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Incidence Of Acute Ischemic Stroke Among Type 2 Diabetic Patients in a Tertiary Care Setting

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ABSTRACT

Background of the Study: Numerous studies demonstrate marked variations in stroke incidence and relative risk in people with diabetes when compared to non-diabetics. Possible explanations for these variations may include contradictory and heterogeneous definitions of diabetes mellitus and the method for counting and describing stroke events.

Methodology: The retrospective study cross sectional in nature had been done at the Department of Medicine, Bahawal Victoria Hospital, Quaid-e-Azam Medical College Bahawalpur, Pakistan. Patients having HbA1c of more than 7.0%, or two random blood glucose measurements of ≥200mg/dl, or prior diabetes diagnosis, or taking anti-hyperglycemic therapy were labelled as type 2 diabetes mellitus. Sudden loss or weakness in the function of one or more limbs (monoplegia or hemiplegia) on clinical examination assessed radiologically by CT brain scan was labelled as acute ischemic Stroke.

Results: Majority (n=289, 73.9%) had poor diabetes control. Acute Ischemic Stroke was seen in 49 (12.5%) patients of type 2 DM, having a statistical association with increasing age (0.002) but not with patient gender (0.452), duration of diabetes (p-value 0.126) or diabetes control (p-value 0.333).

Conclusion: Acute ischemic Stroke was not uncommon in the present retrospective study, being seen in 12.5% of patients with type 2 diabetes mellitus and being statistically linked to increasing age but not with gender of patient, diabetes duration or diabetes control.

Keywords: *Acute Ischemic Stroke, type 2 diabetes mellitus, CT scan brain, HbA1c, monoplegia, hemiplegia, insulin resistance.*

INTRODUCTION

Undeniably, prevalence of type 2 diabetes mellitus has been increasing all over the world, leading to a significant disease burden, especially in Asian populations. The International Diabetes Federation estimates an increase in diabetes prevalence from 4.6% in 2000 to 9.3% in 2019 among the global population aged 20-79 years.[1] This has increased the risk and occurrence of macrovascular and micro- vascular complications of diabetes, such as nephropathy, myocardial ischemia and Stroke[2,3].

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Such burden of type 2 diabetes mellitus is specifically alarming in countries that are in the stage of developing, also where health care resources are limited and awareness is also lacking in terms of disease exacerbating its impact. Many individuals in the Asian populations are experiencing this unusual rise in Diabetes prevalence whether due to the strong genetics or the life style that is clearly unhealthy. Furthermore, urbanization and diet also plays a vital role in this badly rising global trend. Stroke causes significant morbidity, disability and mortality globally in addition to socio-economic consequences such as hospital stay and its costs, physical rehabilitation and social services[4]. Discussing the economic implications is also particularly challenging for countries that are middle income or low income. This is because as mentioned, the access to adequate stroke management and rehabilitation services in limited. Present studies indicate that a significant proportion of stroke-related cost is on rise from long-term care and loss of productivity. Thus, suitable prevention strategies which target on the modifiable risk factors are needed to be mitigated to overcome such conditions and provide better outcomes.

Therefore, it is important to develop solutions to decresae the incidence of Stroke. However, epidemiological studies assessing the time trends of stroke incidence in the diabetic populations are scarce[5,6,7]. This newly formed gap in research put the need in light for studies that are population based and focus on specific demographics rather than linking risk factors to each other but also providing specific demographics and geographic variations. Understanding of these trends only can help professionals from public health to make and implement new public health policies and enhance the necessary preventive measures according to regional needs tailored accurately.

Type 2 diabetes mellitus and acute ischemic Stroke may be two separate entities that share various threads in common and cause an increasing burden of cardiovascular disease, morbidity and mortality worldwide[8]. The vascular damage related to diabetes notably predisposes many patients to events that are ischemic, gauging the risk when combined with the cardiovascular conditions compounding it. This useful interaction among these diseases also mentions the need for comprehensive cardiovascular risk assessment in diabetic individuals.

