

CLINICO-RADIOLOGICAL PROFILE OF ISCHEMIC STROKE IN PATIENTS WITH DIABETES-A PROSPECTIVE OBSERVATIONAL STUDY

¹Dr Boddu Raja Venkata Chandra Sekhar, ^{2*}Dr. B.K Agrawal, ³Dr Pratik Mittal, ⁴Dr Manu Mathew,

¹PG Resident, MBBS, Department of General Medicine, MM Institute of Medical Sciences and Research, Maharishi Markandeshwar (Deemed to be) University, Mullana, Ambala, 133207, Haryana, India, ORCID ID -0009-0000-3683-1138, dr.brvcchandrasedkhar@gmail.com

²Professor and Principal, MBBS, MD, Department of General Medicine, MM Institute of Medical Sciences and Research, Maharishi Markandeshwar (Deemed to be) University, Mullana, Ambala, 133207, Haryana, India, ORCID ID – 0000-0002-0022-0842, onlybimal@gmail.com

³Senior Consultant and Head, MBBS, MD General Medicine, DNB Neurology, Department of Neurology, MM Institute of Medical Sciences and Research, Maharishi Markandeshwar (Deemed to be) University, Mullana, Ambala, 133207, Haryana, India, ORCID ID – 0009-0009-6192-7823 docpratikmittal@gmail.com

⁴Assistant Professor, MBBS, MD General Medicine, Department of General Medicine, MM Institute of Medical Sciences and Research, Maharishi Markandeshwar (Deemed to be) University, Mullana, Ambala, 133207, Haryana, India, ORCID ID – 0009-0005-5359-0790 113@live.in

***Corresponding author: Dr. B.K Agrawal, [ORCID ID – 0000-0002-0022-0842](mailto:onlybimal@gmail.com)**

ABSTRACT

Objective: Globally, stroke remains a leading cause of death and disability, with ischemic stroke contributing to nearly 85% of the overall burden. Diabetes mellitus (DM), a known independent risk factor of ischemic stroke, the clinico-radiological profile of stroke in diabetics compared to non-diabetics remains unclear among the Indian scenario. Thus, our study discusses clinicopathological features and imaging patterns of ischemic stroke in diabetic and non-diabetic patients. **Methods:** This prospective cross-sectional study was carried out at the Department of Medicine & Neurology of Maharishi Markandeshwar Institute of Medical Sciences & Research over a period of two years (2023-2025). 100 ischemic stroke patients were evaluated, split evenly into diabetic and non-diabetic groups. Clinical features, vascular risk factors, laboratory parameters, stroke subtypes, radiological findings, and stroke severity were assessed using a standardized proforma, neuroimaging, and relevant laboratory investigations. **Results:** 54% of non-diabetics & 64% of diabetics were having hypertension. Diabetic patients had considerably higher triglyceride levels ($p=0.007$). Hemiplegia was the most frequent clinical presentation (84% in diabetics vs. 86% in non-diabetics), followed by dysarthria & aphasia. Lacunar infarction was the most common subtype in diabetics (56%) and non-diabetics (48%). Although not statistically significant, radiologically, diabetes and non-diabetes tends to have tiny subcortical infarcts. Stroke severity, as determined by the NIHSS, were similar among the groups, with the majority presenting with mild strokes. **Conclusion:** In diabetes, microangiopathic changes lead to earlier and more severe ischemic strokes, often with lacunar and subcortical infarcts. Thus, early detection and strict control of vascular risk factors are required to reduce stroke burden.

Keywords: Ischemic stroke, Diabetes mellitus, Clinico-radiological profile, Lacunar infarction, Risk factors, Neuroimaging

