

## Impact of Diabetes on Ischemic and Hemorrhagic Stroke

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### Abstract

### Original Research Article

Stroke is the major cause of mortality and morbidity both in the developed and developing countries worldwide. We examined the impact of diabetes among ischemic and hemorrhagic stroke patients. Data from 100 consecutive patients with ischemic (72%) and hemorrhagic (28%) stroke were analyzed. Patients were classified into four categories ischemic and diabetic, ischemic and non-diabetic, hemorrhagic and diabetic, hemorrhagic and non-diabetic. Diabetes is an important risk factor associated with stroke. In the present study, only 21% of studied subjects were diabetic. While the majority that is 79% were non-diabetic. There was difference in sex wise distribution of diabetic status. Proportion of females having diabetes was more i.e., 22.22% (10/45) than males 20% (11/55). Systolic blood pressure shows higher significant difference between diabetic and non diabetic patients in both ischemic and hemorrhagic strokes ( $p < 0.001$ ). Diabetes mellitus have significantly more traditional risk factors in stroke patients. There is a difference between male and female relative frequencies of age and diabetes mellitus.

**Keywords:** Stroke, diabetes mellitus, mortality, risk factor.

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## INTRODUCTION

Stroke is a cerebrovascular accident in which loss of brain function occurs due to the disturbance of blood supply in the brain. WHO described Strokes as rapidly developing clinical symptoms and signs of focal or at time's global loss of cerebral function with symptoms lasting more than 24 hours or leading to death with no apparent reason, other than that of vascular origin [1].

According to the WHO global burden of disease (GBD) data 2015, out of total mortality in India, 7.26% were due to a stroke and stroke contributes to 3.61 to disability adjusted life years (DALYs) of the Indian population [2].

Worldwide stroke is the second leading cause of DAL globally; WHO 2016 global health estimates 5.16% [2].

Stroke is the second leading cause of death worldwide, i.e., 10.2% die due to stroke globally by global health estimates 2016.

Diabetes is a well-established risk factor for stroke. It can cause pathological changes in the blood vessels at various locations and it can lead to stroke if cerebral vessels are directly affected. Additionally,

mortality is higher and post stroke outcomes are poorer in patients with stroke with uncontrolled glucose levels. The incidence of stroke can be reduced by treatment of known risk factor for stroke such as hypertension, diabetes, dyslipidemia, heart disease or by elimination of risk factors in the healthy person (such as smoking, physical inactivity, unhealthy diets, obesity and excessive alcohol intake) [3].

## MATERIAL AND METHOD

A prospective cross-sectional, observational study, conducted among 100 consecutive patients in both the sexes in the age group of 25-75 years admitted in Neurology and General Medicine ward at Mathura Das Mathur Hospital and Department Of Physiology, Dr. SN Medical College, Jodhpur in the year 2019. Patients were classified into four categories- patient with diabetes and ischemic stroke, patient with ischemic stroke and non-diabetic, patients with hemorrhagic stroke and diabetic, and patients with hemorrhagic stroke and non-diabetic. Patients admitted with acute cerebral stroke and diagnosis was confirmed by C.T. scan or MRI brain was included. Patients admitted to the Neurology ward with a brain infection, subdural hematoma, intracranial malignancy and other brain lesions were excluded. This study was approved by the LOCAL RESEARCH ETHICS COMMITTEE, and written consent to participate in the study was obtained

from each patient and from the patient’s relatives when a patient was unconscious or confused.

**Analysis of Data**

All data were expressed as mean ± SD and were analysed statistically by using the Microsoft Excel and OpenEpi software (version 2.3.1).

**RESULT**

The population consisted of 100 apparently stroke patients with the age group of 25-75 years. Ischemic patients were 72 % whereas Hemorrhagic were 28%. The mean age of the studied population was 56.72 ± 14.90. Patients with ischemic stroke were older than hemorrhagic stroke patients (56.72 ± 14.90; 55.14 ± 15.23 years respectively). The mean age of ischemic stroke patients with diabetes was 62 ± 12.23 and without diabetes was 55.09 ± 15.27. The mean age of patients with hemorrhagic stroke with diabetes was 51.25 ± 11.69 and without diabetes was 55.79 ± 15.65. Proportion of females having diabetes was more i.e., 22.22% (10/45) in comparison with males 20% (11/55).

