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# ULTRASOUND EVALUATION OF CAROTID ARTERIES IN STROKE PATIENTS

KEYWORDS: Internal carotid artery, Color Doppler, Peak systolic velocity ratio, atherosclerotic plaque, stenosis.

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**ABSTRACT** *Atherosclerotic cerebral vascular disease is a life threatening and debilitating neurological disease. Studies have shown that there is a close relationship between carotid artery stenosis and ischemic cerebral vascular disease. This study is done to assess carotid arteries with the help of color Doppler and B mode imaging and to correlate cerebrovascular accidents with extracranial carotid artery status.*

## INTRODUCTION

Atherosclerotic cerebral vascular disease is a life threatening and debilitating neurological disease. Following cancer and heart disease, it is the third leading cause of death in the world. Studies have shown that there is a close relationship between carotid artery stenosis and ischemic cerebral vascular disease.

Treatment of stroke depends on reaching the most accurate diagnosis. Precise diagnosis will help to obtain a better understanding of the natural history of this condition and also determine a therapeutic regimen and prognosis. Several modalities of investigation are available to determine carotid artery status. Noninvasive modalities are popular.

## AIMS AND OBJECTIVES

To assess carotid arteries with the help of colour Doppler and B mode imaging in carotid artery disease.
2. To correlate cerebrovascular accidents with extracranial carotid artery status.

### Doppler evaluation of carotid arteries

There are three important areas to consider in Doppler evaluation of an arterial stenosis: the prestenotic region , the stenosis itself and the post stenotic region. The most important Doppler measurements are made in the stenotic zone.

The flow velocity in the stenotic lumen is elevated in proportion to the degree of luminal narrowing and this principle is the basis for Doppler stenosis assessment. The increase in stenotic zone velocity is small until the lumen diameter is reduced to about 50% of its original size. Thereafter the velocity goes up rapidly as stenosis severity increases[1].

Three stenotic zone velocity measurements are key to carotid stenosis diagnosis :the peak systolic velocity, the end diastolic velocity and the systolic velocity ratio[2]. These measurements are called cardinal Doppler parameters. Doppler ultrasound grading of internal carotid stenosis using the two parameters of spectral analysis and internal carotid to common carotid artery peak systolic velocity ratio is well established.

### Peak systolic velocity

The best documented Doppler parameter for carotid stenosis is the stenotic zone peak systolic velocity. At any level of arterial narrowing , the peak systolic velocity is affected by the length of the stenosis and by a host of physiologic factors that differ from one patient to another.

### End Diastolic Velocity

With arterial stenosis of less than 50% diameter reduction, the diastolic velocity remains normal because no appreciable pressure gradient is present across the stenosis during diastole. As stenosis progress beyond 50%, a pressure gradient across the stenosis is present in diastole and diastolic velocities increase in proportion to the severity of the gradient . This parameter is quite valuable for detecting high grade carotid stenosis.

### Systolic velocity ratio

The systolic velocity ratio is recommended to avoid errors caused by physiologic factors or collateralization. This ratio is the peak systolicvelocity in the stenotic ICA divided by the peak systolic velocity in the ipsilateral CCA[3].

## METHODOLOGY

The study was carried out on 50 patients attending ASRAM Medical College Hospital, Eluru in the period of August 2015 to July 2016. A detailed clinical history was taken and clinical examination findings were recorded. Risk factors like hypertension, diabetes mellitus, smoking and ischemic heart disease were documented.

**Selection Criteria**;Clinical symptoms of stroke patients The data gathered from the color Doppler examination consisted of Peak Systolic velocity of common carotid artery, Peak systolic velocity of internal carotid artery, Velocity ratios between internal carotid artery and common carotid artery, Plaque characteristics as seen on the real time image.

## RESULTS

### SEX DISTRIBUTION

Among the 50 patients studied 41 patients (82%) were males and 9 (18%)were females.

### DISTRIBUTION OF AGE GROUPS

The highest number of stroke patients in this study were found in the age group of 50-59 years that is 14 patients (28%). 11 patients (22%) were of the age group of 60-69 years. 10 patients (20%) were in the age group of 40-49 years. 9 patients (18%) were in the age group of 70-79 years. 6 patients (12%) were in the age group of greater than 80 years.

