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Study of clinical profile and pattern of stroke in diabetic and non-diabetic patients in a hospital of Kumaon region

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ABSTRACT

Background: Diabetes enhances the risk of stroke which is one of the leading causes of morbidity and mortality. **Aims and Objectives:** The study was done to analyze the clinical profile and pattern of stroke in diabetic and non-diabetic patients. **Materials and Methods:** This was a hospital-based cross-sectional study done in 130 stroke patients (with/without diabetes – 65 each) presenting to outpatient department\inpatient department general medicine department, Dr. Sushila Tiwari Hospital of Government Medical College, Haldwani during January 2020–September 2021. A detailed history, neurological examination along with assessment of risk factors, pattern, and subtype were done. **Results:** The mean age was significantly higher among stroke patients with diabetes (66.38±11.99 years). The proportion of systemic hypertension was significantly higher in stroke patients without diabetes (89.2%). Abnormal ECG was significantly more reported in stroke patients without diabetes (73.8%). The mean hemoglobin and mean random blood sugar were significantly higher in stroke patients with diabetes (8.82±1.72 and 291.17±107.39, respectively). The mean high-density lipoprotein was significantly higher in stroke patients without diabetes (43.06±5.1), whereas mean low-density lipoprotein, mean triglycerides, and mean total cholesterol were significantly higher in stroke patients with diabetes (126.28±33.19; 186.97±45.91; and 229.31±39.83, respectively). The presenting complaints observed were altered consciousness (67.7%) right hemiparesis (55.4%), left hemiparesis (41.5%), abnormal body movement (28.5%), etc. Ischemic stroke was significantly higher in patients with diabetes (90.8%). Lacunar (34%), basal ganglia (27%), cortical (23%), etc., were stroke subtypes seen among study patients. **Conclusion:** Significant difference was observed between stroke patients with/without diabetes in terms of age, several risk factors, presenting symptoms, pattern, and its subtype.

Key words: Cholesterol; Diabetes mellitus; Dyslipidemia; Hemorrhagic stroke; Ischemic stroke

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INTRODUCTION

Stroke or cerebrovascular accident is defined as an abrupt onset of a neurologic deficit that is attributable to a focal vascular cause. Broadly, stroke can be either ischemic stroke or hemorrhagic stroke. Globally, stroke is the second most common cause of mortality and third most common cause of disability.[1] In India, the rate of incidence of stroke in urban population ranges from 45 to 487/100,000 people and in rural population 55–388.4/100,000 people.[2] Several potential risk factors attributed to stroke include hypertension, smoking, alcohol consumption, dyslipidemia, metabolic syndromes, and most importantly diabetes mellitus (DM).

Numerous studies have evaluated the relationship between stroke and DM. They observed that diabetic patients have two-fold higher risk of ischemic stroke than non-diabetic patients. Furthermore, DM is an independent risk factor associated with stroke and result in higher mortality and

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disability.[3,4] The deranged levels of hemoglobin (HbA1c), microvascular complications, and dyslipidemia highlight the importance of type II DM history and clinical background in the development of stroke.

Hence, it becomes pertinent to properly evaluate the underlying risk factors in the diabetic patients. Preventive measures can be taken to minimize the propensity of stroke. Lifestyle changes and leading an active life can be the most important preventive strategy.

Aims and objectives

Therefore, the present study was aimed at analyzing the clinical profile and pattern of stroke in diabetic and non-diabetic patients.

MATERIALS AND METHODS

The present study was a hospital-based cross-sectional study conducted on 130 stroke patients (with/without diabetes – 65 each) at outpatient department\inpatient department of medicine, Dr. Susheela Tiwari Hospital, Haldwani (Uttarakhand) during study period January 2020–September 2021.

All stroke patients of age group more than 18 years and sudden onset neurologic deficit of >24 h (such as hemiparesis, hemiplegia, hemianaesthesia, speech dysfunction, vertigo, and hemianopia), confirmed by neuroimaging were included in the study. Subjects having age <18 year, sudden onset of weakness due to other causes such as (history of head injury, hypercoagulable states, eclampsia, infection, subarachnoid hemorrhage, migraine, intracranial tumor, patient on anticoagulant and having bleeding diathesis, previous history of stroke), and patients negative on neuroimaging were excluded from the study.