Both of these diseases are on the rise, affecting blood vasculature and are linked to other cardiovascular risk factors including dyslipidemia and hypertension[8,9]. Among them, hypertension is notable as it increases these documented side effects of DM on the cardiometabolic health. So, Effective management of hypertension, therefore, becomes essential in reducing the overall burden of stroke in diabetic populations

Seen in up to two-thirds of patients with ischemic Stroke, diabetes mellitus and abnormal glucose regulation are associated with poor outcomes with tissue plasminogen activator therapy, increased disability and mortality[8,10]. Emerging evidence indicates that maintaining strict glycemic control during the phase of a stroke that is acute may affect recovery outcomes. However, the practicality and safety of intensive glucose-lowering strategies in this setting are still under active investigation.

Furthermore, diabetic patients with microvascular complications are up to 6 times more susceptible to stroke development, especially in younger individuals having co-existent hypertension and other vascular complications such as retinopathy and diabetic foot[8,9,10]. The increased vulnerability of younger individuals to diabetes raises significant concerns about its long-term impact on public health. This demographic trend underscores the need for early interventions and ongoing follow-up care to minimize the risk of complications. Although diabetes mellitus has been considered as one of the most common and recognizable risk factor in terms of Stroke, numerous studies still demonstrated marked variations in stroke incidence and relative risk in individuals with diabetes when comparing to non-diabetics[11,12,13]. These variations also emphasize the importance of

standardized definitions and methodologies in research to allow for accurate comparisons across studies. Establishing global consensus on these definitions can lead to more reliable epidemiological data and informed health policies. Possible explanations for these variations may include contradictory and heterogeneous definitions of diabetes mellitus and the method for counting and describing stroke events. Differences in the prevalence of ischemic Stroke and diabetes mellitus have been reported worldwide. Due to the ethnic differences, disease awareness and healthcare resources, studies from other states might not be that useful to applicate to the Pakistani population. Therefore, we carried out this currently present study to know the incidence of acute ischemic Stroke among type 2 diabetes mellitus patients at settings like tertiary care hospital . The findings of this study offer valuable insights into the distinct risk factors and trends within the local population. This evidence can guide the development of targeted prevention strategies and improve the efficacy of healthcare interventions. Moreover, the study highlights the importance of collaborative efforts to tackle the rising dual burden of diabetes and stroke through integrated clinical and public health approaches.

METHODOLOGY

The retrospective cross-sectional study had been conducted at the Department of Medicine, Bahawal Victoria Hospital, Quaid-e-Azam Medical College Bahawalpur Pakistan, to determine the incidence of acute ischemic Stroke among type 2 diabetes mellitus patients. The ethical standards laid down in the 1964 Declaration of Helsinki, revised in the year 2000 were used to conduct this study. Type 2 Diabetes Mellitus was labelled by HbA1c of more than 7.0%, or 2 blood glucose random measurements of ≥200mg/dl, or prior diagnosis of diabetes, or taking any therapy that is anti-hyperglycemic. Acute Ischemic Stroke was labelled as sudden loss or weakness in the function of one or more limbs (monoplegia or hemiplegia) on clinical examination assessed radiologically by a CT brain scan. Medical records of patients bearing type 2 DM of any age and gender had been included. Patients with hemorrhagic Stroke and cortical venous thrombosis; patients with neurologic diseases such as multiple sclerosis and brain malignancy; patients with psychiatric illness, chronic liver disease (CLD) and end-stage/chronic kidney disease were excluded.

Medical records of 391 patients with type 2 DM per operational definition were assessed using a consecutive non-probability purposive sampling technique from January 2024 to June 2024. Only complete records were included. Medical records were assessed for demographic information, including gender, age and diabetes duration. The patient's records were evaluated for diabetes control and HbA1c levels. Findings of clinical history, examination and CT scan of the brain were assessed for acute ischemic Stroke. All the data was noted and recorded.

All the data had been entered into SPSS version 23 and interpreted. Percentage and frequency were generated for qualitative variables. Mean and standard deviation were generated for numerical data. Confounders and effect modifiers were controlled via stratification. Post-stratification Chi-Square test had been applied, with a significant p-value of less than 0.05.

