Comparative Evaluation of Diabetic and Non-Diabetic Stroke and the Study of Effect of Glycemic Levels on the Outcome of Stroke

Dr.Appari Kanaka MahaLakshmi[1] ,*Dr. NarasingaRaoSiddarathi[2],
Dr. Arjun Ramavath[3], Dr.N.Suresh Babu[4], Dr.M.Jhansi Rani[5]

[1](Department of General Medicine, Andhra Medical College,Dr.NTRUHS,INDIA)
[2](Department of General Medicine, Andhra Medical College,Dr.NTRUHS,INDIA)
[3](Department of General Medicine, Andhra Medical College,Dr.NTRUHS,INDIA)
[4](Department of Pharmacology, Andhra Medical College,Dr.NTRUHS,INDIA)
[5](Department of Pharmacology, Andhra Medical College,Dr.NTRUHS,INDIA)
*Correspondent Author: Dr. NarasingaRaoSiddarathi.

Abstract: _Introduction:_Diabetes poses a major health problem globally and is one of the top five leading causes of death in most developed countries. A substantial body of evidence suggests that it could reach epidemic proportions particularly in developing and newly industrialized countries[4].Diabetes mellitus is a risk factor for both an excess incidence of and mortality from Stroke[5]. The first edition of Diabetes in America documented the strong association of diabetes with risk of stroke, especially strokes due to vascular disease and infarction. [6]_Aim:_To study and compare the clinical profile of stroke with respect to age, sex, stroke type, stroke severity, prevalence of risk factors, and outcome in diabetics and non-diabetics. To study and correlate the effect of admission glucose levels on the outcome of diabetic and non-diabetic strokes. _Methods:_ After obtaining approval from the IEC and valid informed consent, the participants were recruited into the study.The present study is a prospective case control observational study. This study was conducted on 100 patients with stroke(out of which 50 patients were diabetic or found to have diabetes, and 50 were non-diabetic stroke patients) admitted to King George hospital, Visakhapatnam. _Results:_The mean age in Diabetic stroke patients was 56.8±9.74 and in Non-Diabetic stroke patients was 60.5±30.1).History of cranial nerve involvement was in 26% of diabetics and 28%of non-diabetics. Visual disturbance was present in 10% of diabetic patients. Speech disorder was present in 24% of diabetics and 26% of non-diabetics. Altered sensorium was present in 44% of diabetics and 38% of non-diabetic patients. Among diabetic stroke patients 86% were known diabetics where as 14% were newly detected diabetics. 52% of diabetic stroke patients and 44% of non-diabetic stroke patients had no history of addictions in the past. History of tobacco chewing was 10% in diabetics and 6% in non-diabetics. Alcoholism was 18% in diabetics and 28% in non-diabetics. Smoking was in 20% diabetics and 22% in non-diabetics. 50% of diabetic stroke patients and 66% of non-diabetic stroke patients had normal ECG. 18% of diabetics and 20% of non-diabetics had LVH. 66% of diabetics had 56% of non-diabetics had infarction on CT BRAIN. 34% of diabetics and 44% of non-diabetics had hemorrhage on CT BRAIN. Diabetic stroke patients had longer duration of hospital stay 8.52 ± 4.35 days compared with non-diabetics 6.62 ±3.77 days. 64% had fair recovery in diabetic group as compared to 80% in non-diabetic group.24% had poor recovery in diabetic and 10% had poor recovery in non-diabetic group. Death was seen in 12% of diabetic and 10% non-diabetic patients. _Conclusion:_Commonest modifiable risk factors in stroke are hypertension, smoking, dyslipidemia, alcohol consumption, and diabetes mellitus. Early diagnosis, treatment including lifestyle modification and prevention of diabetes may reduce the development of stroke and its complications and it presents a major challenge for health care professionals facing an epidemic of both diabetes and stroke._Keywords:_Diabetes, Stroke, Awareness, clinical research, health-care providers.

I. Introduction

World Health Organization defines the clinical syndrome of "stroke" as 'rapidly developing clinical signs of focal (or global) disturbance of cerebral function with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than vascular origin.[1]

It is important to recognize that it is not a single disease but a syndrome resulting from numerous different pathophysiological processes which result in similar end organ damage[2]. The majority (about80%) of stroke is ischemic; the remainder result from primary hemorrhage either intracerebral or into the subarachnoid space. Ischemic stroke is often thought as a single entity but, in fact it may be the result of quite different disease processes[2,3].