At the time of admission in hemorrhagic stroke patient triglycerides (146 ± 66.94; 93.87± 32.71, p<0.018) and VLDL (29 ± 13.58; 18.54 ± 6.61,

p<0.019) level in diabetic patients were significantly higher than non-diabetics. Cholesterol and HDL level was higher in diabetic patients than non-diabetic in both ischemic and hemorrhagic stroke (NS). At the time of admission amongst patients with hemorrhagic stroke and diabetes the mean serum creatinine was significantly higher compared to non-diabetic patients (2.7 ± 3.139 mg/ dl vs. 1.259 ± 0.539 mg/dl, p < 0.032). At admission blood urea was higher in diabetic patients than non- diabetic patients in both ischemic and hemorrhagic patients (NS) (Table-1).

Mean admission glucose was significantly higher in hemorrhagic stroke than ischemic stroke, in hemorrhagic stroke 157.43 ± 64.601 mg/ dl (167 ± 35.41 mg/ dl in diabetic patient and 155.83 ± 68.13 mg/dl in non-diabetic patients) and 121.44 ± 39.29 mg/ dl in ischemic stroke (134.12 ± 34.32mg/dl in diabetic patient and 117.53 ± 39.90mg/dl in non-diabetic patients).

For diabetic stroke patients, Hypertension shows OR 5.44(1.49-19.88) (p< 0.010) & similarly family history of CVD shows OR of 9.9 (1.19-82.77) (p<0.034) (Table-2).

**Table-1: Clinical characteristics of the studied population at the time of admission to hospital**

	Non-diabetic		Diabetic		Total		p value
	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	
<b>Age</b>							
Ischemic stroke	55	55.09 ± 15.27	17	62 ± 12.23	72	56.72 ± 14.90	0.585
Hemorrhagic stroke	24	55.79 ± 15.65	4	51.25 ± 11.69	28	55.14 ± 15.23	0.053
<b>Blood Pressure[mmHg]:</b>							
Ischemic stroke							
Systolic	55	138.55±23.38	17	166.12±37.93	72	145.06±29.91	0.0001
Diastolic	55	86.23 ± 14.15	17	92.58 ± 17.05	72	87.73 ± 15.13	0.425
Hemorrhagic stroke							
Systolic	24	148.08±27.00	4	189 ± 32.45	28	153.93±31.31	<0.001
Diastolic	24	88.08 ± 11.30	4	109 ± 21.97	28	91.07 ± 15.23	0.425
<b>Cholesterol [mg/dl]:</b>							
Ischemic stroke	55	159.95±43.34	17	180.29±51.69	72	164.75±46.27	0.074
Hemorrhagic stroke	24	176.58±39.94	4	200 ± 35.71	28	179.93±40.21	0.282
<b>Triglycerides [mg/dl]:</b>							
Ischemic stroke	55	123.85±59.79	17	132.88±55.14	72	125.99±58.85	0.529
Hemorrhagic stroke	24	93.87±32.71	4	146 ± 66.94	28	101.32±43.47	0.018
<b>HDL [mg/dl]:</b>							
Ischemic stroke	55	40.61±11.62	17	41.41±10.08	72	40.803±11.282	0.77
Hemorrhagic stroke	24	46.47 ± 13.51	4	50 ± 18.72	28	47 ± 14.46	0.65
<b>LDL [mg/dl]:</b>							
Ischemic stroke	55	95.11 ± 38.21	17	112.59±44.516	72	99.29 ± 40.50	0.079
Hemorrhagic stroke	24	111.78±33.37	4	121 ± 33.50	28	113.15±33.557	0.613
<b>VLDL [mg/dl]:</b>							
Ischemic stroke	55	24.47±11.87	17	26.23 ± 11.08	72	24.88 ± 11.71	0.589
Hemorrhagic stroke	24	18.54 ± 6.61	4	29 ± 13.58	28	20.03 ± 8.78	0.019