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INTRODUCTION

Stroke is the fourth most common source of disease burden & the third most common cause of death worldwide. As per World Health Organization (WHO), a stroke is a sudden brain dysfunction of vascular origin lasting over 24 hours or sometimes causing death.¹ Globally, stroke is the second leading cause of

death, accounting for around 11% of deaths, with over 6.6 million deaths and 143 million disability-adjusted life years (DALYs) in 2019, mostly in low- and middle-income countries.² In India, stroke is the fourth leading cause of death and fifth leading cause of disability, with an incidence of 105–152/100,000 population annually.³ Despite life expectancy exceeding 60 years in India, strokes often affect younger adults, particularly men, with 20–30% occurring <50 years of age and

show a male predominance that varies across regions and age groups.^{2,3} Diabetes mellitus (DM) is a recognized independent determinant of stroke, conferring almost a twofold rise in ischemic stroke risk and mortality. The condition accelerates systemic as well as intracranial atherosclerosis through characteristic vascular alterations in the brain.⁴ Neuroimaging plays a crucial role in the management of acute stroke and guides therapeutic decisions. It assists in ruling out hemorrhage, identifying vessel blockage or narrowing, evaluating perfusion and tissue viability, and assessing collateral blood flow.⁵ In order to provide baseline data for future preventive strategies, particularly for stroke prevention in individuals with diabetes, this study was conducted to assess the clinico-radiological features of ischemic stroke in diabetic patients and also to compare their imaging patterns and clinical presentations with those of non-diabetic patients.

Material & Methods

This prospective study was conducted in the department of Medicine & Neurology of Maharishi Markandeshwar Institute of Medical Sciences & Research over a period of two years (2023-2025). 100 newly diagnosed Ischemic-stroke patients fulfilling the inclusion & exclusion criteria were selected for the study. Institutional ethical approval was obtained (IEC

2881), and written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki (1975).

METHODOLOGY

The study included all stroke patients over the age of 18 years who had a sudden onset neurologic deficit lasting more than 24 hours, as demonstrated by neuroimaging, including hemiparesis, hemiplegia, hemianesthesia, speech difficulty, vertigo, & hemianopia. Participants who had a previous history of head injuries, hypercoagulable conditions, eclampsia, infection, subarachnoid hemorrhage, migraine, intracranial tumor, were on anticoagulants & experiencing bleeding diathesis, had a history of stroke, or had a negative neuroimaging result were excluded

Sample Size

$$n = \frac{Z^2 \times p(1 - p)}{d^2}$$

Where:

- **Z** = 1.96
- **p** = expected proportion (0.5)
- **d** = margin of error (0.10)

$$n = \frac{1.96^2 \times 0.5 \times 0.5}{0.10^2}$$

$$= \frac{3.84 \times 0.25}{0.01}$$

$$= 96$$

A sample of 100 was taken for the study

The sample size was based on a convenience sampling of all eligible ischemic stroke patients presenting over a 24-month period. A post-hoc calculation using the formula for single proportion (95% CI, 10% margin of error, expected prevalence 50%) gave a minimum requirement of 96 patients, which was met (n=100). For comparative analysis between diabetics and non-diabetics, the study was powered to detect only large differences (>25%), which is acknowledged as a limitation.

Statistical analysis

Data was analyzed and entered in an Excel sheet. For statistical analysis, the mean & standard deviations (SD) of the measurements for each group were utilized. The t test & chi square test were used to statistically examine data for each evaluation point. A significant threshold of $p < 0.05$ was established.

