

## ORIGINAL ARTICLE

# RETROSPECTIVE HOSPITAL BASED STUDY OF CAROTID DOPPLER FINDINGS IN ACUTE ISCHEMIC STROKE PATIENTS WITH DIABETES MELLITUS IN A TERTIARY CARE HOSPITAL IN BANGLADESH

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### Abstract

**Background:** To evaluate Doppler study findings of Neck Vessels findings in ischemic stroke patients with Diabetes Mellitus admitted in a tertiary hospital. **Methods:** This cross-sectional descriptive study was carried on 96 diabetic subjects with ischemic stroke aged 40-87 years admitted in the Department of Neurology, BIRDEM general Hospital, over a period of six months. **Results:** The mean age was 63.45 years with standard deviation of mean (SD)  $\pm 19.65$  years and their age ranged from 40 to 87 years. Out of 96 subjects 64 (66.67%) were male and rest 32 (33.33%) were female. Study subjects had hypertension (75%), Dyslipidemia (57.29%), history of smoking (53.12%) and alcoholism (1.04%) as common risk factors of ischemic stroke. It was revealed that mean fasting blood glucose (FBG), after meal blood glucose (AG) and HbA<sub>1c</sub> level was 11.61 mmol/l, 16.53 mmol/l and 9.3% respectively. Mean  $\pm$  SD total cholesterol level was 245 $\pm$ 102.4 mg/dl. Mean ( $\pm$  SD) triglyceride, HDL and LDL levels were 362 ( $\pm$ 265) mg/dl, 35.83 ( $\pm$ 13.72) mg/dl and 135 ( $\pm$ 49.43) mg/dl respectively. It was observed that majority 85 (88.54%) of the subjects presented with hemiplegia after acute stroke. Other common clinical presentations were aphasia 64 (66.67%), headache 33 (34.37%), convulsion 20 (20.83%), vomiting 12 (12.50%) and cranial nerve palsy 15 (15.62%). Atherosclerotic change (60.41%) in the arterial wall was most common finding in doppler study among the study subjects. Plaques were also found and most (29.17%) of the plaques was homogenous. Calcified plaque was seen in 4.17% cases. Complete occlusion of internal carotid arterial flow was found on both right (2.08%) and left (3.12%) sides. 3.12% subjects were hemodynamically normal on Doppler study. **Conclusion:** The majority of the Diabetic subjects with ischemic stroke had atherosclerotic change in carotid arterial systems with presence of plaque in this study.

**Keywords:** Carotid Doppler study, Ischemic stroke, Diabetes Mellitus

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**Introduction:**

Early detection of patients who are at high risk for cardiac events and strokes improves clinical and preventive care<sup>1</sup>. In rural South Asia, type 2 diabetes mellitus (T2DM) is considered to be the second most frequent stroke risk factor.<sup>2</sup> There is marked geographical and ethnic variation in prevalence of diabetes caused by urbanization and demographic and epidemiological transitions that have rendered this one of the major non-communicable diseases in South Asia.<sup>2,3</sup>

Diabetes patients experience the highest rates of morbidity and mortality from cardiovascular disease (CVD), double the risk of heart attack or stroke, and a higher prevalence of atherosclerosis than non-diabetic patients.<sup>4, 5</sup> Multiple measures have been taken to lower this risk, including research into the most effective ways to manage the condition and avoid complications. If stroke is diagnosed early enough, it can be prevented. Since it can measure the number of plaques formed and gauge the degree of carotid stenosis present, ultrasound imaging is crucial in the early detection of carotid atherosclerotic disease. The method uses real-time B-mode ultrasound along with color and spectral Doppler-imaging techniques to assess the extent of atherosclerotic changes and echo patterns within the vessel and determine the severity of carotid stenosis (Duplex ultrasound or DUS)<sup>6</sup>. The method uses real-time B-mode ultrasound along with color and spectral Doppler-imaging techniques to assess the extent of atherosclerotic changes and echo patterns within the vessel and determine the severity of carotid stenosis (Duplex ultrasound or DUS).

Another benefit of carotid DUS is that it is non-invasive and therefore more acceptable to the patient. Subjects with diabetes mellitus are more susceptible to macro vascular disease manifesting as coronary artery disease, stroke/cerebrovascular accident and peripheral arterial disease compared to non-diabetic subjects. It has also been determined that the increased frequency of dyslipidemia, hyperglycemia, obesity, hypertension and associated nephropathy may contribute to accelerated atherogenesis in diabetic subjects.<sup>7, 8</sup>

