

Original Research Article

Color Doppler Evaluation Of Extracranial Carotid Arteries And Risk Factors In Predicting Cerebro Vascular Accident In Patients With Carotid Atheromatous Disease: A Clinical And Radiological Correlation.

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ABSTRACT:

Back ground: WHO defines stroke as “the rapid development of clinical signs and symptoms of a focal neurological disturbance which lasts for more than 24 hours or leading to death with vascular origin as the cause. Stroke is a clinical syndrome, which describes a sudden neurological deficit of presumed vascular origin. The risk factors for stroke are diabetes mellitus, smoking, alcohol and hypertension. Colour doppler ultrasound is one of the important tool for the evaluation of extracranial insufficiency of the carotid arteries. This study was performed to assess the carotid arteries with the help of color doppler in carotid artery disease.

Aims and objectives: To elaborate the color Doppler evaluation of extracranial carotid arteries and risk factors in predicting cerebro vascular accident in patients with carotid atheromatous disease.

Materials and Methods: Of the 102 patients who had come to our department during the study period with symptoms of cerebrovascular disease such as transient episodes of neurological dysfunction, sudden weakness or numbness, hemiparesis, focal neurological deficits, sudden loss of consciousness, altered sensorium, aphasia, slurring of speech, diminution or loss of vision were included into the study. CT scan of brain and color doppler evaluation for the extracranial carotid arteries was done for all the patients to assess the atheromatous disease of extracranial carotid arteries and comparison with brain changes in cerebrovascular disease patients.

Observations and Results: Of the 102 patients included into the study, 51% were males and 49% were females. 59% of the patients were above 61 years of age, 24% of them were between 51-60 years and 12% were between 41-50 years. 82% of the patients had the presence of atherosclerotic plaque while 18% had increased intima-media thickness without the plaque. Among the patients with atherosclerotic plaque, 63.4% had diabetes and 68.3% had hypertension <50% stenosis was

seen among 45.1% of the patients while 36.9% had between 50-70%. Near total occlusion was seen in 6% of the patients.

Conclusions: The color Doppler sonography is a useful tool in evaluation of extra cranial course of carotid vessels. It is a non-invasive, cheap, faster modality without any side effects. Therefore, it could be used in predicting CVA in patients with carotid atheromatous disease.

Keywords: Atheromatous, Hypertension, Hyperlipidemia, Cerebrovascular accidents, Risk factors, Carotid artery stenosis. B mode imaging, Carotid artery, Colour doppler, Plaque, Stroke.

INTRODUCTION

WHO defines stroke as “the rapid development of clinical signs and symptoms of a focal neurological disturbance which lasts for more than 24 hours or leading to death with vascular origin as the cause” [1]. Ischemic stroke is more common and accounts for 50-85% of all the strokes worldwide. Stroke is defined as ischemic if there is imaging (Computed Tomography or Magnetic Resonance Imaging within four weeks), surgical or autopsy evidence excluding haemorrhage, or in absence of such direct evidence if the indirect evidence (e.g., deficit limited to one limb or completely resolving within 72 hours, atrial fibrillation in persons not on anticoagulants) suggest ischemic rather than a haemorrhagic stroke [2] Stroke is the second most common cause of death worldwide. It is leading cause of disability in old age patients. Stroke is a clinical syndrome, which describes a sudden neurological deficit of presumed vascular origin. It is one of the major causes of death. The life of an individual is dramatically affected by having a stroke or Cerebrovascular accident (CVA). Cerebral ischemic stroke is the third major causes of death, only behind malignancy and cardiovascular disease. It is estimated that around 80% of the strokes is due to the atherosclerosis of the intra as well as the extracranial carotid vessels. [3] The association of the carotid atherosclerosis with risk of stroke increases with the severity of stenosis. [4] Even the survivors of stroke have severe irreversible disabilities. [5] The risk factors for stroke are diabetes mellitus, smoking, alcohol and hypertension. [6] Colour doppler ultrasound is one of the important tool for the evaluation of extracranial insufficiency of the carotid arteries. It is critical to accurately diagnose the hemodynamically significant stenosis so that the patients who require surgery can be identified. Color doppler is a low cost, safe and non-invasive test that is very useful for such patients. [7] Conventional carotid angiography is still the gold standard test for the detection of carotid stenosis but carries with it certain disadvantages such as invasiveness and higher expense not to mention risk of the contrast medium and morbidity. Though there are many studies that confirm, contrast enhanced MR angiography and CT angiography could become a diagnostic alternative to digital subtraction angiography, however these are not cost effective and not a primary modality of choice. Now duplex scanning has become the modality of initial investigation of choice of stroke, because of its accuracy, safety, patient comfort and cost effectiveness. It can also assess plaque morphology and complications such as hemorrhage, ulceration which increases the risk of thromboembolic events. [8,9] This study was performed to assess the carotid arteries with the help of color doppler and B-mode imaging in carotid artery disease, as well as to correlate the cerebrovascular accidents with extra cranial carotid status.

