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IMPACT ON STROKE BECAUSE OF TYPE 2 DIABETES OCCURRENCE AND SUBTYPES: A COMPREHENSIVE CROSS-SECTIONAL STUDY

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ABSTRACT –

Background: Substantial research indicates that Type 2 diabetes significantly increases the vulnerability to stroke. Despite the existing knowledge, there is still a gap in understanding the specific clinical attributes of strokes in diabetes patients. This study aims to contrast people with Type 2 diabetes with people without diabetes in terms of the frequency and patterns of strokes.

Materials and Methodology: An 18-month cross-sectional observational study involved 160 patients diagnosed with either ischemic or haemorrhagic strokes. There were two groups of patients: one comprising individuals with diabetes (group 1) and the other without diabetes (group 2), based on specific criteria. The assessment process included a thorough examination of medical histories, physical assessments, and brain imaging. Various parameters, including blood pressure, cholesterol profiles, and types of strokes, were assessed through laboratory tests and statistical analyses.

Results: Diabetes patients had considerably higher systolic and diastolic blood pressure readings than non-diabetics. The prevalence of ischemic strokes was significantly greater in the diabetes group as compared to the non-diabetic group (86.3%) (65%). Laboratory results revealed elevated levels of Diabetes patients' haemoglobin, random blood sugar, serum creatinine, LDL cholesterol, total cholesterol, and triglycerides.

Conclusion: There is a link between type 2 diabetes and higher likelihood of hypertension and abnormal lipid profiles, and it considerably increases the risk of ischemic strokes. Identifying and managing these modifiable risk factors are essential in preventing various stroke types. Thorough assessments conducted by healthcare providers are vital in effectively managing complications for individuals with diabetes.

Keywords: Type 2 diabetes, cross-sectional study, lipid profiles, risk factors, ischemic stroke, haemorrhagic stroke, hypertension.

INTRODUCTION –

Numerous studies have been conducted on the link between diabetes mellitus and stroke.

Diabetes significantly elevates stroke risk and alterations to the cerebral blood vessels of diabetic individuals might differ from those in non-diabetics. Despite this knowledge, our understanding of the clinical and predictive features of stroke in persons with diabetes remains incomplete (Tuttolomondo et al., 2008).

It is commonly acknowledged that having diabetes increases your chance of having a stroke. Long-term studies have demonstrated that stroke in diabetic individuals is linked to high fatality rates. However, there's debate regarding how diabetes influences acute stroke patients' short-term prognosis. Some studies propose that high blood sugar levels upon admission are tied to unfavourable outcomes in acute stroke (Megherbi et al., 2003). Yet, it's still under discussion if people with and without diabetes experience this impact at a same level of importance.

Globally, stroke stands as a major public health challenge, ranking third as a cause of death worldwide, after heart attacks and cancer. While stroke rates have decreased in developed nations, they have risen among both urban and rural populations (Capes et al., 2001). This increase in strokes coincides with the growing prevalence of diabetes. Both conditions substantially contribute to the increasing burden of cardiovascular diseases and mortality across the globe (Stöllberger et al., 2005).

The link between stroke and diabetes goes beyond their shared impact on blood vessels. Both risk factors for several illnesses, such as high blood pressure and abnormal cholesterol levels. Diabetes is a well-known risk factor for stroke and is linked to worse outcomes after a stroke (Guo et al., 2016). Glucose regulation abnormalities, a defining feature of diabetes, are observed in a significant number of individuals experiencing acute strokes. Patients with diabetes who have a stroke are more likely to suffer from severe impairment or pass away, and they are less likely to respond favorably to proven therapies like intravenous tissue plasminogen activator, the only stroke medication recognized by the FDA (Maida et al., 2022).

Conversely, due to issues with their brain's blood vessels, people with diabetes are much more likely to develop having a stroke. Particularly among individuals who are younger, have high blood pressure, or have problems with other vascular areas, a stroke is 2–6 times more likely to occur in diabetic people. In view of the complex relationship between diabetes and stroke, a recent study compared persons with and without type 2 diabetes to see whether group had higher rates of ischemic and haemorrhagic strokes (Petersmann et al., 2019, Kerner & Brückel, 2014).

Understanding the intricate connection between diabetes and stroke depends on the results of this inquiry. The study compared the prevalence of different stroke types among people with and without diabetes in order to shed light on the specific risks that people with diabetes face. This information is crucial for enhancing methods for preventing strokes, developing targeted treatments, and ultimately reducing the prevalence of stroke in people with diabetes (Chen et al., 2016).

