Profile of cerebrovascular accidents in subjects with or without type 2 diabetes mellitus in intensive care units of tertiary care centre

Dinesh Jain, Mukesh Chawala, Birinder S. Paul, Naveen Mittal, Aayush Jain, Sandeep Puri

Departments of Medicine, 1Neurology and 2Endocrinology and 3Intern, Dayanand Medical College and Hospital, Ludhiana, Punjab, India

Introduction

Worldwide increasing incidence of diabetes mellitus (DM) is the leading cause of morbidity and mortality. The major causes of mortality associated with diabetes are a result of the chronic complications that affect many organ systems including the vascular system. The disturbances in the vascular supply of the brain due to ischemia caused by thrombosis, embolism or hemorrhage lead to significant disability.

Background and Aims: Diabetes Mellitus (DM) is a modifiable and independent risk factor for stroke. As the clinical features, radiological profile, outcome and prognosis of the stroke in type 2 diabetic and non diabetic patients are significantly variable, we proposed to evaluate these variations of stroke in patients with or without Type 2 DM.

Material and Methods: A prospective study was conducted from January, 2011 to June, 2012 on in-hospital admitted diabetic and non diabetic patients presenting with stroke. Data was recorded on a predesigned Performa.

Results: A total of 150 cases were enrolled into the study. Out of these, 66% of patients had ischemic stroke and 34% of patients had hemorrhagic stroke. Type 2 diabetes mellitus was present in 52% patients. Ischemic stroke was significantly higher in diabetics than non diabetics (P = 0.007); however, hemorrhagic stroke was more in non diabetics. Mean age was significantly higher in diabetics (P = 0.04). CAD (P = 0.04), recurrent stroke (P = 0.006) had significant association with diabetes. Large vessel stroke was more common than small vessel stroke. Anterior circulation stroke was more common than posterior circulation stroke. There was significant improvement in morbidity and disability of the patients on follow up with treatment.

Conclusions: A greater incidence of anterior circulation ischemic stroke, and recurrent strokes occur in patients with DM.

Keywords: Diabetes, glycosalated hemoglobin, ischemic, stroke

Abstract

How to cite this article: Jain D, Chawala M, Paul BS, Mittal N, Jain A, Puri S. Profile of cerebrovascular accidents in subjects with or without type 2 diabetes mellitus in intensive care units of tertiary care centre. J Anaesthesiol Clin Pharmacol 2020;36:251-4.

Access this article online

Access this article online

Quick Response Code:

Website: www.joacp.org

DOI: 10.4103/joacp.JOACP_181_14

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Jain D, Chawala M, Paul BS, Mittal N, Jain A, Puri S. Profile of cerebrovascular accidents in subjects with or without type 2 diabetes mellitus in intensive care units of tertiary care centre. J Anaesthesiol Clin Pharmacol 2020;36:251-4.

Submitted: 01-Apr-2014 Revised: 03-Dec-2019 Accepted: 11-Dec-2019

Published: 15-Jun-2020
of cerebrovascular accidents in patients with type 2 DM in comparison with non-diabetics.

Material and Methods

A prospective study was conducted over a period of one and half years from January, 2011 to June, 2012 on patients with stroke admitted in Medical and Neurology ICUs in a tertiary care hospital. The criteria for defining critical illness was assessed before admitting in ICUs. Stroke was defined as hemiparesis, hemianesthesia, language dysfunction, vertigo or cranial nerve involvement as the presenting feature. Patients who had history of diabetes in past, or random blood glucose level >200 mg/dl or fasting blood glucose level >126 mg/dl before the onset of stroke were included in Group I (diabetic group). Those who had no history of diabetes mellitus in past, with normal glucose at time of admission were included in Group II (non diabetic group). Patients with either stress hyperglycemia (no history of diabetes in past and normal HbA1c level but elevated blood glucose) at the onset of stroke were also included in Group II. Patients with metastasis, bleed in intra cranial space occupying lesion, hypoglycemia, coagulopathies, cerebro venous thrombosis, history of head injury and steroids prior to onset of stroke were excluded. Detailed clinical history and neurological examination was carried out in all the patients at admission. Informed verbal consent was taken from patients or first blood relation.