Diabetes poses a major health problem globally and is one of the top five leading causes of death in most developed countries. A substantial body of evidence suggests that it could reach epidemic proportions particularly in developing and newly industrialized countries[4].Diabetes mellitus is a risk factor for both an excess incidence of and mortality from Stroke[5]. The first edition of Diabetes in America documented the strong association of diabetes with risk of stroke, especially strokes due to vascular disease and infarction[6].

Bell[7] has reviewed the literature describing the relationship between diabetes and stroke. Most ischemic strokes in diabetic patients are due to occlusion of small Para median penetrating arteries. The occlusions cause small infarcts within the white matter of the brain.

In the Multiple Risk Factor Intervention Trial (MRFIT) in 1973-75, 12-year mortality was determined for 5,163 men age 35-57 years who reported taking medication for diabetes and 324,815 men without a history of diabetes[8].

The risk of mortality from stroke was increased 2.8-fold (95% confidence interval (CI) 2.0-3.7) among those with diabetes, even after adjusting for age, race, income, and cardiovascular risk factors. The risk of stroke mortality was greatest for non-hemorrhagic stroke (relative risk 3.8) than for subarachnoid (1.1) or intracranial hemorrhage (1.5)[9].

In the community of Rancho Bernardo, CA, 3,778 men and women who were age 50-79 years in 1972-74 were evaluated during the next 12 years for fatal and nonfatal stroke. The risk of stroke was significantly higher among diabetic men and women compared with those without diabetes[10].

The improved clinical diagnosis of stroke by computerized tomography and magnetic resonance imaging has probably increased the measured incidence of stroke in the population, especially among older individuals who receive more frequent and intensive medical care. Further, there is probably a very high prevalence of "silent" cerebral infarction that can be documented by these new noninvasive techniques. The incidence and prevalence of stroke among diabetic patients may, therefore, be higher now than was suggested in the past. The incidence of stroke also increases with increasing age. Thus, many stroke patients may have undetected diabetes at the time of the stroke; subsequent examinationin the hospital or following treatment for stroke may identify the previously undetected diabetes. The reported prevalence of diabetes among stroke patients as compared with those without a stroke may therefore be inflated by differences in ascertainment.

Diabetes potentiates stroke by favoring thrombosis by increasing concentration in blood of prothrombotic factors like fibrinogen and von willebrand factor. It also increases platelet adhesiveness. Fibrinolytic capacity is decreased through increased concentrations of plasminogen activator inhibitor type 1.

Diabetes also favor's atherogenesis because of various lipid abnormalities like hypertriglyceridemia, low HDL cholesterol and high triglyceride-enriched HDL. Glycosylation of lipoproteins and oxidation of lipoproteins leads to atheroma formation.

The relative risk of stroke in diabetics approximately doubled compared to with that in patients without diabetes. Clinical profile of stroke is different in diabetics compared in non-diabetics in many aspects. Keirs et al found that diabetics have more severe initial stroke. Intracerebral hemorrhages are less frequent in diabetic patients whereas lacunar infarcts are more frequent in diabetics.

There are many factors which alter the outcome of stroke. Hyperglycemia predicts higher mortality and morbidity after acute stroke independently of other adverse prognostic factors, such as older age, type and severity of stroke and non–reversibility of the neurological deficit. The effect of hyperglycemia on mortality is large[11,12,13,14,15,16].

McCall has noted that a higher blood glucose level at hospital admission predicts a poorer prognosis after a stroke, irrespective of whether the patient is diabetic or not. Also, the degree of disability after the stroke may be worse among individuals with elevated blood glucose at the time of the stroke. Animal models showed that hyperglycemia alone worsens the ischemic brain damage from a stroke[17].

Hyperglycemia is common among patients with acute stroke, occurring in upto 60% of patients overall and approximately 12-53% of acute stroke patients without prior diagnosis of diabetes[18,19,20].

The adverse effect of hyperglycemia is possibly due to anaerobic metabolism of glucose, worsening of intracellular and extracellular acidosis[14,16,19,21].

Wier et al. also showed that raised plasma glucose concentration after acute stroke predicts a poor prognosis after correcting for age, stroke severity, and stroke subtype. Raised plasma glucose concentration is therefore unlikely to be solely a stress response and should arguably be treated actively[12,19].

