

# FREQUENCY OF CAROTID ARTERY STENOSIS IN ISCHEMIC STROKE BY USING CAROTID DOPPLER ULTRASONOGRAPHY IN A TEACHING HOSPITAL

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## ABSTRACT

**Background:** Atherosclerotic disease of carotid arteries outside the cranial cavity has long been recognized as the most common source of emboli to the brain causing stroke. The purpose of this study was to determine the frequency of carotid artery stenosis in ischemic stroke patients by using carotid doppler ultrasonography.

**Material & Methods:** This was a descriptive study, conducted at Radiology Department, Hayatabad Medical Complex, Peshawar, from December 2007 to December 2008. One hundred consecutive patients from 27 to 93 years age of both sexes referred to Radiology Department for CT brain and having cerebral infarction were included in the study. Each patient underwent bilateral carotid doppler ultrasonography using SSD-140 ultrasound machine having 7.5 MHz linear probe. Their history charts were reviewed for risk factors for atherosclerotic disease. The severity and morphology of carotid disease were characterized using standard criteria.

**Results:** Of 100 patients with ischemic infarction on CT brain, 56(56%) had carotid stenosis on color doppler ultrasonography of carotid arteries. 64.3% had mild stenosis, 26.8% moderate and 8.9% severe stenosis. As far as the plaque characteristics, the plaque was soft in majority of cases (58.9%). The prevalence of hypertension and diabetes was 59% and 44% respectively.

**Conclusion:** The frequency of carotid stenosis as detected by Doppler ultrasonography in ischemic stroke is 56% in our set up.

**Key words:** Cerebrovascular accident, Ischemic stroke, Color Doppler, Carotid doppler.

## INTRODUCTION

Stroke is a common cause of physical disability in developed countries, and a leading cause of death. It is also common in many developing countries.<sup>1</sup>

Atherosclerotic disease of the carotid arteries outside the cranial cavity has long been recognized as the most common source of emboli that travel to the brain causing stroke.<sup>2</sup> High-degree internal carotid artery stenosis is the most well-known risk factor for the development of cerebrovascular events.<sup>3</sup>

Arteriography has been long regarded as the gold standard diagnostic tool for carotid stenosis. It is a costly and invasive technique with potentially serious complications. The results of arteriography have not been standardized which makes comparison of results from different laboratories difficult. Duplex ultrasound is inexpensive, non-invasive and can provide functional and anatomical information about ves-

sel stenosis and plaque morphology.<sup>4,5</sup> Color duplex flow ultrasonography has thus become the most widely used noninvasive method of assessing extracranial cerebrovascular occlusive disease because it avoids the expense and risk of routine arteriography.<sup>6</sup> The sensitivity and specificity of carotid duplex US range from 90% to 95% for measurement of carotid diameter reduction, and duplex US may be more sensitive for detection of minimal atherosclerotic plaque.<sup>7,8</sup> The goals of carotid imaging can be described as early detection, clinical staging, surgical road mapping, and postoperative therapeutic surveillance.<sup>9</sup>

In this study, we evaluated the extracranial carotid system with the help of color Doppler ultrasound of patients whose CT scans showed ischemic strokes. The purpose of our study was to know the frequency of carotid artery stenosis in ischemic stroke patients, thus showing the relationship of carotid atherosclerosis with ischemic stroke.

## MATERIAL AND METHODS

This study was conducted in Radiology Department of Hayatabad Medical Complex Peshawar from Dec 2007 to Dec 2008. All patients presenting with stroke were included in the study. A total of hundred consecutive patients (70 male, 30 female, 2.3:1) were selected for this study without any age, sex, ethnic or socioeconomic discrimination. A detailed history and thorough physical examination of all patients were carried out on a questionnaire. Risk factors were also stratified.

Patients whose CT scans showed evidence of cerebral infarction underwent carotid doppler ultrasonography to look for the status of carotid arteries. All examinations were performed by the same operator. Doppler study was performed using Toshiba Nemio 20 with a linear transducer of 7.5MHz, with subject lying in the supine position and the head slightly tilted to opposite side. Initially, the common and internal carotid arteries were scanned transversally and longitudinally, whereby distribution of atheromatous plaques was roughly evaluated. During the initial scanning, optimal insonation angles were determined for the estimation of respective plaque heights, and the measurements were performed on the frozen frame, perpendicular to the vascular walls. Bilateral carotid arteries were examined by the same procedure. Carotid stenosis /occlusion was diagnosed by the commonly used criteria.

The diameter of the residual lumen and the external diameter of the artery at the same level were measured and the degree of stenosis was calculated using the following relationship:

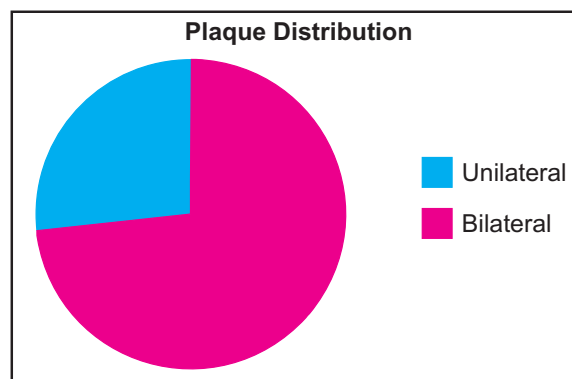
Percent stenosis =  $D-d \cdot 100/D$ , where D is vessel wall-to-wall diameter and d is patent vessel diameter

The gold standard has been angiography and the parameter that angiography provides is diameter stenosis and hence, in ultrasound, we also used diameter stenosis. Results of the study were analyzed using SPSS ver 11.0. As this study deals with only frequency distribution of various factors, so no tests of significance were applied.

