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Risk factors, electrolyte disturbances and lipid profiles in sudanese patients with stroke

Hassan H. Musa[1]*, Idriss H. Musa[2] and Sarah M. El Sadig[3]

[1]Faculty of Medical Laboratory Sciences, University of Khartoum, Sudan.
[2]Sudan Medical Specialization Boards, Khartoum, Sudan.
[3]Faculty of Medicine, University of Khartoum, Sudan.

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Stroke is a growing public health concern in low- and middle- income countries, however no systematic study has been conducted to elucidate possible causes of stroke among most low- and middle- income countries. The aim of the study was to determine the prevalence of stroke, associated risk factors, electrolyte disturbances and lipid profiles in Sudanese stroke patients. A retrospective hospital-based study was conducted for 188 stroke patients. A 59.6% of patients are males and 40.4% are females, 42.55% of their age ranged between 41 to 60 years, with mortality rate 17.02%. A 78.2% of patients had ischemic infarction and 21.8% had hemorrhage. Predisposing factors for the development of stroke was hypertension 43.6%, diabetes mellitus16.5%, heart disease 4.3%, smoking 3.7% and alcohol consumption 3.7%. Stroke patients had strong family history of hypertension 12.23%, diabetes mellitus 10.11%, stroke 3.72% and heart diseases 1.10%. The electrolyte disturbances and lipid profiles showed a significant different (P<0.05) between males and females in hemoglobin (HB), hematocrit (HCT), cholesterol and low density lipoprotein (LDL) levels, and a significant different (P<0.05) between ischemic and hemorrhage stroke in platelets (PLTs), potassium and HDL levels. Our results confirm a high prevalence of risk factors for stroke, and a better understanding of stroke risk factors and outcome may help guide efforts at reducing the community burden of stroke in Sudan.

Key words: Stroke subtypes, risk factors, lipid profiles, Sudan.

INTRODUCTION

Stroke is the second killer in the world, with 6.2 million deaths representing 11.4% of the 54.6 deaths that occurred in 2011 (Boutayeb et al., 2014). Worldwide, stroke incidence showed a divergent trend rates during the last four decades (Boutayeb et al., 2014). While stroke incidence decreased by 42% in high-income countries, it increased by more than 100% in low to middle income countries (Feigin et al., 2009). Differences in burden due to stroke were existing within countries where the incidence and mortality rates vary across

*Corresponding author. E-mail: hassanhm@uofk.edu.

socioeconomic groups. Studies in Western countries have demonstrated a significant positive association between socioeconomic disadvantage and the incidence and mortality due to stroke (Kaplan and Keil, 1993; Cox et al., 2006). Few studies available in developing countries show various patterns, as the social gradient for risk factors leading to stroke may change over time (Engels et al., 2014). In UK, the costs of stroke are estimated to be nearly twice those of coronary heart disease (Rothwell, 2001), accounting 6% of total National Health Service (NHS) and Social Services expenditure (Rothwell, 2001). Among the Asians, the number who died from stroke was more than three times that for coronary heart disease (CHD) (WHO, 1994). In India, stroke represented 1.2% of the total deaths, when all ages were included (Anand et al., 2001).

The epidemiology of stroke in the Middle East and North Africa reported an extensive variation of incidence between different countries (Boutayeb et al., 2014). In African region, more than 1.1 million deaths were caused by cardiovascular diseases and more than half of these were due to ischaemic heart disease and stroke (Laurence et al., 2011). During the period, 1980 to 2007, the age standardized incidence rate of stroke (per 100000) in Saudi Arabia, Iran, Palestine, Kuwait, Bahrain, Libya and Qatar was 38.5, 61.5, 62.7, 92.2, 96.2, 114.2 and 123.7, respectively (Tran et al., 2010). Some developed countries such as the United States, Canada, France, Switzerland, and Australia have experienced declines in mortality, which may be associated with the increased use of preventative treatment, better control of vascular risk factors, and the advances in acute stroke care (Sun et al., 2013).