Laboratory tests included complete blood count and electrocardiogram. HbA1c was also done at onset in all patients in group 1. Diabetics were further divided into 3 groups according to their HbA1c levels i.e., Group A (<6), Group B (6-9), Group C (>9).

CT scan (computed tomography) or and MRI (Magnetic Resonance Imaging) of brain was done in all to identify the type of stroke. Ischemic stroke was classified using TOAST[60] and Oxfordshire Community Stroke Project Subtype classification into small versus large vessel stroke, anterior versus posterior circulation stroke, cardiac-embolic stroke and stroke with hemorrhagic transformation. Hemorrhagic stroke was classified by the location of bleed (basal ganglia, thalamus, brain stem hemorrhages or other).

Severity of stroke was assessed by MRS (Modified Rankin Scale) and NIHSS (National Institute of Health Stroke Scale) Scales. Carotid ultrasound Doppler and/or echocardiography were done where indicated. The observations and interpretations were recorded on pre-designed performa. Results were statistically analyzed using Chi square test, student t test, Z test and ANOVA to see the difference between proportion between diabetics and non diabetics. The results were interpreted at 5% level of significance.

Results

A total of 150 cases of stroke were enrolled, with 66.5% males and 33.5% females. Of 150 cases, 78 (52%) were diabetic and 72 (48%) non diabetic. Mean age of diabetic group was 64.33 ± 10.33 years as compared to non-diabetic 60.15 ± 13.74 years. The demographic and stroke characteristics of cases showed that 99 (66%) had ischemic stroke, while 51 (35%) had hemorrhagic stroke. [Table 1] Ischemic stroke was found to be significantly more common in diabetic patients (60.61% vs. 39.39%; P = 0.007), while hemorrhagic stroke (64.71% vs 35.29%) was more common in non diabetics. The mean hospital stay was longer (9.32 ± 7.29 days) in the diabetic group as compared to non-diabetic group (8.77 ± 7.50 days). Only 3 patients received intravenous thrombolytic treatment (one diabetic and 2 non-diabetics).

Out of 99 patients of ischemic stroke, the number of patients with large vessel stroke was almost three times more than small vessel stroke in either group (77% vs 23%). Among these, 51 had infarct in anterior circulation whereas 44 had in posterior circulation. The proportion of ischemic stroke in anterior circulation was significantly higher in diabetic group than non-diabetic group (P = 0.008). Among the 51 patients of hemorrhagic stroke cases, the location of hemorrhage was basal ganglia in 45%, thalamus in 47% and brain stem and each lobe in 4% of subjects.

There was no significant difference in distribution of diabetic patients in ischemic and hemorrhagic stroke [Table 2]. However, diabetic patients were classified into three categories...
The relationship between small and large vessel ischemic stroke with HbA1c in diabetic cases with infarct was studied. It was found that maximum patients were in class B followed by class C and then A in both small and large vessel stroke. However, there was no significant difference in occurrence of small and large vessel stroke according to HbA1c levels ($P = 0.95$) [Table 4].

The proportion of patients with Coronary artery disease (CAD) was statistically significantly higher in diabetic patients than non-diabetics (11.54% vs. 2.78%; $P = 0.04$). While comparing the type of stroke, the proportion of patients with CAD presenting as hemorrhagic stroke was higher in diabetic group as compared to non-diabetic group ($P = 0.009$). However, in case of ischemic stroke the presence of CAD was not significant (8.33% vs 5.13%) between the two groups.

The proportion of patients with previous stroke was statistically significantly higher in diabetic group than non-diabetics (11.54% vs. 2.78%; $P = 0.04$). While comparing the type of stroke, the proportion of patients with CAD presenting as hemorrhagic stroke was higher in diabetic group as compared to non-diabetic group ($P = 0.009$). However, in case of ischemic stroke the presence of CAD was not significant (8.33% vs 5.13%) between the two groups.

The proportion of patients with previous stroke was statistically significantly higher in diabetic group than non-diabetics (28.21% vs 4.71%, $P = 0.006$). Also recurrent strokes, both ischemic (0.0009) and hemorrhagic were found to be statistically significantly higher in Diabetic group. There was no significant difference in distribution of alcohol intake or presence of renal dysfunction in two groups ($P = 0.89$).