The present study was undertaken in a prospective manner to comparatively evaluate stroke in diabetic and non-diabetic patients and to study the effect of glycemic levels on the outcome of stroke.

II. Aims And Objectives

To study and compare the clinical profile of stroke with respect to age, sex, stroke type, stroke severity, prevalence of risk factors, and outcome in diabetics and non-diabetics. To study and correlate the effect of admission glucose levels on the outcome of diabetic and non-diabetic strokes.

III. Materials And Methods

***Study design*:** After obtaining approval from the IEC and valid informed consent, the participants were recruited into the study. The present study is a prospective case control observational study. This study was conducted on 100 patients with stroke(out of which 50 patients were diabetic or found to have diabetes, and 50 were non-diabetic stroke patients) admitted to King George hospital, Visakhapatnam during the period from November 2016 to September 2018

Patients who were admitted with history of acute stroke and confirmed by thorough physical examination and CT BRAIN to have stroke, and were satisfying the inclusion and exclusion criteria were studied.

Inclusion criteria
1. All stroke patients with diabetes (cases).
2. Diabetes was confirmed on the basis of past history of diabetes , history of taking oral hypoglycemic drugs or insulin, previous medical records suggestive of diabetes or previous reports of blood sugar or HbA1C confirming the diagnosis of diabetes according to WHO criteria.
3. Non-diabetics admitted with high blood sugar levels underwent repeat blood sugar (48 hours after admission) and HbA1C estimation. Those satisfying WHO criteria were labeled as newly detected diabetics and included as cases otherwise were labeled as stress hyperglycemics and included as controls.

Exclusion Criteria
1. Patients receiving diabetogenic drugs.
2. Patients having severe stroke who died before it could be established whether they had diabetes or not.
3. Patients with severe stroke who died before it could be established whether they had stroke or not.

After admission detailed history regarding temporal profile of stroke and risk factors like hypertension, diabetes mellitus, smoking, alcohol intake, previous strokes were taken.
Detailed neurological examination was done and stroke score based on MRC scale was obtained during admission. Three stroke severity categories were developed.

Mild	=4
Moderate	3 – 2
Severe	1 – 0

Stroke score based on MRC (Medical Research Council)scale
Grade 0 :   No contraction
Grade 1:   Flicker of contraction
Grade 2:   Active movement with gravity eliminated

Grade3:   Active movement against gravity

Grade 4: Active movement against gravity and moderate resistance

Grade 5:   Active movement against gravity and full resistance(normal power).
Prognosis of these patients was assessed on the basis of improvement or deterioration based on MRC scale.

Simple hierarchal scale was used to assess upper and lower limb qualitative function on admission and after 6 weeks. Patients were graded according to best unassisted functional outcome achieved as below-

Upper limb :
1. Normal
2. Fasten button
3. Hold cup
4. No use

Lower limb :
1. Normal
2. Climb stairs
3. Walk on flat surface
4. Stand
5. No use

Neurological outcome after 6 weeks was graded as follows-
Good: Patients who can return to normal or previous activites, mild hemiparesis, mild dysphasia(MRC=4)

Fair: Patients who are independent in activities of daily living but are unable to return to previous activities, moderate paresis, moderate dysphasia (MRC 3-2)

Poor : Patients who are dependent on others for daily living activities, severe paresis to plegia, aphasia (MRC 1-0).

This assessment was done immediately after admission and it was repeated after 6 weeks in survivors. Patients were categorized as dead or survived with or without improvement.
The following investigations were done in all the cases –

1. Complete hemogram
2. RBS on admission
3. FBS (48 hours after admission)
4. HbA1C
5. Blood Urea/ Serum Creatinine
6. ECG
7. Lipid profile (including total cholesterol, triglycerides, HDL-cholesterol, LDL-cholesterol).
8. CT Scan Brain

IV. Results
TABLE – 2: Age Distribution Years

Age (Years)	Diabetic	Non diabetic
35-44	10	18
45-54	36	22
55-64	34	20
65-74	14	24
75-84	6	16

TABLE – 3: Mean Age

	Diabetic	Non diabetic
Age (mean) (Years)	56.8	60.5

The mean age in Diabetic stroke patients was 56.8±9.74 and in Non-Diabetic stroke patients was 60.5±30.1. Maximum patients were in the age group from 45-54(36%) in Diabetic stroke and 65-74(24%) in Non-Diabetic group. Difference in mean age in study was not statistically significant.