There are racial and social differences in susceptibility to stroke and in the incidence of the various stroke subtypes. Some of these racial differences are partly caused by differences in risk factor prevalence (Forouhi and Sattar, 2006). In some developed countries, up to 67.3 to 80.5% of stroke cases are attributed to ischemic stroke, whereas only 6.5 to 19.6% are attributed to intracerebral hemorrhage; approximately 0.8 to 7.0% to subarachnoid hemorrhage; and 2.0 to 4.5%, to undetermined types (Feigin et al., 2003). The international prospective epidemiological studies identified the major atherogenic risk factors for stroke as hypertension, diabetes mellitus, hyperlipidemia, and smoking (Wolf, 2004). Fuster and Kelly (2010) indicated that the risk of coronary heart disease and ischaemic stroke increases steadily with overweight/obesity and there is a continuous relationship between blood pressure and the risk of developing heart attacks and stroke. In China, the risk from major stroke factors, including obesity and hypercholesterolemia, has substantially increased (Sun et al., 2013). The rural Japanese prospective studies showed that low total serum cholesterol was related to increased incidence of cerebral hemorrhage (Yano et al., 1989). In Morocco, there was a significant association between household socioeconomic status and the prevalence of stroke (Engels et al., 2014). Electrolyte disturbances are also commonly found in stroke cases and may contribute to mortality of these patients. Kusuda et al. (1989) noted that disorders of sodium and potassium concentration are the commonest electrolyte abnormalities found in stroke patients. Thus, early diagnosis of electrolyte disturbances is essential to prevent morbidity and mortality of Cerebral Vascular Accident (CVA) patients to a large extent (Roy et al., 2014). Studies describing these electrolyte disturbances in stroke patients are rare in Sudan. Therefore, the aim of the present study was to determine the frequency of stroke sub types, associated risk factors, electrolyte disturbances and lipid profiles in Sudanese stroke patients.

MATERIALS AND METHODS

Study design and data collection

A retrospective study of 188 stroke patients admitted to the Soba University Hospital, Sudan was conducted using medical history records during the period of January, 2012 through December, 2013. The diagnosis of stroke was established if patients were already treated with stroke drugs or were diagnosed during their hospital stay. We selected only treated stroke patients who had a record of continued medication in their medical records since being diagnosed with stroke, any other diseases subsequent to stroke onset was included. The data taken from each patient records included demographic data, clinical characteristics of stroke (ischemic or hemorrhagic), occurrence of in-hospital death and stroke risk factors that is, hypertension, diabetes mellitus, dyslipidemia, cardiac disease, smoking status, and previous history of stroke. Biochemical variables presented with stroke including electrolyte disturbances, plasma glucose, serum urea and creatinine, total cholesterol (TC), triglycerides (TG), and high density lipoprotein-cholesterol (HDL-C). Low density lipoprotein cholesterol (LDL-C) was calculated by Friedewald's equation. Ethical approval was received from the local ethics committee prior to the start of the study.

Statistical analysis

Results are given as means ± standard error for continuous variables and number, and percentage for categorical variables. The chi-square test or Fisher's exact test was used for categorical variables and the Students t-test for continuous variables. Statistical analyses were performed using SPSS v.18 (SPSS, Chicago, Illinois, USA) and a p value less than 0.05 was considered significant.

RESULTS

Risk factors of stroke

A total of 188 patients admitted to the Soba University

Table 1. Distribution of Stroke Subtypes and associated risk factors.

Factors	Frequency	Percent (%)
Sex		
Male	112	59.6
Female	76	40.4
Stroke type		
Ischemic	147	78.2
Hemorrhage	41	21.8
Side weakness		
Right	109	58
Left	79	42
Risk factors		
Hypertension	82	43.6
Heart disease	8	4.3
Diabetes Mellitus	31	16.5
Smoking	7	3.7
Alcohol	7	3.7
Family history		
Hypertension	23	12.23
Diabetes mellitus	19	10.11
Stroke	7	3.72
Heart disease	2	1.10

Hospital were studied, 59.6% are males and 40.4% are females. Approximately 78.2% of the patients had ischemic infarction and 21.8% of the patients had hemorrhage, representing 58% right side weakness and 42% left side weakness, while 17.02% of patients were dead. Age, hypertension, diabetes mellitus, hyperlpidemia, obesity and heart disease are known predisposing factors for the development of stroke. In the present study, 43.6% of stroke patients had hypertension, 16.5% had diabetes mellitus and 4.3% had heart disease. Smoking and alcohol consumption are very low among patients represented by 3.7 and 3.7%, respectively. The patients had strong family history of the factors for the development of stroke, 12.23% had hypertension, 10.11% had diabetes mellitus, 3.72% had stroke and 1.10% had heart diseases (Table 1). The common affected age group was between 41 and 60 years (42.55%), followed by age group 61 and 80 (40.96%) (Figure 1).