Because both diseases are growing more prevalent, it is essential to comprehend their connection and the specific risks that diabetics confront. Through in-depth study and advancements in medical science, healthcare professionals can create prevention and

treatment methods that are more successful, improving diabetic and stroke patients' outcomes & long-term quality of life. The goal of the study is to assess the frequency of ischemic and haemorrhagic strokes in individuals both those who have type 2 diabetes and those who do not.

MATERIALS AND METHODOLOGY -

The study, which used a cross-sectional observational design, was carried out from November 2020 to April 2022 in both the outpatient clinic and the inpatient wards of a single tertiary care institution. A total of 140 patients were included, comprising cases of acute completed stroke, both diabetic and non-diabetic, as found in Krishna Hospital, Karad. The research received approval from the Institutional Ethics Committee at KIMS, Karad, and before to their inclusion in the study, all participants gave their written informed permission.

Patients that match the requirements for inclusion, especially those who are admitted to the medical wards and intensive care unit at Krishna Hospital, Karad, were considered. Excluded from the study were patients with residual stroke, those with additional conditions such as trauma, acute-on-chronic infections, or encephalopathy, as well as individuals with type 1 diabetes. Additionally, individuals with stroke resulting from tubercular meningitis, space-occupying lesions, or drug-induced intracerebral haemorrhages were not part of the study.

140 stroke patients were examined and tested for type 2 diabetes mellitus in accordance with the recommendations of the American Diabetes Association. These patients were divided into two categories: those with diabetes and those without. All patients provided informed written consent and underwent detailed examinations, including medical history reviews, physical assessments, and brain imaging through CT or MRI scans, which determined the type of stroke (ischemic or haemorrhagic).

The diagnosis of type 2 diabetes was established through specific criteria, including fasting blood sugar levels exceeding 126mg/dL, 2-hour plasma glucose levels surpassing 200mg/dL during a glucose tolerance test, symptoms of diabetes accompanied by random blood sugar levels over 200mg/Dl, or HbA1c levels higher than 6.5%. Lipid profile assessments were also conducted, with LDL cholesterol levels calculated using the Friedewald equation. Abnormal HDL cholesterol levels, having a haemoglobin level below 40 mg/dL for males and 50 mg/dL for women was associated with an increased risk of heart disease. The incidence of these factors was analysed in both diabetic and non-diabetic groups, considering variables such as age, sex, and dyslipidaemia.

The laboratory investigations encompassed testing for fasting and post-meal blood sugar, as well as assessments of glycosylated haemoglobin, and a comprehensive analysis of lipid profiles. Imaging techniques like CT Brain and MRI Brain were employed for further evaluations.

Microsoft Excel 2010 was used to arrange the data, while SPSS software version 21 and Open Epi software version 2.3 were used for statistical analysis. Qualitative data were reported as percentages or proportions, whilst quantitative data were provided as mean, median, mean + SD, or standard deviation. When doing statistical analysis using the student t-test for quantitative data and the Chi-square test for qualitative data, a p-value of 0.05 or less is regarded as statistically significant.

The study results were thoroughly examined in the context of the resources used, the study design, and the findings from related studies throughout the discussion and interpretation

phase. On the basis of the findings of the current investigation, conclusions were reached and recommendations were given.

RESULTS –

In this comparative cross-sectional study, 160 patients diagnosed with ischemic and haemorrhagic strokes were analysed. Among them, 80 patients meeting the criteria for Type 2 diabetes mellitus were grouped into group 1, while 80 non-diabetic patients constituted group 2. In terms of gender distribution, group 1 (Type 2 diabetes mellitus) comprised 45 (56.2%) males and 35 (43.8%) females, while group 2 (non-diabetic) had 42 (52.5%) males and 38 (47.5%) females. The chi-square tests did not reveal any statistical significance, with a p-value of 0.3.

In table 1, in comparison to Group 2, Group 1 contained more individuals who were between the ages of 41 and 50, 51 to 60, and >60, as well as greater rates of drinking and smoking. Group 1 had 72.5% more cases of hypertension than Group 2, which had 56.3%. With 38.7% in Group 1 and 31.3% in Group 2, the prevalence of coronary artery disease was comparable across the two groups (p-value=0.3).