TABLE – 4 Sex Distribution

Sex	Diabetic	Non diabetic
Male	37(73)	35(70)
Female	13(27)	15(30)

Out of 50 Diabetic stroke patients 37 were males and 13 were females where as in Non-Diabetics 35 were males and 15 were females. Percentage of male population in both the groups were higher.

PRESENTING COMPLAINTS

TABLE – 5: Weakness

Weakness	Diabetic	Non diabetic
Hemiparesis (HP)	45(90)	45(90)
Brachial monoparesis(BMP)	5(10)	5(10)

TABLE – 6: Conscious Level

Consciousness	Diabetic	Non diabetic
Alert(A)	28 (56)	31(62)
Response to pain stimulus(P)	8(16)	7(14)
Unconscious(U)	6(12)	5(10)
Responds to verbal commands(V)	8(16)	7(14)

TABLE –7: Speech Disorder

Speech disorder	Diabetic	Non diabetic
Absent	38(76)	37(74)
Broca's Aphasia (BA)	10(20)	10(20)
Global Aphasia(GA)	2(4)	3(6)

TABLE – 8: Cranial Nerve Involvement

Cranial nerve involvement	Diabetic	Non diabetic
Involved	13(26)	14(28)
Not involved	37(74)	36(72)

TABLE –9: Visual Disturbance

Visual disturbance	Diabetic	Non diabetic
Present	5(10)	0
Absent	45(90)	50(100)

$X^2 = 1.4$ P>0.05 NS

TABLE – 10 : Other Complications

Other complications	Diabetic	Non diabetic
Present	5(10)	4(8)
Absent	45(90)	46(92)

X^2 = 0.0 P>0.05   NS

Stroke patients in both study groups presented with history of motor weakness as their most common presenting complaint (90% in both the groups had hemiparesis/hemiplegia and 10% had monoparesis/monoplegia).History of cranial nerve involvement was in 26% of diabetics and 28%of non diabetics. Visual disturbance was present in 10% of diabetic patients. Speech disorder was present in 24% of diabetics and 26% of non-diabetics. Altered sensorium was present in 44% of diabetics and 38% of non-diabetic patients. Other complications like headache and unsteadiness of gait, convulsions was present in 10% of diabetics and 8% of non- diabetics.

TABLE – 11: Past History

Past History	Diabetic	Non diabetic	P* Value, sig
Hypertension(HTN)	35(70)	17(34)	P<0.05 S
Ischemic heart disease(IHD)	13(26)	4(8)	P>0.05 NS
Previous Stroke	18(36)	6(12)	P>0.05 NS
Newly Diagnosed Diabetic(NDD)	7(14)	0	P>0.05 NS

Among diabetic stroke patients 86% were known diabetics where as 14% were newly detected diabetics.

70% of diabetic stroke patients had past history of hypertension compared to 34% in non-diabetic group which was statistically significant.

Previous history of IHD was present in 26% of diabetics and 8% of non-diabetic stroke patients.

Previous history of stroke was present in 36% of diabetics and 12% of non-diabetic stroke patients.

TABLE – 12: Personal History

Personal history	Diabetic	Non diabetic
Tobacco Chewing(TC)	5(10)	3(6)
No Addictions(NHA)	26(52)	23(46)
Alcohol(AL)	9(18)	14(28)
Smoking(SM)	10(20)	11(22)

52% of diabetic stroke patients and 44% of non-diabetic stroke patients had no history of addictions in the past. History of tobacco chewing was 10% in diabetics and 6% in non-diabetics. Alcoholism was 18% in diabetics and 28% in non-diabetics. Smoking was in 20% diabetics and 22% in non-diabetics.
Smoking and alcohol consumption was more frequent in the non-diabetic group

TABLE – 13: Blood Pressure

| Parameter | Diabetic | | Non diabetic | | Mean difference | t value | P* value, sig |
	Mean	SD	Mean	SD			
Systolic BP	143	22.6	160	13.2	17	4.59	P<0.001 S
Diastolic BP	86.5	12.9	95.0	7.35	8.5	4.04	P<0.001 S

The mean systolic blood pressure on admission was 143±22.6 in diabetic group and 160± 13.2 in non-diabetic group. The difference was statistically significant.

