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# STATUS OF CAROTID ARTERY ATHEROSCLEROSIS AMONG THE ISCHEMIC STROKE PATIENTS

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| ARTICLE INFO | ABSTRACT | ORIGINAL RESEARCH ARTICLE |
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**Background:** Carotid artery atherosclerosis is a widespread pathological condition and one of the most significant risk factors for the development of ischemic stroke. The risk of ischemic stroke increases with the increase in the degree of carotid artery atherosclerosis. **Aim of the study:** This study aimed to assess the status of carotid artery atherosclerosis among ischemic stroke patients. **Methods:** This descriptive cross-sectional study was conducted in the Department of Neurology of Sir Salimullah Medical College & Mitford Hospital (MH), Dhaka, Bangladesh for one year. In total 70 ischemic stroke patients were selected as the study subjects according to the selection criteria. Written informed consents were taken from all the study subjects. Data were analyzed using statistical program SPSS 20.0. **Results:** Among stroke patients 62.9% had carotid stenosis. Among stroke patients 34.3% had mild, 15.7% had moderate and 12.9% had severe carotid stenosis. Degree of stenosis of carotid arteries increased with increasing of age. Most common associated risk factor was DM (64.3%) followed by HTN (45.7%), smoking (37.5%) and dyslipidemia (30.0%). Obesity was observed in 13 (18.6%) cases, MI in 11 (15.7%) cases, CKD in 4 (5.7%) cases and electrolyte imbalance in 3 (4.3%) cases. Majority of the plaques were found in carotid bulb (32.3%), followed by common carotid artery (29.0%), internal carotid artery (22.6%), common carotid artery bifurcation (12.9%) and external carotid artery (3.2%). Majority of the plaques were homogenous (59.7%) followed by heterogenous (17.7%), calcified (17.7%) and ulcerated (4.8%) plaques. **Conclusion:** Carotid artery stenosis is common in ischemic stroke patients. Diabetes mellitus, HTN and smoking are the most common risk factors in ischemic stroke patients. Majority of the plaques are found in carotid bulb and most of the plaques are usually homogenous.

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## 1. INTRODUCTION

Carotid artery atherosclerosis is a widespread pathological condition and one of the most significant risk factors for the development of ischemic stroke. Despite considerable improvement in primary prevention, diagnostic workup, and treatment, stroke is the second most common cause of death worldwide and chronic debilitating neurological disease in elderly patients, ranking behind only cardiovascular disease [1]. Physicians are trying to identify the stroke-prone population in whom timely intervention might avert stroke and its accompanying disability [2]. Carotid atherosclerosis is one of the well-known risk factors for ischemic stroke [3]. The highest risk of large artery stroke appears to be among patients with the highest degree of carotid stenosis, a history of diabetes, presence of asymptomatic carotid plaques, or a combination of these factors [4]. Atherosclerosis can affect the arteries of the brain, heart, kidney, other vital organs and the arms and legs. When Atherosclerosis develops in the arteries that supply the brain, stroke may occur [2]. Various diagnostic modalities are available for the evaluation of carotid atherosclerosis such as ultrasound, computed tomography, and MRI. Color Doppler imaging and MR angiography are now available for the non-invasive evaluation of the vascular system [3]. Color Doppler sonography of carotid arteries forms an important part of the evaluation of extracranial insufficiency. Ultrasound is establishing its role in screening and diagnosis of carotid pathology because of patient comfort, lack of risks, low cost and accuracy in detecting carotid Atherosclerosis [2]. For carotid ultrasound, a high frequency 5-10 MHz linear probe having facility for image steering is required [5]. In a study it was reported that, 'Doppler ultrasound revealed carotid artery atherosclerosis in 52.3% (n=91) patients with 57% males and 34% females'

[6]. In another study, they stated, 'When carotid artery stenosis reaches greater than 50% and it was associated with significant risk of stroke'. [7] Another study reported that, carotid artery atherosclerosis is one of the most important predictors of ischemic stroke. [8] B-mode gray scale imaging is used to identify and characterize the plaque. The addition of color helps in easy identification of vessels and accurate measurement of its lumen. The velocity measurements are used to grade the stenosis. In the present study, Color Doppler ultrasound is used to measure the presence and degree of carotid artery atherosclerosis in ischemic stroke patients. Carotid artery atherosclerosis is a risk factor for ischemic stroke. That is why the purpose of this study is to see the relation between carotid artery atherosclerosis and ischemic stroke patient admitted to a tertiary care hospital.

## 2. OBJECTIVE

**General Objective**:
- To assess the status of carotid artery atherosclerosis among ischemic stroke patients.

**Specific Objective:**
- To assess the clinical features of stroke patients.
- To evaluate the severity of stenosis among stroke patients with stenosis.
- To assess the degree of stenosis among ischemic stroke cases in relation to age.
- To assess the plaque location and morphology among the study subjects.