**Discussion**

In our prospective study diabetes was found to be present in 52% of the patients, which is comparable with other studies. The incidence of ischemic and hemorrhagic stroke was 66% and 34%, compared with the studies of Asian origin which showed incidence of 73% and 27%, respectively. These variations could be due to the differences in selection of patients, size of cohorts, definition of diabetes and methods of measuring hyperglycemia.

On analyzing the type of strokes in two groups, diabetic population had more proportion of ischemic stroke (60.61% vs 39.39%; $P = 0.007$) than hemorrhagic stroke as compared to the non-diabetic population (35.29% vs 64.71%).

As diabetes is one of the major factor for enhanced atherosclerosis causing both micro and macro vascular complications, in our study also there was a significant difference between the ischemic and hemorrhagic type of stroke. This can be attributed to the increased susceptibility of small and large vessels to atherosclerosis, leading to severe fibrinoid necrosis of small cerebral arteriolar walls resulting in ischemia. Previous studies also revealed higher incidence of ischemic stroke in diabetic patients.\(^{[4,5,9]}\)

| Table 2: Distribution of subjects according to risk factors |
|-----------------------------------------------------------|
| Group | Hypertension | CAD | Previous CVA | Alcohol | Smoking | Renal Dysfunction |
|-------|--------------|-----|--------------|---------|---------|------------------|
|       | No. | %age | No. | %age | No. | %age | No. | %age | No. | %age | No. | %age | No. | %age | No. | %age |
| Total |     |      |      |       |      |       |      |       |      |       |      |       |      |       |      |       |
| Diabetic | 70 | 89.74 | 9 | 11.54 | 22 | 28.21 | 15 | 19.23 | 8 | 10.26 | 12 | 15.38 |
| Non-Diabetic | 63 | 87.50 | 2 | 7.28 | 4 | 14.71 | 13 | 18.06 | 3 | 4.17 | 11 | 15.28 |
| $P$ | 0.38101 | 0.04766 | 0.00564 | 0.89406 | 0.11543 | 0.99424 |

| Table 3: Distribution of diabetic subjects according to HbA1C |
|---------------------------------------------------------------|
| Group | A | %age | B | %age | C | %age |
|-------|---|-----|---|-----|---|-----|
| Infarct | 3 | 5.00 | 42 | 70.00 | 15 | 25.00 |
| Hemorrhage | 1 | 5.56 | 15 | 83.33 | 2 | 11.11 |
| $P$ | 0.86053 | 0.14751 | 0.13181 |

| Table 4: Relationship between small vs large ischemic stroke and HbA1c in infarct diabetic cases |
|-------------------------------------------------------------------------------------------|
| HbA1C | Small | Large | Total |
|-------|-------|-------|-------|
|       | No. | %age | No. | %age | No. | %age |
| A     | 1 | 33.33 | 2 | 66.67 | 3 |
| B     | 9 | 21.43 | 33 | 78.57 | 42 |
| C     | 4 | 26.77 | 11 | 73.33 | 15 |
| Total | 14 | 23.33 | 46 | 76.67 | 60 |
| $P$   | 0.95106 |
In our study, anterior circulation large stroke were more common. This may be attributed to referral bias as ours is a tertiary care hospital, as a result of which sick and critical patients are being referred here.

The incidence of stroke was higher in males as compared to females in the present study. The decreased frequency of stroke in females may be due to less incidence of other risk factors in females such as hypertension, smoking and alcohol intake.\(^{[2,8]}\)

It was observed in the study that patients with high HbA1c levels were found to have higher incidence of stroke. Hyvarinen\(\text{et al.}\) (2009) reported that diabetic status could predict the future risk of stroke and has an association with higher incidence of ischemic stroke. Kamel\(\text{et al.}\) reported that the serum levels of glucose and HbA1c at the time of admission are significantly higher in stroke patients with diabetes.\(^{[10,11]}\) High HbA1c (mean = 8.4 ± 1.3) signifies a poor glycemic control hence, more accelerated atherosclerosis and micro-vascular changes in these patients resulted in increased risk ratio for stroke.\(^{[12]}\)

In our study, majority of the patients with stroke were found to be in class B than class C. This could be because patients in class C develop more fatal complications due to severe uncontrolled diabetes such as coronary artery disease or end stage renal disease leading to increased mortality before they present with disabling stroke.\(^{[13]}\) In addition there was no difference in occurrence of either type of stroke with the uncontrolled status of the diabetes but mean age in ischemic stroke was higher than hemorrhagic stroke, suggesting a correlation with the duration of diabetes with the type of stroke. Larger randomized control trials are needed for the confirmation of these observations.