Hematological, serum urea, ceartinine and electrolyte levels in stroke patients

Serum electrolyte analysis should be a part of initial evaluation in all stroke patients, there were significant difference ($P < 0.05$) between males and females in HB and HCT levels, whereas there was a significant difference ($P < 0.05$) between ischemic and hemorrhage stroke in PLTs level (Table 2). Sex has no significant effect on serum urea, creatinine, sodium and potassium levels in patients with stroke. However, there was a significant difference ($P < 0.05$) on potassium levels in patients with ischemic and hemorrhage stroke (Table 3).

Lipid profiles in stroke patients

Cholesterol and LDL level were significantly ($P < 0.05$) different between males and females, while HDL level was significantly ($P < 0.05$) different between patient with ischemic and hemorrhage stroke (Table 4).

DISCUSSION

Cardiovascular diseases caused 17.3 million deaths in 2008 and this number is expected to reach 23.3 million by 2030 (Boutayeb et al., 2014). The incidence of stroke has reached an epidemic level in low to middle income countries (Feigin et al., 2009). Engels et al. (2014) indicate the increase in mortality due to stroke is expected to be faster in low income and middle-income countries than in high-income countries, as a result of the

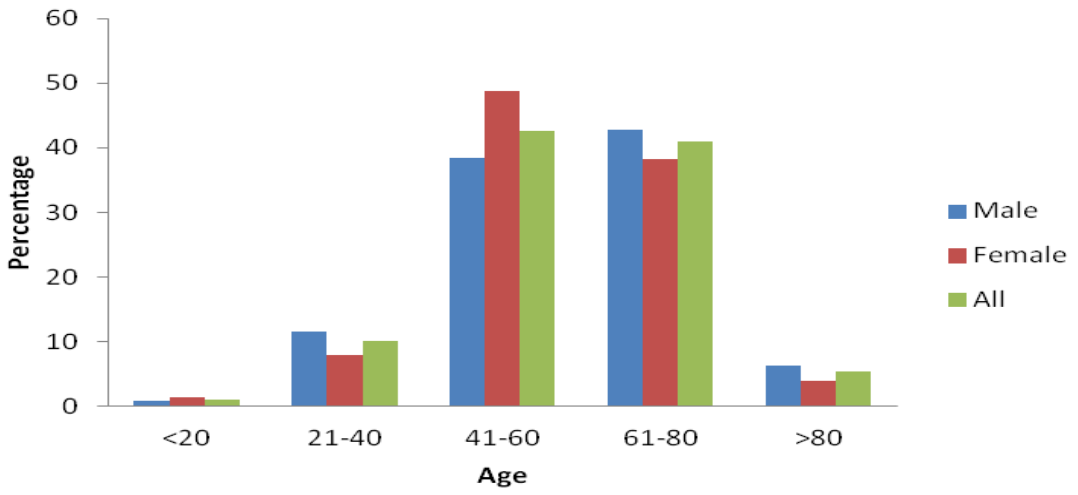

Figure 1. Age distribution of the patients with stroke.

Table 2. Hematological parameters in the patients with stroke.

Items	Over all	Sex			Stroke type		
		Male (n=64)	Female (n=51)	P value	Ischemic (n=87)	Hemorrhage (n=28)	P value
TWBCs	8.51±0.39	7.88±0.49	9.15±0.62	0.110	8.96±0.38	8.07±0.69	0.258
HB	12.51±0.29	13.10±0.36	11.92±0.45	0.043	12.36±0.28	12.66±0.51	0.604
HCT	37.98±0.84	39.96±1.04	36.00±1.32	0.020	37.43±0.80	38.53±1.47	0.510
MCV	84.66±1.01	83.36±1.26	85.95±1.59	0.205	83.78±0.97	85.53±1.78	0.390
MCH	27.74±0.35	27.71±0.44	27.77±0.55	0.919	27.69±0.34	27.78±0.62	0.894
MCHC	32.56±0.25	32.86±0.31	32.26±0.39	0.228	32.50±0.24	32.62±0.43	0.807
PLTs	242.43±13.55	230.59±16.77	254.27±21.28	0.384	275.28±12.96	209.58±23.79	0.017

Total white blood cells (TWBCs); Haemoglobin (HB); Mean Corpuscular Volume or Cell (MCV); Mean Corpuscular Haemoglobin (MCH); Mean Corpuscular Haemoglobin Concentration (MCHC); Platelets (PLTs)

Table 3. Serum urea, creatinine and electrolyte levels in the patients with stroke.