The sample size was calculated based on the previous study[5] using formula given below-

$$n = \frac{[z_{1-\alpha/2}.\sqrt{2P(1-P)} + z_{1-\beta}.\sqrt{\begin{Bmatrix} P_1(1-P_1) \\ + P_2(1-P_2) \end{Bmatrix}}]^2}{(P1-P2)^2}$$

$$= \frac{[1.645 * 0.648 + 0.842 * 0.632]^2}{(0.20)^2}$$

$$= 63.88 \sim 65 \text{ for each group}$$

The study patients were subjected to detailed history, neurological examination along with assessment of risk factors, pattern, and subtyping. The study was approved by the Institutional Ethics Committee, GMC, Haldwani. Informed written consent was obtained from each patient. The nature and consequence of study was explained to them. Strict confidentiality was assured.

Statistical analysis was performed by the SPSS version 17.0. Continuous variables were presented as mean±SD, and categorical variables were presented as absolute numbers and percentage. Data were checked for normality before statistical analysis. Normally distributed continuous variables were compared using the unpaired t-test, whereas the Mann–Whitney U-test was used for those variables that were not normally distributed. Categorical variables were analyzed using either the Chi-square test or Fisher's exact test. For all statistical tests, $P<0.05$ was taken to indicate a significant difference.

RESULTS

The mean age was significantly higher among stroke patients with diabetes (66.38±11.99 years) than stroke patients without diabetes (58.96±11.31 years). In stroke patients with diabetes, maximum proportion of patients belonged to 71–80 years age group (30.8%), whereas in stroke patients without diabetes maximum proportion of patients belonged to 51–0 years age group (35.4%). The proportion of males was higher although not significant in both stroke patients with diabetes (61.5%) and stroke patients without diabetes (58.5%) as compared to females. The proportion of stroke patients with diabetes was more from rural area (56.9%), whereas proportion of stroke patients without diabetes was slightly more from urban area (50.8%), although the difference was not statistically significant. The proportion of systemic hypertension was significantly higher in stroke patients without diabetes (89.2%) than stroke patients with diabetes (30.8%). The proportion of coronary artery disease (CAD) was slightly higher in stroke patients without diabetes (26.2%) than stroke patients with diabetes (24.6%), although the difference was not statistically significant. Abnormal ECG was significantly more reported in stroke patients without diabetes (73.8%) than stroke patients with diabetes (52.3%). The use of alcohol (26.2%) and tobacco (12.3%) was more reported in stroke patients with diabetes, whereas the use of smoking was (47.7%) more reported in stroke patients without diabetes, although the difference was not statistically significant. The mean systolic BP was significantly higher in stroke patients without diabetes (189.75±19.05), whereas mean diastolic BP was equivalent in both study groups. The mean HbA1c and mean random blood sugar (RBS) were significantly higher in stroke patients with diabetes (8.82±1.72 and 291.17±107.39, respectively). The mean high-density lipoprotein (HDL) was significantly higher in stroke patients without diabetes (43.06±5.1), whereas mean low-density lipoprotein (LDL), mean triglycerides (TG), and mean total cholesterol were significantly higher in stroke patients with diabetes (126.28±33.19; 186.97±45.91; and 229.31±39.83, respectively) (Table 1).

Table 1: Distribution of study participants as per risk factors (n=130)