In our study, the number of patients with large vessel ischemic stroke was 3 times more than small vessel stroke in either of the groups. Higher frequency of large artery disease can be the result of an increased incidence of macro vascular intracranial atherosclerosis. This was also the reason of symptomatic carotid stenosis as noted on carotid doppler in diabetic group.\(^{[14]}\)

This study being clinical observational study adds to the knowledge about the type of stroke profile in Diabetes mellitus. Spreading awareness about control of blood sugar in diabetic patients at risk of stroke may improve their long-term outcome.

**Conclusion**

Diabetes is a significant risk factor for stroke, especially causing large vessel occlusion in the anterior circulation.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Powers AC. Diabetes mellitus. In: Kasper LA, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL, editors. Harrison’s Principles of Internal Medicine. Vol 344. New York: McGraw-Hills; 2012. p. 2968-70.
2. Marwat MA, Usman M, Hussain M. Stroke and its relationship to risk factors. Gom J Med Sci 2009;7:17-21.
3. Tuttolomondo A, Pinto A, Salesi G, Di Raimondo D, Di Sciacca R, Fernandez P. Diabetic and non-diabetic Subjects with ischemic stroke: Differences, subtype distribution and Outcome. Nutr Metab Cardiovasc Dis 2008;18:152-7.
4. Meherbi SE, Milan C, Minier D, Couvreur G, Osseby GV, Tilling K, et al. European BIOMED study of stroke care group. Stroke 2003;34:688-94.
5. Zafar A, Shahid SK, Siddiqui M, Khan FS. Pattern of stroke in type 2 diabetics versus non diabetic subjects. J Ayub Med Coll Abbottabad 2007;19:64-7.
6. Adams HP, Bendixen BH, Kappelle LJ, Biller J, Love BB, Gordon DL, et al. Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org 10172 in Acute Stroke Treatment. Stroke 1993;24:35-41.
7. Hamidon BB, Raymond AA. The impact of diabetes mellitus on in-hospital stroke mortality. J Postgrad Med 2003;49:307-10.
8. Wolf PA, D’Agostino RB, Belanger AJ, Kamel WB. Probability of stroke: Arisk profile from the Framingham study. Stroke 1991;22:312-8.
9. Karapanayiotides T, Fiechoeski-Jozwiak B, van Melle G, Bogousslavsky J, Devuyst G. Stoke patterns, etiology and prognosis in patients with diabetes mellitus. Neurology 2004;62:1558-62.
10. Hyvarinen M, Tuomilehto J, Mahonen M, Stehouwer CD, Pyprala K, Zethelius B. Hyperglycemia and incidence of ischaemic and hemorrhagic stroke—Comparison between fasting and 2-hour glucose criteria. Stroke 2009;40:1633-7.
11. Kamel A, Azim HA, Aziz SA, Ghaffar A, El-OkeelyA. Cerebral infarction in diabetes mellitus: A comparative study of diabetic and non-diabetic ischemic stroke. Egypt J Neurol Psychiat Neurosurg 2006;43:167-77.
12. Yamada T, Shojima N, Noma H, Yamauchi T, Kadowaki T. Glycemic control, mortality, and hypoglycemia in critically ill patients: A systemic review and network meta analysis of randomized controlled trials. Intensive Care Med 2017;43:1-15.
13. Chen R, Ovbiagele B, Feng W. Diabetes and stroke: Epidemiology, pathophysiology, pharmacuticals and outcomes. Am J Med Sci2016;351:380-6.
14. Chlumsky J, Charvat J. Echocardiography and carotid sonography in diabetic patients after cerebrovascular attacks. J Int Med Res 2006;34:689-94.