## 3. METHODOLOGY

This descriptive cross-sectional study was conducted in the Department of Neurology of Sir Salimullah Medical College & Mitford Hospital (MH), Dhaka, Bangladesh for a period of one year. In total 70 ischemic stroke patients were selected as the study subjects according to the selection criteria. As per the inclusion criteria of this study, ischemic stroke patients of the age > 40, from both gender groups, willing to participate were

includes as the study subjects. On the other hand, as per the exclusion criteria of this study, severely ill patients or unwilling to participate were excluded. Study populations were selected using consecutive and purposive sampling technic. Before commencement of the study, formal ethical clearance was taken from the Ethical review committee (ERC) of SSMC. All participants were described about the study nature, purpose and potential benefits of the study. They were clearly informed that they would not get any financial benefits. Detailed demographic characteristics and clinical assessment including height and weight of all patients were assessed accordingly. Blood samples were taken for estimation of blood glucose and lipid profile and necessary biochemical tests. Besides, every patient underwent a list of investigations including Electrocardiography (ECG), X-ray Chest (PA), Computed Tomography (CT) scan of brain and Echocardiography to rule out any cardiac source of embolization. The carotid arteries atherosclerosis was evaluated by Doppler ultrasonography using a high-resolution B-mode ultrasonography with 7.5 MHz linear-array transducer (Hitachi 525, Japan, Model 2003) to see the presence and site of plaques and to quantify the degree of stenosis. Carotid arteries were evaluated in postero-lateral and antero-lateral approaches and the best view were taken. Carotid arteries were first assessed using a gray-scale. The intima-media thickness (IMT) > 0.8 mm were considered as increased IMT. Residual lumen diameter at most stenotic portion of carotid arteries were compared to lumen diameter in the ICA bulb as used in Asymptomatic Carotid Atherosclerosis Study (The Asymptomatic Carotid Atherosclerosis Study Group, 1989). The diameter of the residual lumen and the external diameter of the artery at the same level were measured and the degree of stenosis were calculated using the relationship: Percent stenosis = (D – d) 100/D, where D is vessel wall-to-wall diameter and d, is patent vessel diameter. The gold standard was angiography and the parameter that angiography provides were diameter of stenosis. The presence of plaque in carotid arteries was also evaluated. The common carotid, carotid bifurcation and internal carotid artery (ICA) were then evaluated for the type, site and nature of the plaque. The level of stenosis was measured according to the Nicoladis guideline. Carotid luminal stenosis of 30–49% were classified as mild CaAD, luminal stenosis of 50–69% as moderate CaAD, and luminal stenosis of ≥ 70% as severe CaAD. All data were registered, documented and analyzed using the statistical program Statistical Package for Social Science (SPSS) version 20.0. Categorical data were expressed in frequency & percentage and numerical data were expressed as mean & standard deviation. To analysis categorical data Chi-Square test was used. Statistical significance was set at the p = 0.05 level.

## 4. RESULT

In this study, the mean (±SD) age of the patients was 64.10 ± 12.20 years. Majority of ischemic stroke patients were from age 61 to 70 years 20 (28.6%). Majority of the patients were male (71.4%) and female was 28.6%. Family history of ischemic stroke was found in 35.7% patients. Most common clinical feature was unilateral weakness or clumsiness (90.0%) followed by dysphonia (4.3%), unsteadiness (2.9%), dysphagia (1.4%) and unilateral sensory symptoms (1.4%). Most common associated risk factor was DM (64.3%). As comorbidities, obesity was observed in 13 (18.6%) cases, MI in 11 (15.7%), CKD in 4 (5.7%) cases and electrolyte imbalance in 3 (4.3%) cases. In this study, among stroke patients, stenosis was observed in 44 (62.9%) cases. Severe degree of stenosis was in 9 (12.9%), moderate was in 11 (15.7%) and mild was in 24 (34.3%). The mean (±SD) systolic blood pressure was 144.5±36.2 mmHg and mean diastolic pressure was 83.6±18.7 mmHg. In this current study, it was observed that, degree of stenosis

of carotid arteries increased with increasing age. Majority of the plaques were found in carotid bulb (32.3%), followed by common carotid artery (29%), internal carotid artery (22.6%), common carotid artery bifurcation (12.9%) and external carotid artery (3.2%). In analyzing the plaque morphology among the study subjects we observed, majority of the plaques were homogenous (59.7%) followed by heterogenous (17.7%), calcified (17.7%) and ulcerated (4.8%) plaques.