Ischaemic stroke is mostly due to thromboembolic disease, secondary to atherosclerosis in the major extra cranial arteries. carotid and aortic arch.<sup>1,4</sup> Cerebral infarction is a process which takes some hours to completes, even enough through the patient's deficit may be maximal close to the onset of the causative vascular occlusion, when homeostatic mechanisms fail, the process of ischemia starts and

ultimately leads to infarction once blood flow falls below the thresholds for maintenance of electrical activity, neurological deficit appears.<sup>6</sup> The incidence of ischemic stroke in anterior circulation is about 70% whereas in posterior circulation it is about 5-10%.<sup>7, 8</sup> Among the anterior circulation the incidence of ischemic strokes is significantly related to middle cerebral artery and it is less than 3% due to occlusion of the anterior cerebral artery.<sup>9</sup> Duplex ultrasonography currently is the most accurate non-invasive primary diagnostic modality available for assessment of the stenosis of carotid artery. Ultrasound is setting up its role in screening and determination of carotid pathology because of patient comfort, less hazards, minimal effort and precision in distinguishing carotid atherosclerosis and is routinely done.<sup>10</sup> Our study aimed to evaluate the atherosclerotic changes of carotid arteries by doppler study in acute ischemic stroke patients with diabetes mellitus

**Methods:**

This cross-sectional descriptive study was carried out in total 96 adult diabetic patients aged 40-87 years who were admitted in the Department of Neurology, BIRDEM General Hospital, Dhaka. with acute ischemic stroke between October 2013 to March 2014. Stroke was diagnosed on basis of clinical findings and subsequent CT scan or MRI findings. Written consent was taken from all the patients after informing the necessary information's regarding the research study. CT scan or MRI report was collected from the patient after the scan. Doppler study of the neck vessels was done subsequently. Demographic information was prospectively recorded and substantiated by means of inspection of medical record. Information included was the subject's age, gender, medical history, clinical history of acute stroke with diabetes, followed by conduction of the study. Patients with hemorrhagic stroke, ICSOL, acute stroke without diabetes or who were transferred to other hospital before 48 hours from the time of admission were excluded from this study.

Then data were collected in a pre-designed structured data collection sheets from primary source starting from the clinical history to laboratory investigations.

All the relevant collected data were compiled on a master chart first. Then organized by using scientific calculated and standard statistical formulas, percentage was calculated to find out the proportion of the findings. Further statistical analyses of the

results were done by computer software device as statistical packages for social science (SPSS Ver. 20). The results were presented in tables, figures, diagrams etc.

**Results:**

A total of 96 cases were included in the study out of them 64 (66.67%) were male and rest 32 (33.33%) were female. The mean age was 63.45 years with standard deviation of mean (SD) ±19.65 years and their age ranged from 40 to 87 years. Majority (38.58%) of the respondents was found in the age group of 60-69. About 8.33% subjects were found in 40-49 years age group. Thirteen (14.56%) subjects belonged to 80 years and above age groups.

Beside Diabetes, the study subjects had many other risk factors which are shown in Table I.

**Table I**  
*Risk factors of the study subjects*

Risk factors	Number	Percentage
Hypertension	70	75.00
Dyslipidaemia	55	57.29
Smoking	51	53.12
Positive family history of IHD	14	14.58
Positive family history of stroke	10	10.41
Alcoholism	01	01.04

\*Multiple responses were elicited.

Glycaemic status of the study subjects during admission were documented which is presented in Table II

**Table II**  
*Glycaemic status of the study subjects during admission*

Glycaemic status	Mean±SD	Maximum- Minimum
FBG (mmol/l)	11.61±4.96	20.3-6.97
Post Prandial BG (mmol/l)	16.53±8.31	25.01-8.73
Hb A <sub>1</sub> C%	9.3±2.8	11.7-5.3

Lipid status of the study subject are shown in Table III

**Table III**  
*Lipidaemic status of the study subjects during admission*

Lipidaemic status	Mean ± SD	Maximum- Minimum
Cholesterol (mg/dl)	245±102.4	375-120
Triglyceride (mg/dl)	362±265	814-100
HDL (mg/dl)	35.83±13.72	59-17
LDL (mg/dl)	135±49.43	314-74.9

Table IV showed the Doppler study findings among the study subjects

**Table IV**  
*Doppler study findings of the study subjects*

Doppler study findings	Number	Percentage
Normal study	03	03.12
Atherosclerotic changes	58	60.41
Plaque Homogenous	28	29.17
Heterogenous	10	10.41
Calcified	04	04.17
Complete occlusion of ICA		
Right	02	02.08
Left	03	03.12
High grade stenosis (e <sup>n</sup> 71%)		
Right	06	06.25
Left	07	07.29
Moderate stenosis (51-70%)		
Right	12	12.50
Left	13	13.54
Mild stenosis (40-50%)		
Right	23	23.95
Left	19	19.79
No flow seen in vertebral artery		
Right	04	04.17
Left	03	03.12

\*Multiple responses were elicited.