RESULTS

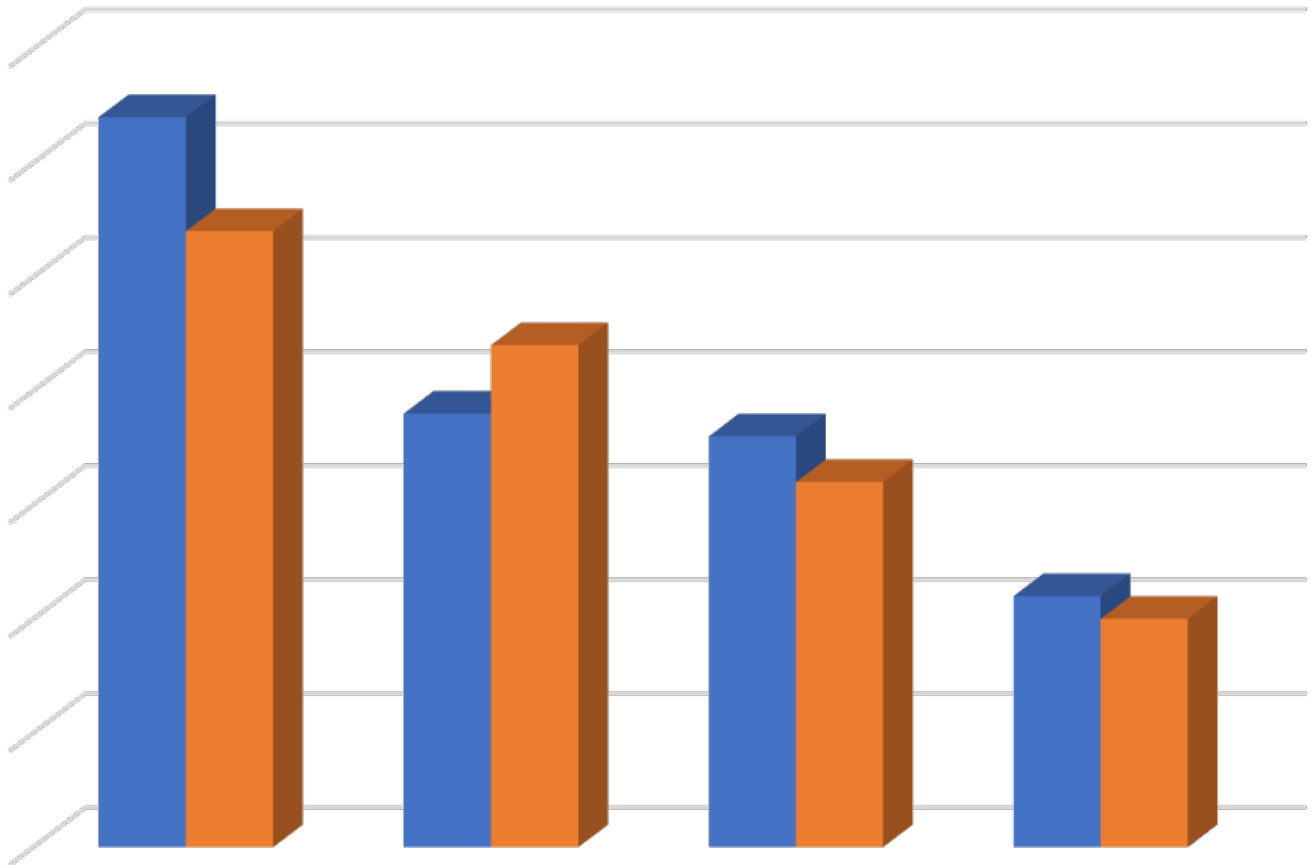
This study shows males were comparatively more as compared to females in both the groups. The mean age of stroke among diabetic patients was 56.28 ± 10.03 years, while among nondiabetics it was 59.81 ± 12.65 years. Although the difference was not statistically significant ($p = 0.44$), diabetic patients tend to develop ischaemic stroke at a relatively younger age, whereas non-diabetic patients were comparatively older at the time of stroke. (table 1).

Gender and mean age among the study groups

Gender	Diabetic	Non-Diabetic		p value		
	N=50	%	N=50	%		
Male	34	68	30	60		0.51
Female	16	32	20	40		
Group		Age in years		p value		
		Mean		SD		
Diabetic		56.28		10.03	0.44	
Non-Diabetic		59.81		12.65		

Risk factors viz. hypertension, smoking, alcohol, TIA, & atrial fibrillation were reported among 64%, 38%, 26%, 36%, & 22% of diabetic subjects, & 54%, 44%, 38%, 32%, & 20% of nondiabetic subjects, respectively. The vascular risk factors were

evenly distributed, & all the risk factors were found to be comparable between diabetic & non-diabetic stroke patients when analyzed using chi-square test ($p > 0.05$) as shown in graph 1.



Graph 1: Risk factors among the study groups

Triglyceride, Total cholesterol, LDL and VLDL were found to be more in diabetic as compared to non-diabetic group, HDL was

found to be lower in diabetes patients. however significant difference was revealed w.r.t. triglyceride (table 2).