The mean diastolic blood pressure on admission was 86.5±12.9 in diabetic group and 95± 7.4 in non-diabetic group. The difference was statistically significant.

TABLE – 14: Admission RBS

	Diabetic		Non diabetic				
	Mean	**SD**	**Mean**	**SD**	**Mean difference**	**t value**	**P* value, sig**
Admission RBS (mg)	212	75.30	128.42	42.48	84	6.83	P<0.0001 HS

The mean blood sugar on admission in diabetic group was 212± 75.30 compared with 128.42± 42.48 in non-diabetic group.

The difference was statistically significant.

TABLE – 15: LIPID PROFILE

	Diabetic		Non diabetic				
Lipid Profile	**Mean**	**SD**	**Mean**	**SD**	**Mean Difference**	**t value**	**P* value, sig**
HDL (mg)	33.06	8.31	41.7	10.6	8.6	4.51	P<0.05 S
LDL (mg)	107.8	37.76	121.96	37.95	14.16	1.87	P>0.05 NS
Triglyceride (mg)	182.88	91.05	140.5	36.84	42.38	3.05	P<0.05 S
TCL (mg)	176.2	47.43	187.58	42.02	11.38	1.26	P>0.05 NS

HDL (mg)

The mean HDL cholesterol was 33.06± 8.31 in the diabetic group and 41.7±10.6 in the non-diabetic group. The mean LDL cholesterol was 107.8±37.76 in the diabetic and 121.96±37.95 in the non-diabetic group. The mean triglycerides was 182.88 ± 91.05 in the diabetic and 140.5± 36.84 in the non-diabetic group. TCL was 176.2 ± 47.43 in the diabetic and 187.58 ± 42.02 in the non-diabetic group.

Mean triglycerides was higher in the diabetic group and mean HDL was lower in diabetic group as compared to the non-diabetic group. Both the values were statistically significant.

TABLE – 16: ECG

ECG	Diabetic	Non diabetic
Infarct (INF)	6(12)	3(6)
Ischemia(ISC)	10(20)	4(8)
Left Ventricular Hypertrophy(LVH)	9(18)	10(20)
Normal (N)	25(50)	33(66)

50% of diabetic stroke patients and 66% of non-diabetic stroke patients had normal ECG. 18% of diabetics and 20% of non-diabetics had LVH.
20% of diabetics and 8%of non-diabetics had ischemia.10% of diabetics and

6% of non-diabetics had infarction on ECG.

TABLE – 17: CT BRAIN

CT Brain	Diabetic	Non diabetic	P* Value, sig
Infarct (INF)	33(66)	28(56)	P<0.05 S
Hemmorhage(HEM)	17(34)	22(44)	P<0.05 S

66% of diabetics had 56% of non-diabetics had infarction on CT BRAIN. 34% of diabetics and 44% of non-diabetics had hemorrhage on CT BRAIN.

Hemorrhagic strokes were more frequent in the non-diabetics and ischemic strokes in the diabetic stroke groups. The difference was statistically significant.

TABLE – 18 : DURATION OF HOSPITAL STAY

Parameter	Diabetic		Non diabetic		Mean difference	t value	P* value, sig
	Mean	SD	Mean	SD			
Duration of hospital stay	8.52	4.35	6.62	3.77	1.9	2.9	P<0.05 S

Diabetic stroke patients had longer duration of hospital stay 8.52 ± 4.35 days compared with non-diabetics 6.62 ±3.77 days. The difference was statistically significant

TABLE – 19 : ASSOCIATION BETWEEN OUTCOME AND RBS

Diabetics		RBS			
Outcome	Range	Mean	SD	P* Value, sig	Significant pairs**
FR (n=32)	90-380	183.62	73.51		
PR (n=12)	205-296	251	29.24	P<0.001 HS	1&2, 1&3
D (n=6)	215-378	313.5	67.36		

* Oneway ANOVA
** Studentised Newman Keul's test

Non Diabetics		RBS			
Outcome	Range	Mean	SD	P* Value, sig	Significant pairs**
FR (n=40)	80-226	118	31.81		
PR (n=5)	82-190	148.4	49.01	P<0.001 HS	1&2, 1&3
D (n=5)	106-230	195.8	50.73		

