92 mg/dl) and this difference too was found to be significant. (p=0.01) There was no significant difference in the parameters like serum triglycerides, HDL, and VLDL levels in both groups.

No significant difference was observed in the mean CPK-MB and Troponin I values in both the groups which were well within the normal range. (**Table 2**)

Discussion

This retrospective study was conducted on data of 100 stroke patients-50 ischaemic stroke and 50 hemorrhagic strokes. In our study, the mean age of patients was 59 years. The male to female ratio was equal. Previous studies show that stroke incidence increases with advancing age affecting more males than females.[5,12,13] Diabetes Mellitus type II, Hypertension, Ischaemic heart disease,past history of CVA were some of the common risk factors in our study. Many studies in past have reported these risk factors.[4,5,14,15]

The most common type of stroke is ischaemic stroke.[13,14] The incidence of CVA and mortality due to it are rising.[1–4] The cause of death is multifactorial[5] and early diagnosis of electrolyte and other biochemical imbalances can reduce mortality. In our study, the mean blood sugar levels were higher in patients of ischaemic stroke than hemorrhagic stroke but the difference was insignificant. The HbA1c levels were significantly higher in patients of ischaemic stroke than hemorrhagic stroke(p=0.028). The mean urea and creatinine levels were within normal and no significant difference was present between both groups. **El-fawal et al**, in their study, found raised blood glucose levels in patients of stroke. However, they also found no difference in blood glucose levels in patients of ischemic and hemorrhagic stroke. [15] In contrast to our findings, a study by **Wali and Patil** found an increased serum level of urea, creatinine in both ischemic and hemorrhagic stroke. However, the difference between the groups was not significant. [5]

Sodium, potassium, and calcium electrolyte abnormalities are commonly found in stroke patients. [6,7] Early diagnosis of electrolyte and other biochemical imbalances can reduce mortality due to stroke. Sodium abnormalities are common in the acute phase of stroke which leads to an increase in brain natriuretic peptide and atrial natriuretic peptide. [6,8] In our study, hyponatremia was seen in 61% of patients, hypokalaemia was seen in 64% of patients, and hypocalcemia was seen in 61% of patients. The proportion of hyponatremia was higher in ischaemic stroke (p=0.06) and hypokalaemia was more in hemorrhagic stroke (0.004). Similar to our study **Wali and Patil** also reported the similar reults.[5] **Siddiqui MR et al , reported that** 62.22% of haemorrhagic stroke patients and 43.39% of ischaemic stroke patients had electrolyte imbalance of which 36% had sodium imbalance and 31% had potassium imbalance. They also reported higher proportion of hyponatremia and hypokalaemia among patients of haemorrhagic stroke. Imbalances like hypernatremia, hypochloraemia were also reported.[13] **El-fawal et al**, reported that hyponatremia was the most common electrolyte imbalance followed by hyperkalemia and hypokalaemia. There was no difference in patients of ischaemic and hemorrhagic stroke.[15] Many other studies have reported the proportion of electrolyte imbalance in stroke in the range of 52-70%.[7,16]

Serum lipid levels are also related to CVA. Studies have shown that high serum lipid levels are associated with ischaemic stroke. They cause brain ischemia by blockage of the artery. [5,9–11] In our study, mean total cholesterol levels and LDL levels were higher in patients of hemorrhagic stroke than ischaemic stroke (p=0.05 and p=0.01 respectively). **Mahmood et al** reported high serum total cholesterol and lower HDL-cholesterol levels in ischaemic stroke patients as compared to hemorrhagic stroke. They found no significant difference in serum values of triglycerides, LDL-cholesterol, and VLDL-cholesterol in ischaemic and hemorrhagic stroke.[10]

Serum troponin t and CK-MB levels are reported to be raised in patients with acute ischaemic stroke. Their rise indicates the severity of a stroke and neurologic deficits. [17] In our study,

CK-MB and Troponin I values in both the groups were within the normal range and showed no significant difference in both groups. In a study by **Apak et al**, the serum levels of both CK-MB and troponin were raised in both hemorrhagic and ischaemic stroke but the difference was not significant.[18]

Conclusion:

To conclude, we found that, blood sugar levels are raised in stroke patients. Diabetes Mellitus type II, Hypertension, Ischaemic heart disease, past history of CVA are some of the common risk factors. The mean urea and creatinine levels were within normal limits and no significant difference was present between both groups. Hyponatremia, hypokalaemia, and hypocalcemia were common electrolyte imbalances. The proportion of hyponatremia was higher in ischaemic stroke and hypokalaemia was more in hemorrhagic stroke. There was no significant difference in calcium, magnesium, and phosphorus levels in both groups. Mean total cholesterol levels and LDL levels were higher in patients of hemorrhagic stroke than ischaemic stroke. There was no significant difference in the parameters like serum triglycerides, HDL, and VLDL levels in both groups. No significant difference was observed in the mean CPK-MB and Troponin I values in both the groups.

Our study had certain limitations. The sample size was purposive keeping in mind the caseload at our institute. Larger studies that are prospective, multicentric with adequate sample size need to be undertaken.

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