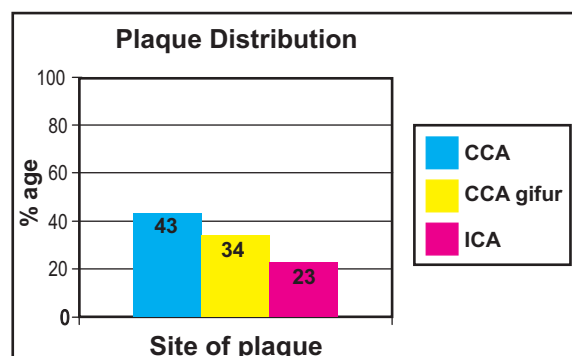
## RESULTS

A total of 100 patients; 70 males and 30 females underwent CT scan. Age range was from 27 to 93 years with a mean of 62.43 years. Among males the mean age was  $64.13 \pm 10.95$  years while in females it was  $58.47 \pm 9.54$  years. About 55% of patients were above 60 years of age.

Stenosis due to plaque of carotid system was found in 56 (56%) patients; being unilateral in 41 (73%) patients and bilateral in 15 (27%).



Of these 56 patients, plaques were found in the region of common carotid artery bifurcation (CCA bifur) in 34% (n=19), in proximal part of internal carotid artery (ICA) in 23% (n=13) and in common carotid artery (CCA) in 43% (n=24).



The plaque was soft in 33 (58.9%) patients and echogenic (including both fibrotic and calcified) in 23 (41.1%). The degree of stenosis among various patients is shown in Table.

**Table: Degree of carotid stenosis in patients with ischemic stroke**

Degree of stenosis	Percent diameter stenosis	Number of patients	Percentage
Mild	<50%	36	64.3
Moderate	50-70%	15	56.8
Severe	>70%	5	8.9

Risk factor assessment revealed past history of hypertension in 59%, diabetes mellitus in 44% and transient ischemic attacks in 40%. Majority of patients with diabetes as well as non-diabetics had soft plaques (57.7% of diabetics and 60% of non-diabetics). 65.8% of the patients with hypertension had soft plaques while majority of patients without hypertension had echogenic plaques

(55.6%). Majority of patients with or without history of TIA had soft plaques (56% and 61.3%).

## DISCUSSION

The ischemic stroke patients admitted in our unit were not representative of any specific area or socioeconomic class belonging mainly to middle to lower socioeconomic class. The study included a total of hundred consecutive patients, all presented with recent ischemic stroke proven by CT scan. Most of our study subjects (55%) were 60 years or older. This is in accordance with the data already available.<sup>10</sup>

Carotid Doppler ultrasonography of patients with ischemic strokes showed that 56% had involvement of carotid arteries (right, left or both) as compared to Razzaq et al who reported the rate of carotid stenosis in their study population to be 31%.<sup>10</sup>

In 56 patients with stenosis on doppler study, 64.3% had mild stenosis (<50%) while significant stenosis (>70%) was noted only in 8.9% patients. Razzaq et al report mild stenosis in 35%, moderate stenosis in 21% and significant stenosis in 21%.<sup>10</sup> Wasay et al reported mild stenosis in 78%, moderate stenosis in 8% and severe stenosis in 12% and total occlusion in 1% in a study with 672 patients undergoing bilateral carotid doppler ultrasound.<sup>11</sup> Atif et al reported the frequency of significant carotid stenosis in acute ischemic stroke patients as 21%.<sup>12</sup>

The male preponderance (70%) is in accordance with most of the local as well as international studies. Atif et al have shown a 1.6: 1 male to female ratio in their study conducted at Karachi.<sup>12</sup> In a study conducted by Masoud SA at Kashan, Iran the male-to-female ratio turned out to be 1.1:1.<sup>13</sup> Khan SN et al reported male to female ratio of 1.05:1 in his study conducted at Ziauddin Medical University Hospital, Karachi.<sup>14</sup>

Majority of patients had soft plaques (58.9%) which is in accordance with a study conducted by Razzaq A et al in which soft plaques were found in 43%.<sup>10</sup>

Main risk factors involved in this study were hypertension (59%) and diabetes mellitus (44%) whereas 40% had past history of TIA. Hypertension was also found to be the major risk factor in other studies.<sup>10,12,15,16</sup> The reason behind this may be the sedentary life style along with improper diet.

There were certain limitations to our study. Doppler studies can be operator-dependent, but did not analyze intra-observer or inter-observer variability for evaluation of degree of stenosis.

## CONCLUSION

The frequency of carotid stenosis as detected by Doppler ultrasonography in ischemic stroke is 56% in our set up.

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