Risk factors	Diabetes	Non-diabetes	P-value
	n (%)/Mean±SD	n (%)/Mean±SD	
Age (in years)			
	66.38±11.99	58.96±11.31	0.0004
40–50	9 (13.8)	18 (27.7)	0.009
51–60	15 (23.1)	23 (35.4)	
61–70	16 (24.6)	16 (24.6)	
71–80	20 (30.8)	6 (9.2)	
81–90	5 (7.7)	2 (3.1)	
Sex			
Female	25 (38.5)	27 (41.5)	0.858
Male	40 (61.5)	38 (58.5)	
Area of residence			
Rural	37 (56.9)	32 (49.2)	0.482
Urban	28 (43.1)	33 (50.8)	
Systemic Hypertension	20 (30.8)	58 (89.2)	0.0001
Coronary artery disease	16 (24.6)	17 (26.2)	1.000
Abnormal ECG	34 (52.3)	48 (73.8)	0.018
Substance abuse			
Alcohol	17 (26.2)	14 (21.5)	0.681
Smoker	25 (38.5)	31 (47.7)	0.376
Tobacco	8 (12.3)	7 (10.8)	1.000
Blood pressure (in mm Hg)			
Systolic BP	181.91±14.63	189.75±19.05	0.009
Diastolic BP	102.86±7.08	104.86±8.36	0.143
HbA1c	8.82±1.72	5.57±0.65	0.0001
Random blood sugar	291.17±107.39	128.14±34.93	0.0001
Lipid profile			
HDL	31.51±6.59	43.06±5.1	0.0001
LDL	126.28±33.19	89.51±20.74	0.0001
TG	186.97±45.91	146.72±38.5	0.0001
Total Cholesterol	229.31±39.83	178.43±32.69	0.0001

HDL: High-density lipoprotein, LDL: low-density lipoprotein, TG: Triglycerides, BP: Blood pressure

The most common presenting complaint among stroke patients was altered consciousness (67.7%), followed by right hemiparesis (55.4%), left hemiparesis (41.5%), and abnormal body movement (28.5%) (Table 2).

Ischemic stroke was higher in patients with diabetes (90.8%), whereas hemorrhagic stroke was higher in patients without diabetes (58.5%), the association was statistically significant. Among subtype of stroke lacunar involvement was most commonly reported (34%), followed by basal ganglia (27%) and cortical involvement (23%) (Table 3).

DISCUSSION

The pattern of stroke is different in diabetes patients than in non-diabetic patients. Studies show that the incidence of stroke is 1.5–3 times higher in diabetic as compared to non-diabetic patient.[6] It also causes a major proportion

Table 2: Distribution of study participants as per presenting complaints (n=130)

Presenting complaints	Non-diabetes	Diabetes	Total
	n (%)	n (%)	n (%)
Weakness			
Lt brachial monoparesis	0 (0.0)	2 (3.1)	2 (1.5)
Lt hemiparesis (hp)	27 (41.5)	27 (41.5)	54 (41.5)
Rt brachial monoparesis	1 (1.5)	1 (1.5)	2 (1.5)
Rt hemiparesis	37 (56.9)	35 (53.8)	72 (55.4)
Consciousness			
Alert	17 (26.2)	25 (38.5)	42 (32.3)
Altered	48 (73.8)	40 (61.5)	88 (67.7)
Speech Disorder			
Brocas Aphasia	5 (7.7)	3 (4.6)	8 (6.2)
Global Aphasia	6 (9.2)	12 (18.5)	18 (13.8)
Slurred	6 (9.2)	8 (12.3)	14 (10.8)
Cranial Nerve Involvement			
Lt 7 supranuclear palsy	11 (16.9)	16 (24.6)	27 (20.8)
Rt 7 supranuclear palsy	10 (15.4)	9 (13.8)	19 (14.6)
Visual Disturbances			
No	65 (100)	65 (100)	130 (100)
Others			
Abnormal body movement	25 (38.5)	12 (18.5)	37 (28.5)
Vertigo	1 (1.5)	0 (0.0)	1 (0.8)
Vomiting	1 (1.5)	1 (1.5)	2 (1.5)

of deaths in diabetic patients as compared to non-diabetic patients. Therefore, the present study was conducted with an aim to study the pattern of stroke in diabetics and non-diabetic patients by comparing their clinical profile and identifying the associated risk factors.

Patients were sub-divided based on age in both non-diabetic and diabetic group. It was observed that in non-diabetic group maximum number of patients was from 51–60 years of age group (35.4%) followed by 24.6% patients in 61–70 years age. While in diabetic group, maximum patients (30.8%) were from 71–80 years age, followed by 24.6% in 61–70 years age group. It was observed that there was a significant difference in the age distribution of the patients when compared between the two groups of non-diabetic and diabetic patients (P=0.009). However, finding in our study was contradictory to the study done previously that showed that diabetic patients with ischemic stroke are younger, but these findings were more likely in African-American.[6]

Percentages of male population in both the groups were higher. This gender difference was not found to be significant in our study. A similar study was conducted by Ali et al.,[7] and Subhash et al.,[8] ratio of males was higher than females similar to our study and it was not found to be significant.