* Oneway ANOVA
** Studentised Newman Keul's test

Outcome	Diabetic	Non diabetic
FR	32(64)	40(80)
PR	12(24)	5(10)
D	6(12)	5(10)

$X^2 = 4.4$ P>0.05 NS

Outcome	Diabetic		Non diabetic	
	Mean	SD	Mean	SD
FR	183.62	73.51	118	31.81
PR	251	29.24	148.4	49.01
D	313.5	67.36	195.8	50.73

64% had fair recovery in diabetic group as compared to 80% in non-diabetic group.24% had poor recovery in diabetic and 10% had poor recovery in non-diabetic group. Death was seen in 12% of diabetic and 10% non-diabetic patients. Overall outcome was better in the non-diabetic stroke patients.

In the diabetic group; patients with a fair recovery had a mean RBS of 183.62±73.51, patients with poor recovery had a mean RBS of 251±29.24, patients who died had a mean RBS of 313.5 ±67.36.

In the non-diabetic group; patients with a fair recovery had a mean RBS of 118± 31.81, patients with poor recovery had a mean RBS of 148.4±49.01, patients who died had a mean RBS of 195.8± 50.73.

Overall in both the groups patients with a higher admission RBS value had a poor outcome. The difference was statistically significant in both the groups.

V. Discussion

Stroke is a common clinical problem, current treatment for patients with established stroke is relatively ineffective. Approximately 50% of patients are left with permanent disability. Effective risk factor intervention offers a real hope of reducing stroke morbidity and mortality. Certain risk factors have been consistently identified as significant predictor of stroke outcome, while some are less consistent.

The present study involved 100 patients who satisfied the inclusion and exclusion criteria out of which, 50 were diabetic stroke patients and 50 non-diabetic stroke patients. Out of the 50 diabetic stroke patients 43 were known diabetics and 7 were detected to have type 2 diabetes during hospital stay.

AGE INCIDENCE:

In the present study, the mean age in Diabetic stroke patients was 56.8±9.74. and in Non-Diabetic stroke patients was 60.5±30.1. Maximum patients were in the age group from 45-54(36%) in Diabetic stroke and 65-74(24%) in Non-Diabetic group.

Study	Age in years	
	Diabetics	Non -Diabetics
Zafar A[125] et al (2007)	59.5 (±11.82)	60.4 (±14.80)
Megherbi SE[126] et al(2003)	70.7±10.2	71.7±13.1
Kamel A[127] et al(2006)	58.8±10.1	61.6±12.5
Sarkar RN[128] et al	51.2	67
Present study	56.8±9.74	60.5±30.1

In the Copenhagen Stroke Study (**Jorgensen H[129]et al 1994)** the diabetic stroke patient was 3.2 years younger than the nondiabetic stroke patient (P < .001).

The observation in the present study, that Stroke occurs at a younger age in diabetics than in non-diabetics was similar to the other studies.

Study	Diabetics		Non-diabetics	
	Male	Female	Male	Female
Zafar A[125] et al (2007)	56%	44%	68%	32%
Kamel A[127] et al(2006)	52%	48%	60%	40%
Present Study	73%	27%	70%	30%

The observation in the present study, that men were at greater risk for stroke in both the diabetic and non-diabetic group was similar to the above studies.

Our observation was contrary to that by Seppo Lehto[130] et al 1996, who found women at greater risk for stroke than men.

PRESENTING COMPLAINTS :
Stroke patients in both study groups presented with history of motor weakness as their most common presenting complaint (90% in both the groups had hemiparesis/hemiplegia and 10% had monoparesis/monoplegia).History of cranial nerve involvement was in 26% of diabetics and 28% of non diabetics .Visual disturbance was present in 10% of diabetic patients. Speech disorder was present in 24% of diabetics and 26% of non diabetics.
Altered sensorium was present in 44% of diabetics and 38% of non-diabetic patients. Other complications like headache, unsteadiness of gait and convulsions was present in 10% of diabetics and 8% of non diabetics.