RESULTS

In the present study, 391 medical records of patients having type 2 diabetes mellitus were assessed. There was a female preponderance of 228 (58.3%) patients, as shown in Table 1. The mean age was 53.1±12.9 years, with 197 (50.4%) patients aged 54 years or above. The mean duration of disease (diabetes) was 6.5±5.4 years, with 232 (59.3%) patients having diabetes mellitus for five years or more, as shown in Table 1. Mean HbA1c was 9.9±2.5%, and the majority of the patients (n=289, 73.9%) had poor diabetes control. In the present study, Acute Ischemic Stroke was seen in 49 (12.5%) patients with type 2 diabetes mellitus, as shown in Figure 1. Stratification of data with regards to Acute ischemic Stroke demonstrated a statistical association with increasing age (p-value 0.002) but not with patient gender (p-value 0.452), diabetes duration (p-value 0.126) or diabetes control (p-value 0.333) as shown in Table 2.

Variables	Frequency (n)	Percent (%)
Gender:		
Female	228	58.3
Male	163	41.7
Age (years):		
53 or less	194	49.6
54 or more	197	50.4
Duration of Diabetes (years):		
4 or less	159	40.7
5 or more	232	59.3
Diabetes Control:		
Controlled / Good	102	26.1
Uncontrolled / Poor	289	73.9
Acute Ischemic Stroke:		
Present	49	12.5
Absent	342	87.5

Table 1: Clinico-demographic variables

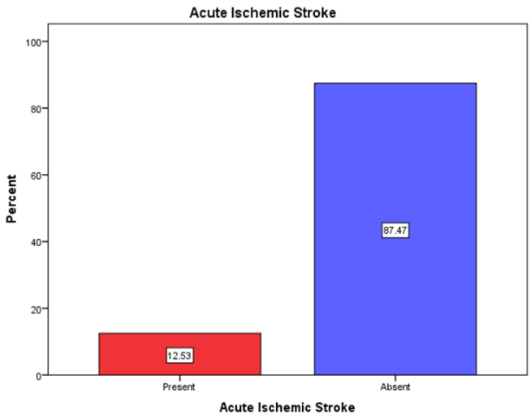

Fig 1: Result of assessment for Acute Ischemic Stroke

Clinical Variables	Carpal Tunnel Syndrome		p-value
	Absent	Present	
Gender:			
Female	197 (86.4%)	31 (13.6%)	0.452
Male	145 (89.0%)	18 (11.0%)	
Age (years):			
53 or less	180 (92.8%)	14 (7.2%)	0.002
54 or more	162 (82.2%)	35 (17.8%)	
Duration of Diabetes (years):			
4 or less	144 (90.6%)	15 (9.4%)	0.126
5 or more	198 (85.3%)	34 (14.7%)	
Diabetes Control:			
Good / Controlled	92 (90.2%)	10 (9.8%)	0.333
Poor / Uncontrolled	250 (86.5%)	39 (13.5%)	

Table 2: Stratification of data with regards to Acute Ischemic Stroke

DISCUSSION

Luitse et al. demonstrated that hyperglycemia at admission was linked with poor functional outcomes in stroke patients due to increased ischemic injury caused by disturbances in recanalization and reperfusion injury[14]. Hyperglycemia may be an independent risk factor that

predicts poor outcomes in diabetic patients with Stroke.[15,16] Many studies suggest that hyperglycemia increases the oxidative stress and responses of inflammation which can further damage the tissues of brain thus further complicating the recovery processes. This physiological process highlights the need for monitoring that should be careful and blood glucose level management in the acute phase of stroke to minimize or diminish the outcomes that are adverse. It has also been that the poor glycemic control leads to reduced cerebral blood flow and inadequate tissue oxygenation, thereby elevating intracranial pressure resulting in cerebral edema and neuronal death[16,17]. In addition to this, rising evidence also suggests that interventional protocol targeting the hyperglycemia might be helpful in mitigating such complications, though more of the clinical trials are also needed not only to confirm but apply these benefits.