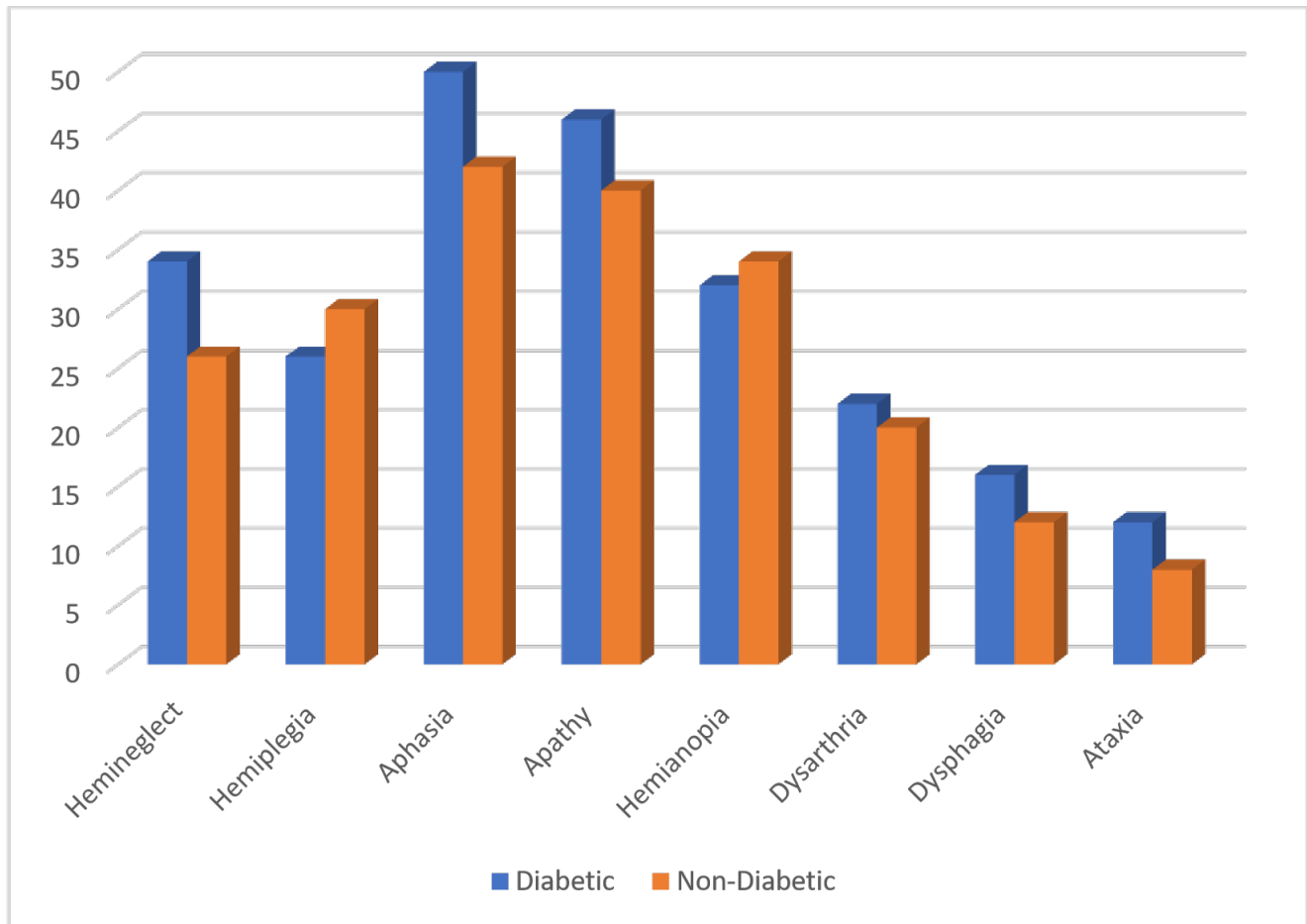
Table 2: Investigative profile among the study groups

Variables	Diabetic		Non-Diabetic		p value
	Mean	SD	Mean	SD	
Triglyceride	207.92	44.11	170.24	41.95	0.007*
Cholesterol	248.17	54.88	215.31	59.66	0.08
HDL	36.24	4.96	41.24	1.55	0.04
LDL	126.82	25.63	106.76	27.29	0.03
VLDL	45.18	9.72	30.20	5.20	0.02

*: statistically significant

Although diabetics showed slightly higher rates of dysarthria, aphasia, apathy, & dysphagia, while non-diabetics had marginally more hemiplegia, hemianopia, & ataxia, these

differences were not statistically significant (all $p > 0.05$). Thus, ischemic stroke patients, irrespective of diabetic status, presented with broadly similar clinical characteristics (graph 2).