MATERIAL AND METHODS:

This study was performed by the Department of Radio diagnosis, Azeezia Institute of Medical Sciences, Meeyannoor, PO, Kollam, Kerala, India. 102 patients who had come to authors' Department during the study period with symptoms of cerebrovascular disease such as transient episodes of neurological dysfunction, sudden weakness or numbness, hemiparesis, focal neurological deficits, sudden loss of consciousness, altered sensorium, aphasia, slurring of speech,

diminution or loss of vision were included into the study. Patients with evidence of haemorrhagic stroke were excluded from the study. All the patients and their relatives were briefed about the nature of the study, the interventions used and written informed consent was obtained. Detailed demographic data such as age, smoking, alcoholism were taken from all the patients. Blood was collected from all the patients to assess the blood sugar. Following a thorough medical and clinical evaluation, CT scan of head and color doppler evaluation for the extracranial carotid arteries was done for all the patients to assess the atheromatous disease of extra-cranial carotid arteries and comparison with brain changes in cerebrovascular disease patients. The patients were placed in supine position with the head hyper extended and the neck either straight and oblique in the contralateral position. A high frequency imaging probe (7.5 to 10 MHz) should be used to allow optimal visualization of vessel anatomy and vascular pathology in both transverse and sagittal planes. The examination was carried out in two steps. Firstly, multiple longitudinal and transverse B-Mode images were obtained for determination of vessel course, detection of wall thickening and atheromatous lesions and definition of plaque extent and morphology. Scanning was done from the supraclavicular notch to the angle of jaw. Inferior angulation of the transducer in the supraclavicular area allows one to image the origin of the common carotid artery as well as the subclavian and vertebral arteries. Next, color coded flow was superimposed for evaluation of hemodynamics in general and for detailed analysis of any areas of pathology. Atheromatous plaques were analyzed for surface characteristics and structure facilitated by observing the presence or absence of color at each point along the contour of the suspected lesion. For each examination the velocity scale was adjusted to give as complete color coding of the flow lumen as possible without causing aliasing. The sensitivity of the system for detection of motion was set individually for each patient slightly above the level of color noise and was then reduced to just below the noise threshold. The gain should be set so that color just reaches the optimal surface of the vessel the color bleed was checked. The wall filter settings were checked and if the wall filter settings were set too high, low frequency signal generated by low velocity flow were eliminated. A peak frequency shift in the CCA or ICA, proximal to a stenotic lesion was identified by positioning a small sample volume doppler cursor in the center of the patent lumen. The doppler sample volume was repositioned in the area of maximum stenosis. The degree of stenosis can be calculated by directly using electronic caliper on the residual lumen and total lumen at the same level.

OBSERVATIONS AND RESULTS:

Of the 102 patients included into the study, 52 (51%) were males and 50 (49%) were females (Table 1, Figure 1). Though the males were slightly more than the females, this difference was not significant. Most of the patients were above 61years of age (59.9%) showing that the elderly were more prone to CVA. 23.5% of them were between 51-60years and 11.8% were between 41-50years. Only 1 patient was between 21-30years (Table 2, Figure 2). 82% of the patients had the presence of atherosclerotic plaque while 18% had increased intima-media thickness without the plaque (Table 5, Figure 4). Out of these 82 patients, there was equal distribution in the gender with 41 males and 41 females.