<b>Blood Urea At Admission</b>							
Ischemic stroke	55	37.83 ± 26.92	17	44.76± 54.48	72	39.47 ± 35.54	0.48
Hemorrhagic stroke	24	39.54 ± 23.06	4	76.25 ± 84.73	28	44.78 ± 40.57	0.07
<b>Serum Creatinine At Admission [mg/dl]:</b>							
Ischemic stroke	55	1,216 ± 0.884	17	1,414± 1.762	72	1,263 ± 1.567	0.536
Hemorrhagic stroke	24	1,259 ± 0.539	4	2.7 ± 3.139	28	1,465 ± 1.328	0.032
<b>Blood Glucose at admission [mg/dl]:</b>							
Ischemic stroke	55	117.53±39.90	17	134.12 ± 34.32	72	121.44 ± 39.29	0.08
Hemorrhagic stroke	24	155.83±68.13	4	167 ± 35.41	28	157.43±64.601	0.753

**Table-2: Binary logistic regression with dependent factor diabetes mellitus and other variables**

	B	S.E.	Wald	df	Sig.	OR	95% C.I. for OR	
							Lower	Upper
HTN	1.694	0.661	6.571	1	0.010	5.4	1.490	19.882
F/H of CVD	2.295	1.082	4.498	1	0.034	9.925	1.190	82.770

## DISCUSSION

Diabetes is an important risk factor associated with stroke. In the present study, only 21% of studied subjects were diabetic. While the majority i.e., 79% were non-diabetic. There was difference in sex wise distribution of diabetic status. Proportion of females having diabetes was more i.e., 22.22% (10/45) than males 20% (11/55).

Framingham and other studies like Dhamija R K [4] Henning Mast [5], Craig J [6], Khan F Y [7] reported diabetes as a major risk factor for stroke incidence.

Exposure of brain tissue to excessive levels of glucose resulted in disruption of blood brain barrier, anaerobic glycolysis, lactate accumulation, tissue acidosis, the formation of free radicals, release of excitatory neurotransmitters and calcium influx into the cell. Poorly controlled hyperglycemia reduces cerebral blood flow and oxygenation of tissues, and increased intracranial pressure, cerebral edema and neuronal death.

Diabetes mellitus has a deteriorating effect on arterial blood vessels and is a risk factor for ischemic stroke.

Goldstein et al., and Idris et al., have reported the relative risk of ischemic stroke for diabetic individuals between 1.3 and 6 [8, 9]. Diabetes also increases the risk of stroke recurrence [9]. Lacunar infarct may be common in diabetic patient [10]. The effect of diabetes may in part be mediated by other risk factors such as hypertension and lipid alterations and it is also possible that these and other risk factors such as smoking potentiate each other.

Our study demonstrated that comprehensive comparison between ischemic and hemorrhagic stroke patients with and without diabetes mellitus. The present study observed that the mean value of all parameters

was more in diabetic patients as compared to non diabetic.

In our study, the mean age of ischemic stroke of the diabetic patients was 62 ±12.23 years, and it was 55.09 ± 15.27 years for the non-diabetic patients. There is an increase in the incidence of ischemic stroke as the age increases in diabetic patients in comparison to non-diabetic patients, which decreases in hemorrhagic stroke. Similar study done by Katarzyna K. Snarska et al., [11] and Avin Subhash et al., [12] shows that there is an increase in the incidence of ischemic as well as hemorrhagic stroke in diabetic patients in comparison to non-diabetic patients (Table-3).

In our present study, ischemic stroke showed highly significant increase in the systolic blood pressure in diabetic patients (166 ± 37.93) than non-diabetic patients (138.55 ± 23.38) (p<0.001). In hemorrhagic stroke also, there is a highly significant increase in systolic blood pressure in diabetic patients (189±32.45) than non diabetic patients (148.08±27.00) (p <0.001). The results obtained were similar to the studies performed by Katarzyna K. Snarska et al., [11] and Avin Subhash et al., [12] (Table-4).