Graph 2: Clinical characteristics among the study groups

In the present study, lacunar infarction was the most common clinical subtype, observed in 56% of diabetic and 48% of non-diabetic stroke patients. Partial anterior circulation infarction was more frequent among non-diabetics (38% vs 26%), whereas total anterior circulation infarction was comparable in both groups (18% vs 14%). Although lacunar infarcts being more common in

diabetics & PACI being more frequent in non-diabetics and the differences were not statistically significant ($\chi^2=2.91$, $df=2$, $p=0.23$). Thus, the distribution of stroke subtypes did not differ significantly between the groups, suggesting that both diabetics & non-diabetics present with a similar spectrum of stroke types (table 2).

Clinical classification among the study groups

Clinical Classification	Diabetic		Non-Diabetic		p value
	N	%	N	%	
Total anterior circulation infarction	9	18	7	14	0.23
Partial anterior circulation infarction	13	26	19	38	
Lacunar infarction	28	56	24	48	
Total	50	100	50	100	

Regarding CT findings, non-statistically significant differences were observed between stroke patients with and without diabetes regarding location, size of cerebral infarcts and the presence of brain edema. These results suggest that radiological characteristics of stroke are comparable in diabetics & non-

diabetics, though diabetes show a slight trend toward small, subcortical infarcts — consistent with microangiopathy (table 3), however these differences could not reach a statistically significance level.

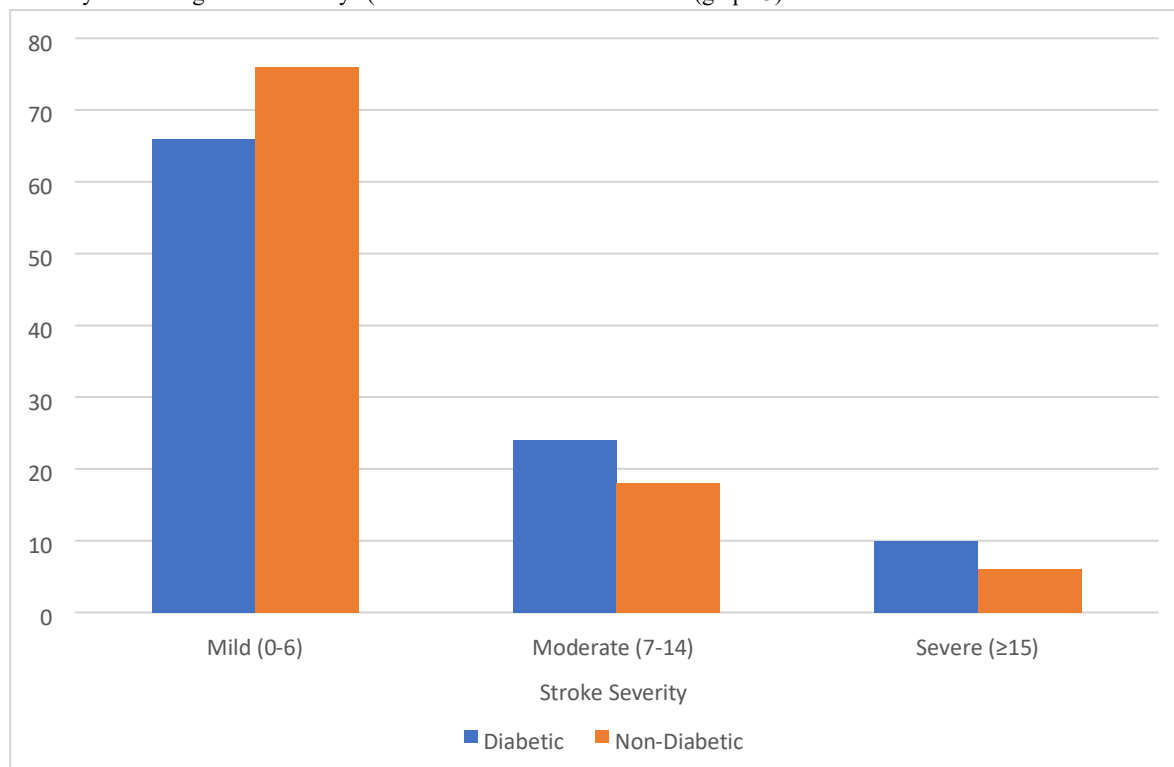
Radiological findings among the study groups