**Table 1:** Clinical features of the stroke patients (N=70)

| Clinical features | n | % |
|---|---|---|
| Unilateral weakness, clumsiness | 63 | 90 |
| Dysphonia | 6 | 4.3 |
| Unsteadiness | 2 | 2.9 |
| Dysphagia | 1 | 1.4 |
| Unilateral sensory symptoms | 1 | 1.4 |
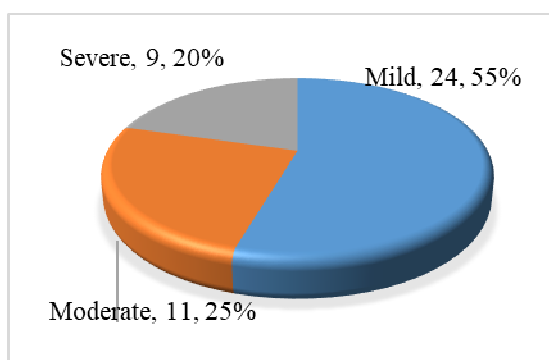


**Figure 1:** Severity of stenosis among stroke patients with stenosis (N=44)

**Table 2:** Distribution of degree of stenosis among ischemic stroke cases in relation to age (N=70)

| Age (Year) | n | Stenosis | | | | p value* |
|---|---|---|---|---|---|---|
| | | Normal | Mild | Moderate | Severe | |
| | | <30% | 30-49% | 50-69% | ≥70% | |
| 41 – 50 | 12 | 11(91.7%) | 1(8.3%) | 0(0.0%) | 0(0.0%) | <0.001 |
| 51 – 60 | 15 | 7(46.7%) | 7(46.7%) | 1(6.7%) | 0(0.0%) | |
| 61 – 70 | 21 | 8(38.1%) | 7(33.3%) | 4(19.0%) | 2(9.5%) | |
| 71 - 80 | 14 | 0(0.0%) | 8(57.1%) | 3(21.4%) | 3(21.4%) | |
| >80 | 8 | 0(0.0%) | 1(12.5%) | 3(37.5%) | 4(50.0%) | |

**Table 3:** Plaque location in stroke cases (N=62)

| Location of plaque | n | % |
|---|---|---|
| Common Carotid Artery (CCA) | 18 | 29 |
| Carotid Bulb | 20 | 32.3 |
| Common carotid artery bifurcation | 8 | 12.9 |
| Internal carotid artery | 14 | 22.6 |
| External carotid artery | 2 | 3.2 |

**Table 4:** Plaque morphology among the study subjects (N=62)

| Morphology of plaque | n | % |
|---|---|---|
| Homogenous | 37 | 59.7 |
| Heterogenous | 11 | 17.7 |
| Calcified | 11 | 17.7 |
| Ulcerated | 3 | 4.8 |
| Total | 62 | 100 |

## 5. DISCUSSION

The aim of this study was to assess the status of carotid artery atherosclerosis among ischemic stroke patients. Several studies are reported frequency and degree of carotid artery stenosis in stroke patients and non-stroke individuals [9]. Many of the association studies involving stroke and non-stroke patients mainly focuses on comparison of carotid intimal thickness in those groups [10,11]. This study is conducted to determine the association between the degree of carotid atherosclerosis and ischemic stroke. Total of 70 cases of ischemic stroke are enrolled in this study. HTN is the most prevalent risk fact for of stroke in this study (45.7%). Hypertension (HTN) is the most common modifiable risk factor for stroke [12]. In this study 64.3% of ischemic stroke patients were found to have diabetes mellitus. DM is a recognized significant risk for stroke. Among patients, with DM several factors contribute in varying degrees to the overall cerebrovascular risk including hypoglycemia, vascular risk factors such as hypertension and dyslipidemia and also genetic, demographic, and lifestyle factors and several studies have shown that diabetic people have approximately twice the risk of ischemic stroke compared with those without diabetes [13]. Among stroke patients 62.9% had carotid stenosis to an extent. Carotid stenosis was found in 64% cases in the study of Haq et al. [9]. This result supports the findings of previous studies which have shown an association of presence of carotid stenosis with ischemic stroke [14, 15]. Plaques seen on ultrasonography of carotids are classified in many different ways in the previously done studies. In present study, the location and morphology of the plaque are taken into consideration. Majority of the plaques are found in carotid bulb (32.3%) in this group. This is consistent with the findings of Haq et al. [9] and Garg et al. [16] who also reported majority plaques in carotid bulb. Majority of the plaques are homogenous (59.7%) followed by heterogenous (17.7%), calcified (17.7%) and ulcerated (4.8%) plaques. Sultana et al. (2012) found 58.0% homogenous plaque, 20% heterogenous plaque, 17% calcified plaques and 5% ulcerated plaques in their study involving ischemic stroke patients.

**Limitation of the study:**

This was a single centered study with a small sized sample. So, findings of this study may not reflect the exact scenario of the whole country.

## 6. CONCLUSION & RECOMMENDATION

In this study stenosis was present in 62.9% cases. According to this study findings, most common risk factors are diabetes mellitus, HTN and smoking, common co-morbidity is obesity and homogenous is the most common type of plaque. Degree of stenosis of carotid arteries increased with increasing of age in stroke patients. Majority of the plaques are found in carotid bulb and most of the plaques are usually homogenous.

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