Table 3: Distribution of study participants as per pattern of stroke (n=130)

Pattern of stroke	Non-diabetes		Diabetes	
	Ischemic	Hemorrhagic	Ischemic	Hemorrhagic
	n (%)	n (%)	n (%)	n (%)
Type of stroke P=0.0001	27 (41.5)	38 (58.5)	59 (90.8)	6 (9.2)
Basal ganglia	4 (15)	27 (71)	1 (2)	4 (57)
Brain Stem	1 (4)	2 (5)	6 (10)	0 (0)
Cerebellar	1 (4)	8 (21)	0 (0)	2 (29)
Cortical	12 (44)	1 (3)	15 (26)	1 (14)
Internal capsule	1 (4)	0 (0)	0 (0)	0 (0)
Lacunar	8 (29)	0 (0)	36 (62)	0 (0)

Systemic hypertension and CAD are known risk factors of stroke. However, we observed that incidence of systemic hypertension was much higher in non-diabetic patients than in diabetic patients and the co-relation was statistically significant (89.2% vs. 30.8%; P<0.001). Incidence of CAD was comparable between the two groups (26.2% vs. 24.6%), while abnormal ECG was seen more in non-diabetic than in diabetic group (73.8% vs. 52.3%). Contrary to our results, Subhash et al., in their study, found that number of stroke patients with DM with history of hypertension was 75% and that of non-diabetic group was 42.5%.[8] Further, in diabetic stroke, patients with history of CAD were 32.5% and that of non-diabetic group were 27.5%. Similarly, Sarkar et al., Mahalakshmi et al., and Kamel et al., also reported higher incidence of hypertension history in diabetic patients as compared to non-diabetic patients.[9-11] Findings in our study were contradictory to the study done previously as most patients were from rural areas, where there is limitation of health care facilities; hence, many patients included in our study were not diagnosed of systemic hypertension beforehand.

Patients in both the groups were taking alcohol, smoking, and tobacco. The difference was comparable and non-significant. The risk for stroke in smokers is 2 to 3 times greater than in non-smokers. The mechanisms of enhanced atherogenesis promoted by cigarette smoking are incompletely understood but include reduced capacity of the blood to deliver oxygen, cardiac arrhythmias, increased blood coagulability, and triggering of arterial thrombosis and arterial spasm. Tobacco also increases carotid artery plaque thickness. Heavy drinking may precipitate cardiogenic brain embolism. Alcohol consumption increases the risk for hemorrhagic stroke; alcohol-induced hypertension predisposes to spontaneous intracranial hemorrhage. Furthermore, active drinkers have a higher frequency of obstructive sleep apneas with more severe hypoxemia.[12]

Blood sugar alone is not a good indicator of metabolic state, as blood sugar levels are dependent on patient factors such as compliance to medication and regimen. For that reason, the glycated HbA1c levels were also looked along with RBS levels to determine if the diabetic stroke patients had good control of their disease. The mean levels of RBS and HbA1c were significantly higher in diabetic patients as compared to non-diabetic patients (291.17±107.39 mg/dl vs. 128.14±34.93 mg/dl; P<0.001 and 8.82±1.72% vs. 5.57±0.65, P<0.001; respectively). This suggests that poor control of diabetes might be the reason for stroke in these patients. In this region of Kumaon, it was also found that either due to limited health-care delivery system or due to unawareness of chronic diseases among population, patients of diabetes were not taking medications and also had poor compliance to medications leading to poor RBS control and increased HbA1c levels in our study. Our results are in line with studies by Mahalakshmi et al., Kamel et al., where in RBS was higher in diabetic patients.[10,11]