Infarcts	Diabetic		Non-Diabetic		p value
	N	%	N	%	
Size					
Small	31	62	26	52	0.67
Medium	8	16	10	20	
Large	11	22	14	28	
Site					
Cortical	7	14	9	18	0.40
Subcortical	29	58	23	46	

Infarcts	Diabetic	Non-Diabetic	p value		
Corticostubcortical	14	28	18	36	
Edema					
Present	23	46	21	42	0.83
Absent	27	54	29	58	

Both diabetic & non-diabetic patients most commonly presented with mild strokes ($\text{NIHSS} \leq 6$). While diabetics showed a small tendency toward greater severity (more moderate & severe

strokes), this was not statistically significant. Hence, stroke severity distribution was broadly similar across both groups (graph 3).



Graph 3: Stroke severity among the study groups

DISCUSSION

Stroke and diabetes mellitus are closely linked vascular conditions, sharing common risk factors and significantly contributing to global cardiovascular morbidity and mortality.⁶ Thus, the principal finding of this study suggest that ischemic stroke patients with and without diabetes exhibited comparable demographic, clinical, biochemical, radiological, and severity profiles, with no statistically significant differences across most parameters ($p > 0.05$), except for higher triglyceride levels in diabetics.

The mean age in our study was 56.28 ± 10.03 years in diabetic group and 59.81 ± 12.65 years for the non-diabetic group; however, this difference was not statistically significant. The relatively younger age of diabetic stroke patients may be related to hyperglycemia, which accelerates cerebral ischemia, and the early progression of atherosclerosis in diabetes.^{7,8} These findings are consistent with Sarkar et al.⁹ and Amr Kamel et al.,¹⁰ who also reported earlier onset of stroke in diabetics. In contrast, Devuyt et al.¹¹ found diabetics to be in the advanced age group, while Megherbi et al.¹² and Jorgensen et al.¹³ reported no age difference between groups. Such variations likely reflect differences in sample size, patient selection, definitions of diabetes, and methods used to assess hyperglycemia. In the present study, males were more frequently affected in both groups. This finding is consistent with Davis et al.¹⁴ however, it contrasts with Kamel et al.,¹⁰ who reported no sex difference, and with Sarkar et al.⁹ and Lehto et al.,¹⁵ who observed a female predominance.

Elevated blood pressure increases stroke risk by causing arterial wall thickening, narrowing of vessels, dysfunction of the endothelium, and heightened vascular constriction, leading to impaired blood flow in the brain.⁴ Hypertension, smoking, alcohol use, TIA, and atrial fibrillation were observed in 64%, 38%, 26%, 22%, and 20% of diabetics, compared to 54%, 44%, 38%, 32%, and 20% of non-diabetics, respectively, and findings are statistically significant ($p < 0.05$). The higher prevalence of hypertension among diabetics is consistent with Sarkar et al.,⁹ who also reported markedly higher rates of hypertension in diabetic stroke patients, and with Tuomilehto et al.,¹⁶ who suggested that glucose intolerance may partially explain the strong link between diabetes, hypertension, and stroke. Smoking leads to endothelial dysfunction, increased blood viscosity, and reduced oxygen availability, thereby predisposing individuals to stroke.¹⁷ The risk rises further with greater tobacco exposure, household smoking, and higher concentrations of toxic substances.¹⁷ The smoking data of the present study closely aligns with Tuomilehto et al.¹⁶ and Abbott et al.¹⁸ who observed that smoking contributes more to stroke mortality risk in non-diabetics than in diabetics.