Table 1: Relationship between coronary artery disease between the groups

Coronary artery disease	Present	Absent	Total
Group 1	31 (38.7%)	49(61.3%)	80
Group 2	25(31.3%)	55(68.7%)	80

Regarding lipid profiles, 71.3% of patients in group 1 displayed dyslipidemia, while 28.7% did not. In group 2, 46.3% had dyslipidemia, and 53.7% did not. Both groups had elevated systolic blood pressure, with mean systolic blood pressure measuring 145 (+14.2) mm of Hg in group 1 and 132.6 (+15.5) mm of Hg in group 2. A t-test with a p-value of 0.0020 demonstrated statistical significance.

Furthermore, the mean diastolic blood pressure in groups 1 and 2 was 112 mm Hg and 80.6 mm Hg, respectively, higher in group 1 than in group 2. There was a statistically significant difference here (p-value=0.0001).

Upon conducting MRI brain or CT brain scans, it was observed that 86.3% of patients in group 1 had ischemic strokes, while 13.7% had haemorrhagic strokes. In group 2, 65% experienced ischemic strokes, and 35% had haemorrhagic strokes. Group 1 experienced a considerably greater incidence of ischemic strokes, as indicated by the statistical difference in table 2 (p-value=0.03).

Table 2: Patients in the study group with type 2 diabetes mellitus and those without diabetes were at risk for ischemic and haemorrhagic stroke.

Stroke	Ischemic	Hemorrhagic	Total
Group 1	69 (86.3%)	11 (13.7%)	80

Group 2	52 (65%)	28 (35%)	80

High-density lipoprotein (HDL), low-density lipoprotein (LDL), creatinine, cholesterol, triglycerides, haemoglobin, and random blood sugar levels were all examined in the study. Compared to those without diabetes (Group 2), those with Type 2 diabetes mellitus (Group 1) had substantially higher levels of creatinine, total cholesterol, triglycerides, and LDL. This shows a distinctive metabolic profile linked to diabetes, which may point to greater cardiovascular risk in this population as described in table 3.

Table 3: Laboratory parameter frequency distribution for Group 1 and Group 2

Laboratory investigation	**Group 1**	**Group 2**
	Mean ± SD	**Mean ± SD**
Haemoglobin in gm%	13.5 ± 2.6	11.7 ± 1.5
Random blood sugar in mg/dl	225.3 ± 11.7	111.5 ± 8.6
Serum creatinine in mg/dl	1.7 ± 0.75	1.3 ± 0.2
Serum total cholesterol in mg/dl	215.3 ± 85.7	144.3 ± 45.2
Triglyceride level in mg/dl	217.6 ± 66.3	153.1 ± 58.6
High Density Lipoprotein in mg/dl	53.4 ± 6.4	37.2 ± 12.9
Low Density Lipoprotein in mg/dl	123.7 ± 30.6	103.1 ± 24.3

DISCUSSION -

The study aimed to analyse stroke occurrence and types in individuals with and without Type 2 diabetes in an 18-month cross-sectional study involving 160 patients with ischemic and haemorrhagic strokes. Both groups showed a male predominance, although this wasn't statistically significant. Similar to previous research, a higher incidence of strokes, especially in males, was observed in diabetic populations.

In terms of age, most patients in both groups were between 50 to 60 years old. However, the average age for group 1 was 61.3 years, and for group 2, it was 68.9 years. Although not statistically significant, other studies have shown an increased stroke risk in individuals over 60 years, especially those with diabetes.

Regarding lifestyle factors, both groups mainly comprised non-smokers and non-drinkers, with no significant differences noted through statistical analysis. Previous studies have linked stroke risk to factors like high cholesterol and smoking, particularly in cases of large artery atherosclerotic strokes.

The study found that both groups, particularly those with Type 2 diabetes (group 1), had significant rates of hypertension. An substantial link between Type 2 diabetes and hypertension was found through statistical research. In addition, despite the fact that group 1

had 31 instances and group 2 had 25, the difference did not achieve statistical significance. In group 1 (57 instances), dyslipidemia was more prevalent than in group 2 (37 cases), and this difference was statistically significant. Prior studies have identified diabetes as an independent stroke risk factor, showcasing differences in stroke characteristics and risk factors between diabetic and non-diabetic individuals. These differences include higher triglyceride levels and lower HDL cholesterol levels in diabetic stroke patients, contributing to their unique risk profile.