**Discussion:**

Ischemic stroke is one of the major complications of Diabetes Mellitus. Doppler Study of Neck Vessels is considered as routine test for ischemic stroke workup to see the atherosclerotic plaque of the carotid

arteries as a risk factor. The mean age in this study was 63.45 years with standard deviation of mean (SD)  $\pm 19.65$  years and their age ranged from 40 to 87 years. Majority (38.58%) of the respondents was found in the age group of 60-69. Out of which 64 (66.67%) were male and rest 32 (33.33%) were female. These were the common demographic findings in ischemic stroke patient with diabetes.<sup>1, 3, 4, 11</sup>

Among preexisting risk factors, the study subjects had hypertension (72%), Dyslipidemia (59%), history of smoking (56%) and alcoholism (2%). Other risk factor was positive family history of IHD & CVD which prevailed as 12% & 13% respectively.<sup>12, 13</sup>

The study subjects were diabetic and most of them had dyslipidemia. So, mean fasting blood glucose (FBG), after meal blood glucose (AG) and Hb A<sub>1c</sub> level was 11.61 mmol/l, 16.53 mmol/l and 9.3% respectively. Mean  $\pm$  SD cholesterol level was 245 $\pm$ 102.4 mg/dl. Mean ( $\pm$  SD) triglyceride, HDL and LDL levels were 362 ( $\pm$ 265) mg/dl, 35.83 ( $\pm$ 13.72) mg/dl and 135 ( $\pm$ 49.43) mg/dl respectively.

In current study, the study subjects had hypertension (75%), dyslipidemia (57.29%), history of smoking (53.12%) and alcoholism (1.04%). Other risk factors were positive family history of IHD and stroke which prevailed as 14.58% and 10.41% respectively. In similar previous study common risk factors of ischemic stroke were hypertension, hyperlipidemia and ischemic heart disease which is similar to our study.<sup>14</sup> Another comparable study revealed risk factors of developing ischemic stroke was hypertension. Researchers also revealed Presence of hypertension ( $p < 0.01$ ), systolic blood pressure, smoking ( $p < 0.05$ ), history suggestive of peripheral arterial disease ( $p < 0.01$ ), previous CVA ( $p < 0.01$ ) were determined to be statistically significant risk factors in ischemic stroke patient undergoing carotid Doppler study.

Atherosclerotic change (60.41%) in the arterial wall was most common findings in Doppler study among the study subjects in present study. Plaques were also found and most (29.17%) of the plaques was homogenous. Calcified plaque was seen in 4.17% cases. Complete occlusion of internal carotid arterial flow was found on both right (2.08%) and left (3.12%) sides. 3.12% subjects were hemodynamically normal on Doppler study. To determine the prevalence of carotid stenosis in a selected T2DM group using DUS and to correlate these findings with other predisposing atherosclerotic risk factors in T2DM population a study<sup>15</sup> was carried out and found that 63 out of 103 T2DM patients revealed no evidence of a carotid stenosis, thereby lowering the risk profile.

Forty patients were identified as having carotid stenosis; 22 symptomatic patients had a  $> 70\%$  carotid stenosis which warranted surgical intervention. A greater prevalence of stenosis in the Caucasian group, in both the male ( $p = 0.0411$ ) and female ( $p = 0.0458$ ) cohorts, was noted. In a retrospective of CT diagnosed case with ischemic stroke more than 2/3<sup>rd</sup> patient had more than 50% stenosis in carotid arteries.<sup>13</sup> Another study was carried out to focus<sup>13</sup> on the role of carotid Doppler ultrasonography (CDUS) in the diagnosis and management of carotid stenosis in stroke patients with DM and hypertension. The rate of carotid stenosis in the study population was found to be 31%. The degree of stenosis was mild in 35% and moderate in 21%. High-grade stenosis was found in 21% of patients. In our present study plaque and stenoses were found mostly on left side. The plaque was soft in the majority of cases (43%). In another similar study to evaluate the morphological and hemodynamic changes that take place in carotid arteries by Color Doppler in patients presenting with features of stroke it was observed that Atheromatous plaque was most commonly found in the right carotid system (60%). Most common site for atheromatous plaque was found to be carotid bifurcation (33.3%). Significant stenosis, i.e.,  $> 50\%$  was found in 12 (60%) of the cases. Peak systolic velocity ratio showed significant stenosis in 12 (60%) of symptomatic cases and in 4 (20%) of asymptomatic controls. Plaque characteristics showed 9 hyperechogenic, 8 calcific, 4 low echogenic and 5 moderate or heterogeneous plaques.<sup>14</sup> Researchers<sup>16</sup> showed that in patients with ischemic stroke majority of plaques (50%) were located at the bifurcation. Color Flow imaging showed a definite advantage over B-mode scanning in identification of the hypoechoic plaques and in identification of plaque ulcerations. The overall perfect agreement between Color Doppler Flow Imaging and Conventional Duplex scanning was 96.8%. In patients with complete occlusion findings of color flow imaging and spectral analysis were confirmed on power Doppler imaging.

#### **Conclusion:**

It was concluded that in most of the diabetic subjects with ischemic stroke had atherosclerotic change in carotid arterial systems with presence of plaque that is found in this study. So diabetes patients who have atherosclerotic alterations in a Doppler scan should pay for primary prevention of ischemic stroke.

#### **Limitations:**

The sample size was calculated statistically, the original sample size was relatively smaller in relation



to huge number of population. As the study period was only six months, large sample could not be included. Only one center (BIRDEM General Hospital) was enrolled in this study, multiple centers involvement was not only laborious but also expensive.

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**Declaration of Interest:**

The authors report no conflict of interest.

**Ethical Consideration:**

Ethical clearance was obtained from ethical review board of BIRDEM General Hospital.

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