It should also be noted that patients with type 2 diabetes mellitus are usually overweight or obese, eat a less healthy diet, are physically inactive and have co-existent atherosclerosis and peripheral artery disease, all of which significantly increase stroke risk[18,19]. Furthermore, other factors which may play an impact on stroke aetiology in diabetes mellitus include insulin resistance, diabetes duration, smoking, and the presence of other diabetes complications such as retinopathy and nephropathy.[2,19]

In the present study, the medical records of 391 patients were assessed, and acute ischemic Stroke was seen in 49 (12.5%) patients with type 2 diabetes mellitus. There was a statistical association of acute ischemic Stroke with increasing age (p-value 0.002) but not with patient gender (p-value 0.452), diabetes duration (p-value 0.126) or diabetes control (p-value 0.333). Of the 197 patients aged 54 or more in the present study, 35 (17.8%) had acute ischemic Stroke, whereas 14 (7.2%) were among the 194 patients aged 53 or less. Acute ischemic Stroke was present in 18 (11.0%) male patients as compared to 31 (13.6%) female patients. Out of the 232 patients with diabetes for five years or more, 34 (14.7%) suffered acute ischemic Stroke, while 15 (9.4%) it was reported in 15 (9.4%) patients had diabetes duration of 4 years or less. Acute ischemic Stroke was present in 10 (9.8%) patients with reasonable diabetes control as opposed to 39 (13.5%) patients with poor diabetes control. Little is known about the role ethnic differences play in the link between diabetes mellitus and Stroke, and the studies so far are contradictory[20,21,22].Folsom et al. reported in the Atherosclerosis Risk in Communities study that ethnic differences were not identified regarding the association of diabetes mellitus and Stroke[20]. However, an updated analysis with additional follow-ups demonstrated black diabetic adults to have a stronger association with Stroke as compared to white diabetic adults[23]. Being a significant modifiable risk factor of Stroke, diabetes mellitus, and hyperglycemia at admission requires active correction, but optimal therapy remains unclear[24,25]. Therefore, critical steps to effective stroke prevention include appropriate glycemic control through medications, lifestyle changes and modification of co-morbid risk factors[24,25].The present study has some limitations that should be taken into consideration. Being retrospective, the study was centered in a single institute and did not investigate the role of other stroke risk factors such as smoking, dyslipidemia, obesity and hypertension. Therefore, the findings of this study might only apply to some of the population. It is, therefore, pertinent to carry out further prospective studies with a larger sample size to highlight the role and importance of diabetes mellitus in the aetiology and management of acute ischemic Stroke with the aim to reduce disease morbidity and improve the life quality of these patients.

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CONCLUSION

Acute ischemic Stroke was not an uncommon finding in the present retrospective study, being seen in 12.5% of patients with type 2 diabetes mellitus and being statistically linked with increasing age but not with patient gender, duration of diabetes or diabetes control. This finding underscores the intricate relationship between age-related vascular changes and diabetes in increasing the risk of stroke. It highlights the importance of vigilant management for older adults with diabetes, who

may face a heightened risk of cerebrovascular events. Although factors such as gender, diabetes duration, and glycemic control did not show significant direct associations with stroke in this cohort, their potential indirect impact through other pathways or comorbidities, such as hypertension or dyslipidemia, cannot be overlooked. We recommend that future studies with larger sample sizes should be planned and conducted to highlight the role and importance of diabetes mellitus in the aetiology and management of acute ischemic Stroke to reduce disease morbidity and improve the life quality of these patients. Prospective cohort studies are particularly well-suited to uncovering temporal relationships and causative mechanisms. Further research should focus on identifying potential biomarkers that can predict stroke risk in diabetic patients, paving the way for more targeted preventive strategies. Addressing these challenges will require interdisciplinary collaboration among endocrinologists, neurologists, and public health experts.

AUTHORS' CONTRIBUTION:
The following authors have made substantial contributions to the manuscript as under:
Conception or Design: Nauman Ismat Butt, Muhammad Sohail Asmat Ghoauri, Umaima Waris
Acquisition, Analysis or Interpretation of Data: Nauman Ismat Butt, Muhammad Sohail Asmat Ghoauri, Dur-e-Sabeh, Muhammad Muddasir Shafiq
Manuscript Writing & Approval: Muhammad Sohail Ajmal Ghoauri,Nauman ismat Butt ,Dur-e-Sabeh, Umaima Waris, Muhammad Muddasir Shafiq, Muhammad Umair Javed
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