RISK FACTORS FOR STROKE :
a.   Previous history of hypertension:

Study	Diabetics	Non-diabetics
Sarkar RN[128] et al	70.9%	47.6%
Zafar A[125] et al (2007)	92%	86%
Kamel A[127] et al(2006)	60%	48%
Megherbi SE[126] et al(2003)	59.1%	45.5%
Present Study	70%	34%

The observation in the present study, that previous history of hypertension was more common in the diabetics than in the non-diabetics was similar to the above studies. Similar results were also found by Kiessla BM[131] et al 2005 and in the Copenhagen Stroke Study (**Jorgensen H etal 1994).**

b.   Previous history of ischemic heart disease

Study	Diabetic	Non-diabetic
Zafar A[125] et al (2007)	32%	28%
Kamel A[127] et al(2006)	36%	28%
Present Study	27%	8%

The observation in the present study, that previous history of ischemic heart disease was more common in the diabetics than in the non-diabetics was similar to the above studies.

c.   Previous stroke :

Study	Diabetic	Non- Diabetic
Zafar A[125] et al (2007)	18%	18%
Sarkar RN[128] et al	15.8%	5.7%
Present Study	36%	12%

In the present study, previous history of CVA was more common in the diabetic group which was similar to the study by Sarkar RN[128] et al and is contrary to the study by Zafar A[125] et al (2007) which found similar incidence in both the groups.

PERSONAL HISTORY :

Study	Diabetics		Non-Diabetics	
	Smoking	Alcoholism	Smoking	Alcoholism
Megherbi SE[126] et al(2003)	34.9%	25.6%	37.6%	31.7%
Present Study	20%	18%	22%	28%

The observation in the present study, that current or previous smoking was distributed equally between the 2 groups, but alcohol consumption was low in the diabetic group was similar to the above study.

Blood Pressure on admission:

Study	Diabetics		Non-Diabetics	
	SBP	DBP	SBP	DBP
Kamel A[127] et al(2006)	156.8±23.3	94.4±11.6	143.2±14.0	86.8±8.0
Present Study	143± 22.6	86.5±12.9	160±13.2	95.0±7.4

The observation in the present study, that mean systolic and diastolic blood pressure on admission was higher in the non-diabetic than the diabetic group, was contrary to the above study.

Diabetics were under treatment for hypertension than non-diabetic, which could be the explanation for low blood pressure on admission in diabetics than non-diabetics.

GLYCEMIC STATUS ON ADMISSION :

Study	Diabetic	Non-DIABETIC
Kamel A[127] et al(2006)	259.8±63.9	173.6±33.4
Present Study	212±75.30	128.±42.5

The observation in the present study, that admission RBS was higher in the diabetic group than in the non-diabetic group was similar to the above study.

ECG :

50% of diabetic stroke patients and 66% of non-diabetic stroke patients had normal ECG. 18% of diabetics and 20% of non-diabetics had LVH. 20% of diabetics and 8% of non-diabetics had ischemia.10% of diabetics and 6% of non-diabetics had infarction.

STROKE TYPE :

In the present study, 66% of diabetics had 56% of non-diabetics had infarction on CT BRAIN. 34% of diabetics and 44% of non-diabetics had hemorrhage on CT BRAIN. Hemorrhagic strokes were more frequent in the non-diabetics and ischemic strokes in the diabetic stroke groups.

In the study by Sarkar RN[128] et al ischemic stroke were higher in diabetic group (66%) as compared to non- diabetic group (56%). Haemorrhagic stroke was higher in non-diabetic group (44%) than in diabetic group (34%).

In the Copenhagen Stroke Study (**Jorgensen H[129]et al 1994**) intracerebral hemorrhages were six times less frequent in diabetic patients .

DURATION OF HOSPITAL STAY

Duration of hospital stay was longer in diabetic than in the non-diabetic group. The mean duration of hospital stay was 8.52±4.35 days in diabetic and 6.62 ±3.77 days in the non-diabetic group.

Control of blood sugar and treatment of other complications in diabetic subjects like hypertension, ischemic heart disease, diabetic nephropathy took longer time and was the cause of longer stay in the hospital.

LIPID PROFILE :

In the present study, diabetic patients had higher mean triglycerides (182.88± 91.05 Vs 140.5± 36.84) and lower HDL (33.1± 8.31 Vs 41.7±10.6) as compared to non-diabetic group.

Kamel A[127] et al(2006) found higher triglycerides in the diabetic group (211.6±80.2 Vs 166.5±35.8) as compared to the non-diabetic group.