Items	Over all	Sex			Stroke type		
		Male (n=68)	Female (n=53)	P value	Ischemic (n=91)	Hemorrhage (n=30)	P value
Urea	50.15±5.91	49.93±7.14	50.37±9.42	0.970	53.14±5.63	47.16±10.39	0.613
Creatinine	1.51±0.28	1.51±0.33	1.51±0.44	0.999	1.81±0.26	1.21±0.48	0.275
Serum Na	138.04±0.87	136.72±1.05	139.37±1.38	0.130	138.37±0.83	137.72±1.53	0.711
Serum K	3.56±0.09	3.62±0.12	3.50±0.14	0.517	3.74±0.08	3.38±0.15	0.040

Urea mg/dl; creatinine mg/dl; Serum Na and K meq/l

increasing prevalence of risk factors (due to both an ageing population and changes in lifestyle) and lesser availability of primary prevention and acute care programs (Paul et al., 2007; Strong et al., 2007; Addo et al., 2012). A systematic review of population-based studies carried out from 1970 to 2008 showed a 42% decrease in incidence of stroke in high-income countries, as compared to a more than 100% increase in incidence in low and middle-income countries (Johnston et al., 2009).

Table 4. Lipid profiles in the patients with stroke.

Items (mg/dl)	Over all	Sex			Stroke type		
		Male (n=17)	Female (n=5)	P value	Ischemic (n=18)	Hemorrhage (n=4)	P value
Cholesterol	171.867±9.61	151.82±12.22	191.92±14.82	0.051	161.73±10.27	182.00±16.24	0.305
Triglyceride	86.275±12.93	76.22±16.46	96.33±19.96	0.447	97.80±13.83	74.75±21.86	0.385
HDL	56.928±3.70	60.86±4.71	53.00±5.71	0.303	43.61±3.96	70.25±6.26	0.002
LDL	77.550±7.51	52.27±9.56	102.83±11.59	0.003	82.10±8.03	73.00±12.69	0.552

HDL, high density lipoprotein; LDL, low density lipoprotein.

In the present study, 59.6% of stroke patients are males and 40.4% are females, and 78.2% of the patients had ischemic infarction and 21.8% had hemorrhage. Similarly, Boutayeb et al. (2014) indicated that stroke is more prevalent among men than women with ratios varying from 1.3:1 to 2:1. In the previous studies, stroke caused by infarction was found in 58.3% while stroke caused by hemorrhage was found in 41.6% in Sudanese population (Sokrab et al., 2002). In Congo, haemorrhagic and ischemic strokes were present in 52 and 48% of the study population, respectively (Longo-Mbenza et al., 2008). Stroke subtype identification was often not possible in early studies because of a lack of brain and vascular imaging and it remains problematic today because of the frequent difficulty in ascribing a cause for a given stroke even when imaging is available.

Although hypertension, obesity, diabetes mellitus, and atrial fibrillation were important stroke risk factors, in many patients, these were detected only after a stroke. In the present study 43.6% of stroke patients had hypertension, 16.5% had diabetes mellitus and 4.3% had heart disease. Smoking and alcohol consumption are very low among patients represented by 3.7 and 3.7%, respectively. Hypertension was the most common associated risk factor constituting 46.9%, cardiac disease was found in 16%, diabetes mellitus in 14.6%, syphilis in 4.1%, and previous transient ischemic attack in 2.1% (Sokrab et al., 2002). In Congo, the rates of hypertension and diabetes mellitus among the stroke patients were 81 and 14.6%, respectively (Longo-Mbenza et al., 2008). The population of the Eastern Mediterranean region is known to suffer from high rates of diabetes and hypertension and the problem is accentuated by the late diagnosis and the high proportions of people who are unaware of their disease (Boutayeb et al., 2014). The relationship between smoking and cerebral infarction has been confirmed in case control studies from the U.S., Australia, U.K., Scandinavia, and Russia (Donnan et al., 1989).