### STENOSIS AND AGE GROUP

Out of the 14 patients with significant stenosis (>60% stenosis) the age distribution was maximum in the age group of 50-59years that is 6 patients. Next was the age group of 70-79 years with 3 patients. 2 patients each were in the age group of 60-69 years and >80 years. 1 patient was in the age group of 40-49 years.

### VISIBLE PLAQUE – SIDE INVOLVED

Out of the 25 patients having plaque in the extracranial carotid system 9 (36%) patients had bilateral involvement. 8 patients (32%) had plaque on the right side and 8 patients (32%) had plaques on the left side.

### PLAQUE DISTRIBUTION

Internal carotid artery was the commonest site of involvement with 9 patients showing plaques in the right internal carotid

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artery and 11 patients in the left internal carotid artery.4 patients showed plaques in the right common carotid and 3 patients on the left. Carotid bulb plaque were seen in the right side in 4 patients and left side in 3 patients.

**DEGREE OF STENOSIS IN PATIENTS WITH SIGNFICANT BLOCK**

On the right side 9 patients had 60-79% block, 1 patient had 80-99% block and 1 had total block. On the left side – 5 patients had 60-79% stenosis, 1 had 80-99% block and 3 patients had total block.

**SIDE OF STROKE**

Of the 50 patients studied 20 patients had right sided stroke. 18 patients had left sided stroke. Bilateral involvement was seen in 2 patients and 10 patients had transient ischemic attacks.

**DISCUSSION**

Cerbrovascular disease is the third leading cause of death after heart disease and cancer in the developed countries[4]. About 30-60% of strokes are caused by atherosclerotic disease involving the extracranial carotid arteries usually within 2 cms of carotid bifurcation[5].

Angiography is gold standard but invasive and expensive and involves significant risk to the patients. Sonography is unique among vascular imaging procedures in that it can assess plaque composition. Sonographically detected plaque characteristics may have prognostic value and may be useful for selection of medical and surgical therapy[6].

The present study was done to evaluate the extracranial carotid arterial system in the population who presented with stroke.
Out of the 50 patients studied 20 patients had right sided stroke, 18 patients had left sided stroke. Bilateral involvement was seen in 2 patients and 10 patients had transient ischemic attack.

Diabetes mellitus is another risk factor for atherosclerosis. Lindberg Pertu and Roine Risto in their study had observed that two thirds of all ischemic stroke types on admission had diabetes mellitus8 . In this study 7 patients had diabetes mellitus of which 3 had significant stenosis.

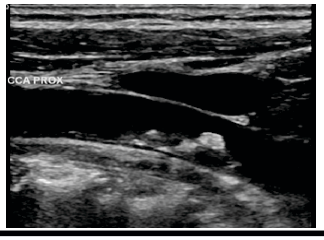
The patients in our study were ruled out from cardiac problem, which will interfere in the velocity profiles of the carotid system. A diminished cardiac output will reduce both systolic and diastolic velocities.

On the right side, 9 patients had 60-79% stenosis, one patient had 80-99% stenosis and one had total block. On the left side 5 patients had 60-79% stenosis, one had 80-99% stenosis and 3 patients had total block.

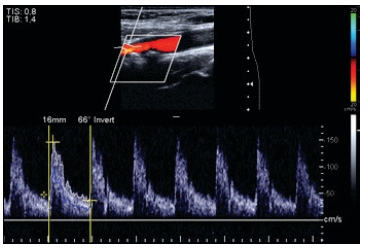
In this study 5 patients had homogenous plaques on the right side, 3 had non-homogeneous plaques and 9 patients were found to have calcified plaques. On the left side 6 patients had homogenous plaques, 6 had non homogenous plaques andhad calcified plaques.

**CONCLUSION**

Our study concludes that colour Doppler examination is noninvasive, economic, safe, reproducible and less time consuming method of demonstrating the cause of cerebrovascular insufficiency in the extracranial carotid artery system and will guide in instituting treatment modalities.




Heterogenous plaque in proximal CCA.




Heterogenous plaque in CCAwith increased PSV.

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