Table 1: Sex distribution of the patients with CVA.

Sex	Number of cases	Percentage
Male	52	51%
Female	50	49%
Total	102	100%

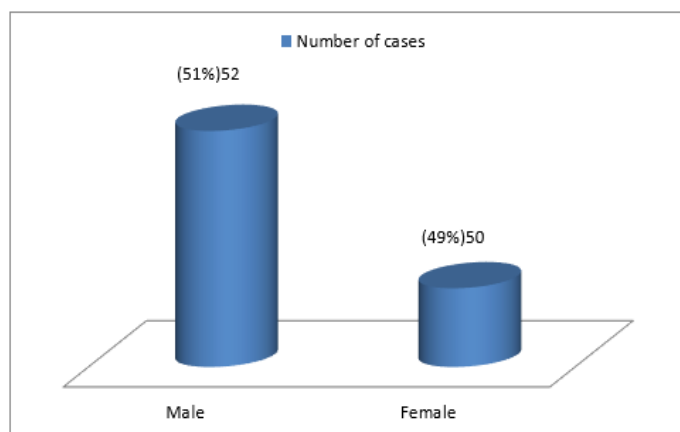


Figure 1: Sex distribution of the patients with CVA.

Table 2: Age wise distribution of the patients with CVA.

Age (years)	Number of cases	Percentage
21-30	1	0.9%
31-40	4	3.9%
41-50	12	11.8%
51-60	24	23.5%
>61	61	59.9%
Total	102	100%

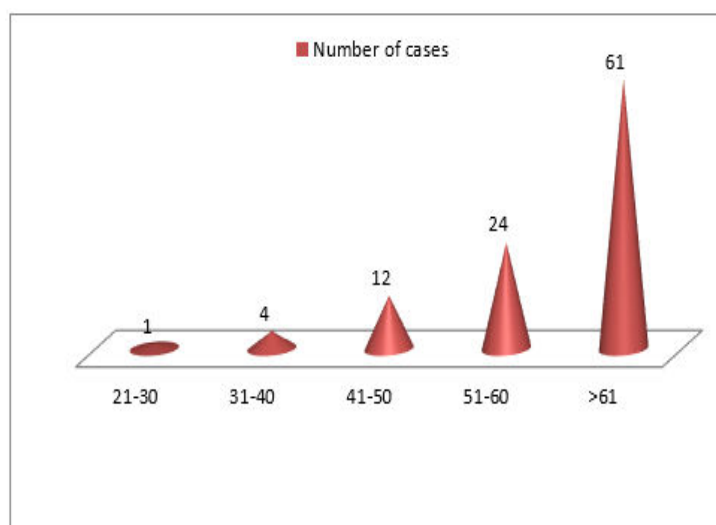


Figure 2: Age distribution of the patients with CVA.

Table 3: Clinical features

Clinical features	No of patients	Percentage
Right hemiplegia	47	46%
Left hemiplegia	38	37%
Aphasia	20	20%
Cranial nerve palsy	18	18%
Monoparasis	15	15%
Quadriparasis	4	4%

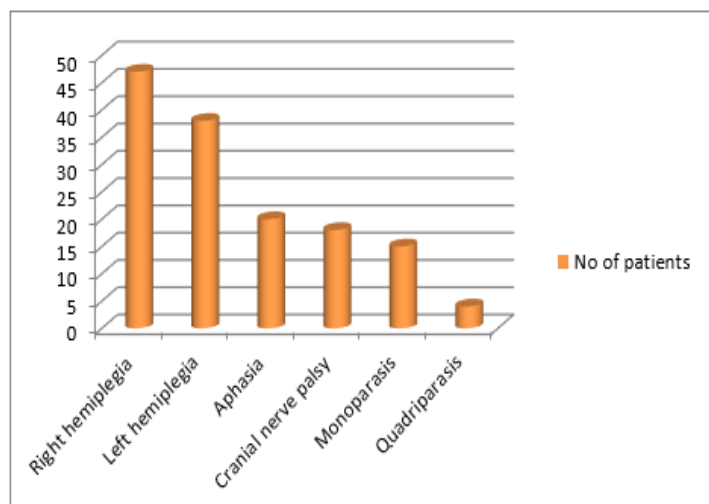


Figure 3: Clinical features Vs No. of patients

The predominant clinical presentation among the patients was right hemiplegia (46%), followed by left hemiplegia in 37% patients. Aphasia was observed in 20% of the patients while 18% came with cranial nerve palsy (Table, 3, Figure 3).