In a study among more than 400 patients in Australia, Donnan and colleagues found that the risk of cerebral infarction due to smoking was substantially higher than in the previous meta-analysis (Donnan et al., 1989). Another review on global variation in stroke burden and mortality indicated raised mean systolic blood pressure and greater prevalence of smoking as predictors of stroke mortality but the national per capita income was the strongest predictor of mortality (Johnston et al., 2009). Sudanese patients had strong family history of the factors for the development of stroke such as hypertension, diabetes mellitus, stroke and heart diseases.

The most effected age group was between 41 and 60 years 42.55% and the mortality rate was 17.02%. The proportion of stroke death was increased with age, and in the oldest group (> 70 years of age) stroke contributed to 2.4% of all deaths (Anand et al., 2001; Gaziano, 2008). A 44% of all stroke type patients, 29% of haemorrhagic stroke and 31% of ischaemic stroke patients were dead (Longo-Mbenza et al., 2008). Compared to the survivors, deceased patients were significantly (p < 0.001) older with higher leukocyte counts and haematocrit, haemoglobin and fibrinogen levels, but lower glycaemic levels (Longo-Mbenza et al., 2008). Cerebrovascular accident represents a major cause of death and disability among women. In Sudan, the common age group affected was between 70 and 79 years (27.2%) (Shadia et al., 2011). The age-standardized death rate attributed to stroke varies six-fold between developed countries while very little is known about the developing world (Connor et al., 2007). Approximately 25% of men and 20% of women can expect to suffer a stroke if they live to be 85 years old (Bonita, 1992).

The definition of the available independent correlates of serum biomarkers with cerebral lesions and sites could further help in the clinical practice for the acute ischemic stroke management reducing complications following acute treatment (Meng and Ji, 2011). Sex and stroke subtypes have a significant effect on hematological, serum urea, creatinine and electrolytes levels. Blood glucose and urea levels and leukocyte counts were higher in patients who died than in survivors, and altered awareness of risks for stroke was the major independent predictor of fatality rates (M'Buyamba-Kabangu et al., 1995). Serum urea and bicarbonate can be helpful in estimation of fluid deficit independently from serum sodium (Gurubacharya et al., 2006).

The relationship between plasma lipid abnormalities and ischemic stroke remains controversial, in the present study cholesterol and LDL level were significantly ($P < 0.05$) different between males and females, while HDL level was significantly ($P < 0.05$) different between patient with ischemic and hemorrhage stroke. A meta-analysis of 45 prospective cohorts, including 450,000 subjects and 13,000 strokes, found no association between total cholesterol and stroke (Prospective Studies Collaboration, 1995). Hypertriglyceridemia is commonly found in patients with ischemic cerebrovascular disease whatever the etiologic subtype, whereas hypercholesterolemia is more related to large vessel disease and small vessel disease (Boutayeb et al., 2014; Laloux et al., 2004). However, they are not as well established as risk factors for first or recurrent stroke in contrast to what is seen in cardiac disease (The American Stroke Association, 2006). Therefore, epidemiological studies can help identify groups of individuals or regions at higher risk of stroke. They can also help better understand the natural history of certain associated conditions and therefore push the direction of prevention and therapeutic investigations (Sun et al., 2013). Health decision makers should pay a particular attention to the high burden of stroke due to ageing and risk factors like hypertension, diabetes, smoking, dyslipidemia, overweight/obesity and physical inactivity (Boutayeb et al., 2014).

CONCLUSION AND RECOMMENDATION

The study concludes that there was a high prevalence of risk factors of stroke (hypertension, diabetes mellitus, heart disease). The family history of the factors for the development of stroke hypertension, diabetes mellitus, stroke and heart diseases, electrolyte disturbances and lipid profiles were strongly associated with the prevalence of stroke. Electrolyte abnormalities may adversely affect outcome of the stroke patients. Serum electrolytes level should be determined in every patient with stroke. Further studies with larger samples are needed. Therefore a better understanding of stroke risk factors and outcome may help guide efforts at reducing the community burden of stroke in Sudan.

Conflicts of interest

The authors declare that they have no conflict of interest

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