In the present study, we assessed the association between type of stroke and diabetes. A statistically significant difference was found between the two groups (P<0.001). Among non-diabetic group patients, more number of patients had hemorrhagic stroke as compared to ischemic stroke (58.5% vs. 41.5%); however, among diabetic patients, 90.8% had ischemic stroke, while only 9.2% had hemorrhagic stroke. Thus, our study indicates that ischemic stroke was more common in diabetic patients. In diabetics, there is increased susceptibility for large vessel atherosclerosis and small vessel occlusive disease. Excessive glycation and oxidation, endothelial dysfunction, and increased platelet aggregation may be responsible for endothelial proliferation, dysfunction, and thickening of plasma membrane in small blood vessels (“lipohyalinosis”) leading to lacunar infarction in diabetic patients. Our results were consistent with studies by Ali et al., Subhash et al., and Sarkar et al., who found that frequency of ischemic stroke was significantly higher in diabetes patients and hemorrhagic stroke was less prevalent.[7-9] A large multi-centric study in Europe showed that diabetic patients are more likely to develop ischemic stroke (77.5% vs. 71.9%) and less likely to have hemorrhagic stroke than non-

diabetics (8.5 vs. 11.5%).[13] Infratentorial infarcts are also more frequent in patients with diabetes and are associated with a worse prognosis with a two-fold increase in the likelihood of subsequent stroke.[14] Small vessel disease might be underlying cause of lacunar or subcortical infarcts being more common in diabetic patients.

In the present study, lipid profile of all the patients was also evaluated. We found that in diabetic patients LDL, TG, and total cholesterol that were significantly higher than non-diabetic patients (126.28±33.19 mg/dL vs. 89.51±20.74mg/dL;186.97±45.91mg/dLvs.146.72±38.5mg/dL; and 229.31±39.83 mg/dL vs. 178.43±32.69, respectively; P<0.001 each), while HDL was significantly lower in diabetic patients (31.51±6.59 mg/dL vs. 43.06±5.1 mg/dL; P<0.001). Our results were in line with study by Subhash et al., and Kamel et al., who found that diabetic patients had higher mean TG and lower HDL as compared to non-diabetic group.[8,11] Higher total cholesterol and high LDL concentration were correlated with atherosclerosis. Dyslipidemia is a recognized risk factor for ischemic stroke. Meta-analyses had suggested that ischemic stroke risk increases with increasing serum cholesterol, and the reduction in stroke risk associated with 3-hydroxy 3-methylglutaryl coenzyme A reductase inhibitor (statin) therapies was related to reduction in LDL cholesterol. Lipid-modifying therapy with statins had definitely established that reduction of LDL cholesterol reduces cardiovascular risk. Statins benefit stroke survivors as well. Lipid-lowering agents may slow progression of atherosclerotic plaque growth and may cause a regression in rate of plaque formation.[15]

The present study was conducted in foothills of hilly region that caters to most of the population indulged in moderate-to-severe levels of exercise/activity due to agricultural work and geographical distribution. In addition, our study was conducted in COVID era and being a tertiary referral center and COVID-dedicated hospital that most of the patient included in the study were critical, elderly, and referred patients. Furthermore, our study was done in a single center hence including very few numbers of population leading to discrepancy from the previous study results.

CONCLUSION

Diabetes is one of the modifiable risk factors for stroke. The pattern of stroke differs in diabetic and non-diabetic patients. The incidence of ischemic stroke was significantly higher in diabetic patients; particularly, lacunar stroke subtype was higher. Further, HbA1c levels were significantly higher in diabetic stroke patients, stating that poor glycemic control is an independent risk factor to develop stroke in diabetic patients. Stroke patients with DM had significantly higher levels of total cholesterol, LDL, and TG, while low levels of HDL cholesterol. Hence, dyslipidemia is associated with increased incidence of stroke in diabetics due to increased atherosclerosis in the vessels. The association of systemic hypertension and diabetes in stroke patients was also statistically significant.

Although occurrence of stroke could not be avoided as such in a diabetic person; however, lifestyle modifications including controlling weight, minimizing total fat intake, especially saturated fat intake, augmenting fiber intake, strict glycemic control, and increasing physical activity, could reduce incidence of stroke in high-risk individuals.

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Authors' Contributions:
DJ- Concept, design, definition of intellectual content, literature search, data acquisition, data analysis, manuscript preparation, manuscript editing, and manuscript review; **MM-** Concept, design, definition of intellectual content, statistical Analysis, manuscript preparation, manuscript editing, and manuscript review; **SCJ-** Concept, design, definition of intellectual content, manuscript preparation, manuscript editing, and manuscript review; **VS-** Concept, design, definition of intellectual content, manuscript preparation, manuscript editing, manuscript review, and guarantor.

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