Seppo Lehto[130] et al. 1996 also observed hypertriglyceridemia and low HDL in diabetic stroke patients.

STROKE OUTCOME:
Diabetic Vs Non-diabetic stroke

In the present study, stroke patients with diabetes had a poor outcome compared to stroke patients without diabetes. Similar observations were made by Megherbi SE[126]et al(2003), KamelA[127] et al(2006) and in the Copenhagen Stroke Study (**Jorgensen H[129] et al 1994).**

Hyperglycemia on admission and outcome
In the present study, patients with high admission blood sugar had a poorer outcome as compared to those with lower blood sugar values in both the diabetic and non-diabetic study groups.
Similar observations were made by McCall[17] et al. and Fuentes B[132] et al.

In the Copenhagen Stroke Study (**Jorgensen H[129]et al 1994**) increased glucose levels on admission independently increase mortality from stroke in non diabetic but not in diabetic patients.
The influence of diabetes mellitus as an independent predictor of the incidence of ischemic stroke is well recognized and relates to a variety of causes. Recent analyses of both prospective and case control studies have confirmed the importance of acute hyperglycemia as a predictor of outcome after stroke.

Hyperglycemia worsens outcome and increases rate of mortality from stroke.
Two mechanisms have been postulated to explain the negative influence of hyperglycemia on outcome following stroke: (1) poorer reperfusion due to vascular injury and a loss of vascular tone through oxidation of nitric oxide dependent mechanisms; and (2) increased acidosis, perhaps from lactic acid/acid sensing channels, leading to further tissue injury.

VI. Conclusion
Commonest modifiable risk factors in stroke are hypertension, smoking, dyslipidemia, alcohol consumption, and diabetes mellitus. Commonest non modifiable risk factors are increasing age, male sex and family history of stroke.
Diabetes is an independent risk factor for stroke.
Stroke in diabetes differs from that of stroke in non-diabetics with respect to age, sex, stroke type, stroke severity, prevalence of risk factors, and outcome.
Early diagnosis, treatment including lifestyle modification and prevention of diabetes may reduce the development of stroke and its complications and it presents a major challenge for health care professionals facing an epidemic of both diabetes and stroke.
Hyperglycemia at stroke onset is associated with higher risk of poor outcome independent of the other variables.
Treatment or prevention of modifiable risk factors can reduce the mortality and morbidity of stroke.

VII. Summary
Ø The mean age in Diabetic stroke patients was 56.8±9.74 and in Non-Diabetic stroke patients was 60.5±30.1. Maximum patients were in the age group from 45-54(36%) in Diabetic stroke and 65-74(24%) in Non-Diabetic group.
Ø Out of 50 Diabetic stroke patients 37 were males and 13 were females where as in Non-Diabetics 35 were males and 15 were females. Percentage of male population in both the groups were higher.
Ø Stroke patients in both study groups presented with history of motor weakness as their most common presenting complaint (90% in both the groups had hemiparesis/hemiplegia and 10% had monoparesis/ monoplegia).
Ø 70% of diabetic stroke patients had past history of hypertension compared to 34% in non diabetic group which was statistically significant.
Ø Previous history of IHD was present in 26% of diabetics and 8% of non-diabetic stroke patients.
☐ Previous history of stroke was present in 36% of diabetics and 12% of non-diabetic stroke patients.
Ø The mean systolic blood pressure on admission was 143± 22.6 in diabetic group and 160±13.2 in non-diabetic group. The mean diastolic blood pressure on admission was 86.5± 12.9 in diabetic group and 95±7.4 in non-diabetic group.
Ø The mean blood sugar on admission was significantly higher in diabetic group (212± 75.30) compared with in non-diabetic group (128± 42.5).
☐ The mean HDL cholesterol was lower in the diabetic group (33.06±8.31) compared to that in the non-diabetic group(41.7± 10.6).

The mean triglycerides was significantly higher in the diabetic (182.88 ± 91.05) than in the non-diabetic group(140.5± 36.84).

Ø Diabetic patients had greater percentage of ischemic stroke(66%) as compared to non-diabetic patients(56%). Hemorrhages were less in diabetic stroke patients(34%) as compared to non-diabetics(44%).

Ø Diabetic stroke patients had longer duration of hospital stay 8.52 ± 4.35 days compared with non-diabetics 6.62 ± 3.77 days.

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