Table 4 : Risk factors among patients with CVA with and without plaque.

Clinical presentation	Patients with plaque N=84	Patients without plaque N=18
Diabetes	53(63%)	6(33.3%)
Alcohol	28(33.3%)	4(22.2%)
Smoking	29(34.5%)	5(27.8%)
Hypertension	57(67.9%)	7(38.9%)

Table 5 : Presence of plaque in patients with CVA

Plaque presentation	Number of patients
Atherosclerotic plaque	84
Increased intoma - media thickness	18
Total	102

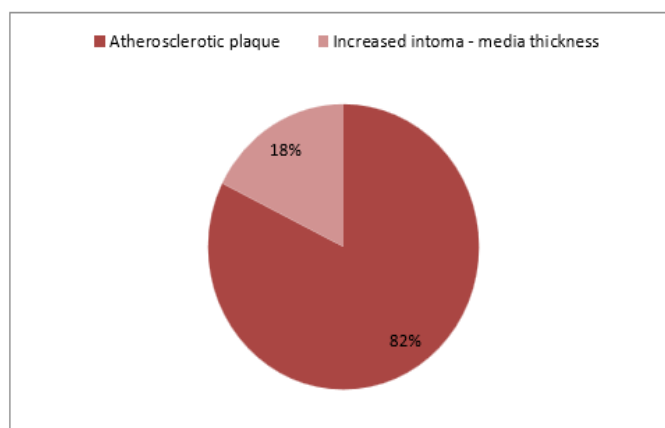


Figure4 : Presence of plaque in patients with CVA

Among the patients with atherosclerotic plaque, 63% had diabetes and 67.9% had hypertension. Around 35% of them were either smokers, or alcoholics or both. Even among the ones without plaque, around 35% of the patients had diabetes and hypertension. 22% of them were alcoholics and 27% were regular smokers (Table 3)

Table: 6: Intima media thickness in patients with and without carotid plaque.

IMT	Mean(in mm)	Minimum IMT	Maximum IMT
In patients with plaque	1.38±0.6	1.2	1.8
In patients without plaque	1.07±0.2	1.0	1.2

The mean intima media thickness was 1.38mm among the patients with carotid index, with maximum being 1.8mm. Among the stroke patients without plaque, the mean intima media thickness was 1.07mm with maximum being 1.2 mm (Table 6).

Table: 7: Radiological evaluation of patients with atherosclerotic plaque

Presentation	Number	Percentage
Peak systolic velocity (cm/sec)		
<125	38	45.2%
125-130	31	36.9%
135-200	10	11.9%
>200	5	6%
End diastolic velocity (cm/sec)		
<40	38	45.2%
40-100	31	36.9%
>100	15	17.9%
Carotid index		
<2.0	38	45.2%
2-4	31	36.9%
>4	15	17.9%
No. of plaques		
1	45	53.6%
2	26	31%
3	10	12%
4	3	3.4%
Type based on B-mode imaging		
Type I	28	27.5%
Type II	37	36.3%
Type III	19	18.6%
Type IV	18	17.6%
Diameter stenosis based on color doppler		
<50%	38	45.2%
50-70%	31	36.9%
>70%	10	11.9%
Near total occlusion	5	6%

More than 50% stenosis was seen among 45.2% of the patients while 36.9% had between 50-70%. Near total occlusion was seen in 6% of the patients while none of the patients had a complete occlusion (Table 7).