Moreover, research explored indices like the triglyceride glucose (TyG) index, indicating elevated TyG levels linked to a higher stroke risk in elderly hypertensive patients, even after adjusting for various cardiovascular risk factors. This study provided valuable insights into stroke risks among older adults with hypertension, a population with common insulin resistance and notably elevated stroke risk.

The study found significant differences in the two groups' blood pressure values. Notably, the mean systolic blood pressure in group 1 was 145 mm Hg, which was substantially higher than the mean in group 2 of 132.6 mm Hg (p-value = 0.0020). Additionally, a statistically significant difference in mean diastolic blood pressure was seen between groups 1 and 2, with group 1 recording 112 mm Hg while group 2 recorded 80.6 mm Hg (p-value = 0.0001). According to studies like ACCORD, those with Type 2 diabetes who set a systolic blood pressure goal below 120 mm Hg had a lower risk of stroke than those who strive for a target below 140 mm Hg.

Diabetic patients had a higher incidence of strokes. In group 1, 86.3% experienced ischemic strokes, and 13.7% had haemorrhagic strokes. In contrast, in group 2, 65% suffered from ischemic strokes, and 35% had haemorrhagic strokes. Statistical analysis indicated a significant disparity (p-value=0.03) in stroke incidence between the two groups. Other studies also highlighted substantial differences in stroke frequency and types between diabetic and non-diabetic individuals.

Laboratory tests revealed that group 1 had higher levels than group 2 in comparison. For instance, mean haemoglobin levels in group 1 were 13.2, random blood sugar levels were 222.6, serum creatinine levels were 1.5, and serum total cholesterol levels were 214.3., the serum triglyceride level was 216.6, the high-density lipoprotein level was 54.1, and the low-density lipoprotein level was 125.6. The mean haemoglobin was 11.5, random blood sugar was 108.6, serum creatinine was 1.1, total cholesterol was 145.3, triglycerides were 152.1, high-density lipoprotein was 36.2, and low-density lipoprotein was 102.1 in group 2, in contrast. These findings suggested that people with Type 2 diabetes mellitus had greater levels. These findings were replicated by other studies, highlighting how crucial it is to distinguish between diabetes and non-diabetic individuals, especially when it comes to lipid profiles and cholesterol levels.

According to a number of studies, including ACCORD, people with Type 2 diabetes who maintain a systolic blood pressure (SBP) target below 120 mm Hg had a considerably lower risk of both fatal and nonfatal strokes than people with a higher SBP target of 140 mm Hg. Research by Subhash A and Kumar CR indicated that Type 2 diabetes independently increased the stroke risk, leading to differences in stroke characteristics related to factors like age, gender, and severity. Hypertension, along with high-density lipoprotein (HDL) and

triglyceride (TG) levels, was notably linked to Type 2 diabetes. Diabetic stroke patients had higher TG levels and lower HDL levels compared to non-diabetic patients.

There are significant differences between diabetics and non-diabetics in terms of acute ischemic strokes, according to research investigations by Tuttolomondo A and Lihua Guo (Tuttolomondo et al., 2008; Guo et al., 2016). In example, Guo's study (Guo et al., 2016) highlighted a greater prevalence of strokes and a variety of stroke subtypes, notably among females with Type 2 diabetes. Additionally, according to Yang T et al's research, some diabetes people get haemorrhagic strokes (Yang et al., 2020).

Additional studies by Arboix A et al, Morsy E.Y et al, Karapanayiotides et al, and Liao et al emphasized the prevalence of atherothrombotic strokes and lacunar infarctions in diabetes patients (Arboix et al., 2005; Karapanayiotides et al., 2004; Morsy et al., 2022; Liao et al., 2015). The entire clinical environment was impacted by the higher prevalence of concomitant ischemic heart disease and hyperlipidaemia among diabetics. These studies highlight the substantial impact of diabetes on stroke risk and the critical need of controlling blood pressure and cholesterol levels to lower this risk in people with diabetes.

CONCLUSION –

The study aimed to examine the stroke incidence rates between those with and without type 2 diabetes. It showed how the chance of suffering an ischemic stroke is significantly raised by having type 2 diabetes. Diabetic patients were more prone to hypertension, high random blood sugar, irregular lipid profiles, and elevated creatinine. It's imperative to address and control these modifiable risk factors proactively to prevent various types of strokes. Given the heightened stroke risk associated with type 2 diabetes, thorough evaluations by healthcare providers are essential to prevent complications.

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