In this study, diabetic stroke patients had lower rates of current or past smoking, higher prevalence of transient ischemic attacks (TIA) and hypertension, and a similar distribution of atrial fibrillation compared to non-diabetic patients, findings that align with those of Amr Kamel et al.¹⁰ In contrast, Megherbi et al.¹² reported similar TIA rates between groups, atrial fibrillation being more common in non-diabetics, and hypertension more prevalent in diabetics, highlighting variations likely due to differences in study populations and methodology. Diabetes

patients had higher cholesterol and triglycerides levels than nondiabetics, with triglycerides showing significant difference. The most prevalent lipid abnormality in DM patients is hypertriglyceridemia. Despite the fact that lipid abnormalities have been linked to cerebral atherosclerosis, there is little information on the connection between dyslipidemia & stroke. According to Sarkar et al.,⁹ hypercholesterolemia was a significant risk factor for stroke patients with or without diabetes. Diabetes has been demonstrated to increase the permeability of vessel walls, especially in individuals who have microalbuminuria or proteinuria. In individuals with diabetes, microalbuminuria is a separate predictor of coronary heart disease. Diabetes can also result in cerebrovascular disease through the same method. Therefore, regardless of age, poor metabolic management, as seen by elevated blood glucose level and glycosylated hemoglobin (HbA1c), is a significant risk factor for stroke.

Most prevalent characteristics seen in both groups were hemiplegia & dysarthria followed by hemianopia apathy, ataxia dysphagia and hemineglect. This supports the findings of Megherebi et al.,¹² Jorgensen et al.¹³ and Kiers et al.¹⁹ who hypothesized that dysarthria could be the result of bilateral minor lesions that disrupt the pyramidal corticonuclear pathways through lacunar lesions. According to Kamel et al.¹⁰ aphasia was prevalent in non-diabetic stroke patients, while dysarthria was more common among diabetic patients.

Clinical subtypes of stroke distribution among our diabetics group were different and lacunar syndromes were prevalent among them, whereas partial anterior circulation infarction was more common in the non-diabetic group. This finding is consistent with research by Sarkar et al.,⁹ Kamel et al.,¹⁰ Megherebi et al.¹² and Arboix et al.²⁰ who observed that lacunar infarcts were more common among diabetics group.

Regarding the CT results, we discovered that the location and size of cerebral infarcts as well as the existence of brain edema did not statistically significantly differ between stroke patients with & without diabetes. Overall, infarcts were most frequently modest & subcortical in size and location. Toni et al.²¹ observed no correlation between the size of the CT lesion and the admission hyperglycemia within 12 hours of hemisphere stroke. According to Kamel et al.¹⁰ no correlation existed between dimension of the ischemic lesion and the occurrence of diabetes among patients that used traditional MRI. There are statistically negligible changes in the location & magnitude of cerebral infarcts as well as the occurrence of brain edema between stroke patients with & without diabetes. These results are comparable to those of the current investigation. However, utilizing CT, Horowitz et al.²² discovered an association between glucose levels and hemorrhagic transformation along with the size of the infarct.

Regarding the severity of stroke, there was no discernible difference between the diabetic & non-diabetic groups. The majority of participants in both the diabetes & non-diabetic groups experienced mild strokes, which were followed by moderate & severe ones. The study by Devuyst et al.¹¹ also observed that the severity of strokes did not differ between diabetics and non-diabetics. In contrast, Kamel et al.¹⁰ reported that stroke patients having diabetes had worst outcomes than non-diabetic stroke patients, though not statistically significant. According to Barrett-Connor et al.,²³ diabetes may predispose people to more irreparable brain damage after ischemia rather than stroke per se.

LIMITATIONS

- Firstly single-centric design and hospital specific small sample size limits the applicability of the findings in wider population with restricted generalizability
- Secondly, patients were not followed up for a considerable amount of time to detect the prognosis

Thus, a multicentric longitudinal study is necessary to analyze the long-term results.

CONCLUSION

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To conclude, ischemic stroke was prevalent among diabetic patients in advanced age group with a male predominance. DM is linked to a higher incidence of TIA, dyslipidemia, & hypertension & predisposes to an earlier onset of ischemic stroke. Diabetic patients are prone for lacunar infarcts, which may indicate a tendency toward small-vessel disease. Despite these variations, the short-term clinical presentation, CT features, & stroke severity were comparable between patients with & without diabetes. Elevated triglycerides & HbA1c, which indicate poor metabolic control is a major risk factor, highlighting the need of effective glycemic regulation in preventing stroke. Clinical manifestations of stroke in diabetic patients highlight the importance of early diabetes diagnosis & treatment. The burden of stroke in diabetics may be decreased by early identification & vigorous control of cardiovascular risk factors.

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