DISCUSSION:

This study was done to evaluate extra cranial course of carotid artery by duplex and colour Doppler and correlate with individual risk factors in patients with ischemic stroke and TIA. In the present study, out of 102 patients who were included into the study, 84 patients had evidence of atherosclerotic plaque on color doppler evaluation in their extra cranial carotid arteries and 18 patients were found to be having no carotid atherosclerotic changes. Out of these 84 patients 42 were males and 42 were females. However, in a study by Sethi et al, the incidence of atherosclerosis as seen more in males than females. [10] This was attributed to the protective nature of the hormones in the females. However, after menopause, the incidence becomes similar. [11] The maximum number of patients i.e. 59% of patients were aged 61 years and above, 24% of patients were in their 6th decade, 12% of patients were in their 5th decade, 4% of patients were in their 4th decade, and 1% of patients were in their 3rd decade. Present study results were in accordance to a study done by Malik et al. [12] In a study by Sethi et al, the mean age was 65.4 in males and 66.1 in females. A study by Fernandez et al, reported the most common age to be affected was 60-69 years. [13] Among the patients with atherosclerotic plaque, 63.4% had diabetes and 68.3% had hypertension. Around 35% of them were either smokers, or alcoholics or both. Even among the ones without plaque, more than 35% of the patients had diabetes and hypertension. 22% of them were alcoholics and 25% were regular smokers. In a study by Fernandez et al, most of the patients had hypertension (38%). Smoking was also seemed to have a positive correlation in his study. A study by Mannami et al, had attributed 22% of stroke patients to smoking. [14] A comparatively low association of hypertension with stroke was observed in a study by Lawes et al. [15] In a study by Lindsberg and Roine, 2/3rd of the ischemic stroke patients had diabetes mellitus. [16] Hemiplegia was the most common clinical presentation among the patients in the present study. 35% of patients presented with right sided hemiplegia and 28% of patients presented with left sided hemiplegia, 15% of patients presented with aphasia, 13.5% of patients presented with cranial nerve palsy, 7.5% of patients presented with monoplegia, and 1.5% of patients presented with quadriplegia. In a study by Malik et al, 41% had right hemiplegia, 35% had left, aphasia was seen in 18% of the patients which corroborated present study. The mean intima media thickness was 1.38mm among the patients with carotid plaque, with maximum being 1.8 mm. Among the stroke patients without plaque, the mean intima media thickness was 1.07mm with maximum being 1.2mm. In a similar study by Sahoo et al, the mean IMT in patients with stroke was 1.08 mm. [17] Multiple plaque was seen in 47.55% of patients with C.V.A and study by Malik R et al, show multiple plaque in 44% of patients with stroke which was in accordance to present study. A similar result was observed in yet another study by Bhagat et al. [18] In study by Muhammad-al-Najim et al, 63% of patients with stroke had evidence of plaque in extra cranial carotid arteries. [19] The type I and type II plaques were the most common ones in the present study accounting to almost 64% of the cases, while in the study by Malik et al, these two types accounted for 56%. Most of the patients had 70% stenosis was seen in 12% of the cases, which was also most often caused by type I plaque. Similar results were found in a study by Malik et al. None of the patients in present study has complete occlusion. In a study by Fernandez et al, most of the patients had between 60-70% stenosis. The relationship of risk factors for stroke with carotid artery stenosis and/or carotid intima-media thickening especially if multiple, makes carotid doppler absolutely essential [20]. Thus, patients between 60 to 70 years of age and with smoking history, hypertension, hyperlipidemia and previous history of cerebrovascular accident has increased risk of developing carotid artery stenosis.

CONCLUSION:

The color doppler sonography is a useful tool in evaluation of extra cranial course of carotid vessels. It is a non-invasive, cheap, faster modality without any side effects. It helps to assess the location of plaque, multiple sites of plaque, plaque morphology, its complications and determine % stenosis in extra cranial carotid arteries, and as per observations 59% of patients with CVA were above age 60 years. 82% of patients with atheromatous plaque had CVA, the percent of population with associated risk factors. The mean intima media thickness was more than 1.05mm in patients with CVA, and most of them had type 1 and type 2 plaques. Therefore, color doppler assessment of extra cranial carotid arteries could be used in predicting CVA in patients with carotid atheromatous disease. Hence, carotid Doppler investigation plays an important role in prevention of stroke mainly in patients with risk factors like hypertension, smoking and hyperlipidemia although they are asymptomatic. Early detection of plaque helps in treating patients with either medical or surgical management for stroke and TIA in south Indian population.

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CONFLICTS OF INTEREST: None.

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