In ischemic stroke, diastolic blood pressure increases in diabetic patients (92.58±17.05) than non-diabetic (86.23±14.15) and in hemorrhagic stroke, there is a significant increase in diastolic blood pressure in diabetic (109±21.97) patients than non-diabetic patients (88.08±11.30).similar observations have been made by Katarzyna K. Snarska et al., [11] and Avin Subhash et al., [12] (Table-5).

In our present study, ischemic stroke showed increased risk of stroke in diabetic patients because of increased level of cholesterol in diabetic patients (180.29 ± 51.69) in comparison to non-diabetic (159.95 ± 43.34) (p= 0.07). In contrast study done by Katarzyna K Snarska et al., [11] shows that there is increased level of cholesterol in non diabetic patients (184.36±40.97) rather than diabetic (168.83±42.30) (p<0.001) and Avin Subhash et al., also show there is increased level of

cholesterol in non diabetic patients ( $212 \pm 84.7$ ) rather than diabetic ( $198.1 \pm 59.8$ ) ( $p=0.392$ ) [12].

In our present study, in hemorrhagic stroke, there is a significant increase in triglyceride in diabetic patients ( $146 \pm 66.94$ ) than the non-diabetic patient i.e., ( $93.87 \pm 32.71$ ) ( $P = 0.01$ ). Based on our review of the existing evidence, we can conclude that there is biological plausibility and epidemiological evidence to suggest that hypertriglyceridemia potentially contributes to an increased risk for a stroke.

David Tanne [13] reported in his study that elevated blood triglycerides increase a person's risk of suffering from an ischemic stroke. "Those with high

blood triglycerides (over 200 mg/dl) have a nearly 30 percent higher risk of suffering a stroke, after taking into account other risk factors for stroke such as high blood pressure, cigarette smoking or diabetes."

In our study, in an ischemic stroke there is increased risk of stroke in diabetic patients ( $44.76 \pm 54.48$ ) as serum creatinine level increases in diabetic patients in comparison to non-diabetic ( $37.83 \pm 26.92$ ). Katarzyna K. Snarska et al., [11] showed that at the time of admission of patients with ischemic stroke and diabetes, the mean serum creatinine was significantly higher as compared to non-diabetic patients ( $1.35 \pm 1.28$  mg/dl vs.  $1.07 \pm 0.60$  mg/dl,  $p < 0.000$ ).

**Table-3: Similar study showing distribution of age [11, 12]**

Author	Type	Diabetic Mean $\pm$ SD	Non-diabetic Mean $\pm$ SD	p value
Katarzyna k Snarska	Ischemic	73.17 $\pm$ 10.19	63.94 $\pm$ 16.01	0.054
	Hemorrhagic	72.90 $\pm$ 9.28	71.92 $\pm$ 11.90	NS
Avin shubhash		57 $\pm$ 12.7	61.3 $\pm$ 12.9	0.137

**Table-4: Similar study: showing systolic blood pressure [11, 12]**

Author	Type	Diabetic Mean $\pm$ SD	Non-diabetic Mean $\pm$ SD	p value
Katarzyna k Snarska	Ischemic	156.99 $\pm$ 23.53	152.67 $\pm$ 25.10	NS
	Hemorrhagic	164.17 $\pm$ 33.43	164.53 $\pm$ 36.14	NS
Avin subhash		142 $\pm$ 16.9	132 $\pm$ 15.5	0.0115

**Table-5: Similar study: showing diastolic blood pressure [11] [12]**

Author	Type	Diabetic Mean $\pm$ SD	Non-diabetic Mean $\pm$ SD	p value
Katarzyna k Snarska	Ischemic	88.90 $\pm$ 12.59	88.20 $\pm$ 12.49	NS
	Hemorrhagic	94.17 $\pm$ 16.21	93.50 $\pm$ 16.23	NS
Avin subhash		110 $\pm$ 13.7	79.4 $\pm$ 9.4	<0.001

## CONCLUSION

Our study concluded that the incidence of stroke is more in diabetic patients than non-diabetic. Proportion of females having diabetes was more than males. Both the systolic and diastolic blood pressure shows statistically significant ( $p < 0.001$ ) differences in diabetic and non-diabetic.

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