Impact of Atherosclerotic Carotid Artery Disease in Patients of Stroke and Recent TIA Using Colour Doppler Sonography- A Prospective Study in Eastern India

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ABSTRACT

Introduction: Cerebral ischemic stroke is life-threatening and debilitating neurological disease, it is the second leading cause of death in the world. Previous many studies emphasise on significant importance of atherosclerotic carotid diseases on development of ischemic stroke.

Material and Methods: This prospective non randomised clinical study done in a teaching hospital in Eastern India from December 2016 to February 2018.95 indoor patients of Ischemic CVA and symptomatic or recent history (<3months) of TIA were selected based on inclusion and exclusion criteria. Other established risk factors like hypertension, diabetes mellitus, smoking, age, family history etc documented properly.

Result: Age variation, Sex variation, Distribution of risk factors, risk of Major stroke in first 3 months after TIA (ABCD2 score) were calculated. Collected data were analyzed and presented in the form of tables, figures, graphs and diagrams wherever necessary. Frequency distribution graphical representations done accordingly.

In our study we had total 95 patients of which 61 patients had CVA and 34 patients had recent TIA. Male population between 55 to 65 years were found to have highest incidence of stroke. 23(24%) found to have significant stenosis of >60% of which 13 (58%) had cortical infarct.70 patients (74%) found to have atherosclerotic plaque most commonly (42%) found in Common Carotid bifurcation.

Conclusion: Ischaemic CVA being one of the leading causes of mortality and morbidity specially in the elderly have modifiable and non modifiable risk factors. Of them carotid atherosclerotic plaque is a predictable correlation in both TIA and CVA patients. Color doppler study being an available, non-invasive and cost-effective tool to evaluate visible carotid disease can be an extremely useful modality to describe and predict the causality of CVA and outline a treatment guideline in a large number of patients with TIA or stroke.

Keywords: Athersoclerotic Plaque, Color Doppler Sonography, Cerebrovascular Accident (CVA), Transient Ischemic Attack (TIA), Carotid, Peak Systolic Velocity (PSV), PSV Ratio, Stenosis, Stroke, Perfusion CT

INTRODUCTION

Cerebral ischemic stroke is a third leading cause of mortality worldwide only after malignancy and cardio vascular disease. At least 20% or more patients of TIA progress to ischaemic CVA.[1] The risk of progression to major stroke in a patient of TIA is highest in first 3 months (ABCD[2] score).[2] Major risk factors are diabetes, hypertension, smoking, dyslipidaemia, age, positive family history.[3]

Color Doppler sonography is an important tool to evaluate the neck vessels. Duplex sonography combining high-resolution imaging and Doppler spectrum analysis has proved to be a noninvasive and cost-effective means to assess carotid disease in comparison to Angiography.[4] Timely end arterectomy can prevent major stroke in patients with significant stenosis. Carotid angiography is the gold standard for detecting the severity of carotid stenosis, but it is an invasive and expensive procedure and associated with contrast related complications. In recent development, Magnetic resonance angiography may give similar or better results, especially for flow quantification but it is expensive. Apart from the degree of stenosis, it can characterize plaque and identify plaques with higher risk of embolization. High-resolution ultrasound can detect intraplaque hemorrhage, a precursor for plaque ulceration.[5,6] In this prospective study, our objective is to find out the distribution of atherosclerotic carotid artery disease in patients with recent TIA or ischemic CVA.

MATERIAL AND METHODS

We have conducted a prospective non randomised clinical study in a tertiary care hospital in Eastern India from December 2016 to February 2018 on 95 indoor patients of Ischaemic CVA and recent TIA of less 3 months duration. The aims and objectives was to find out the impact of atherosclerotic carotid artery disease in ischemic stroke and TIA. Associated risk factors like diabetes, hypertension, smoking, age, dyslipidaemia and positive family history were

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also taken into consideration and prevalence were measured. Congenital and acquired Hypercoagulability disorders, Vasculitis, Non inflammatory vascular diseases, primary and metastatic brain tumours, vertebro-basilar insufficiency, drug induced vasculopathy etc.), pts with Cardiac Diseases and pts. With age<40 yrs were excluded from study. All patients were examined clinically with detailed history and physical examinations during the study with informed consent. These Patients had perfusion CT scan of Brain to determine the vascular territory of Iscahemic Stroke and cotical / subcortical distribution.

Patients undergone duplex doppler study of carotid using Samsung ACCUVIX XG[R] machine in the department of Radiology to determine site, distribution, echogenicity and consistency of atheromatous plaque, CIMT, degree of stenosis, ICA/CCA PSV ratio.

STATISTICAL ANALYSIS

All data were collected prospectively, analysed and presented into frequency distribution charts and figures wherever applicable using relevant statistical methods to calculate the age variation, sex variation, distribution of risk factors, risk of major stroke in first 3 months after TIA ABCD[2] score.

RESULT

In total 95 patients, 61 had CVA and 34 had recent TIA. Highest incidence of stroke was found in male population of 55-65 years (Figure 1). Out of 23 patients with significant stenosis Figure 7, 13 had cortical infarct (Figure 2). Out of 70 patients with atherosclerotic plaque, 17 had plaque in right carotid, 14 in left carotid artery and rests bilateral (Figure 3). Most common site of plaque was bifurcation of CCA (Figure 4). 23 had calcified and 30 had strongly echogenic plaque (Figure 5). 74 Patients had hypertension, 40 had DM, 61 had dyslipidemia, 46 were smoker and 20 patients had positive documented family history (Figure 7).

DISCUSSION

It has been found that most cases of stroke (30-60%) are related to atherosclerotic carotid artery disease.[7] Carotid duplex Doppler study has important diagnostic and prognostic value in evaluation and management of stroke patients.[8] We have conducted a prospective clinical study on 95 patients with stroke or recent TIA to evaluate the extracranial carotid arterial system by duplex Doppler method to establish a correlation.

Bowman TS et al found that stroke increases after 60 years of age.[9] The highest number of stroke patients in our study were found in the age group of 55-65 years which was 40% (39/95), followed by the age group between 65 and 75 years

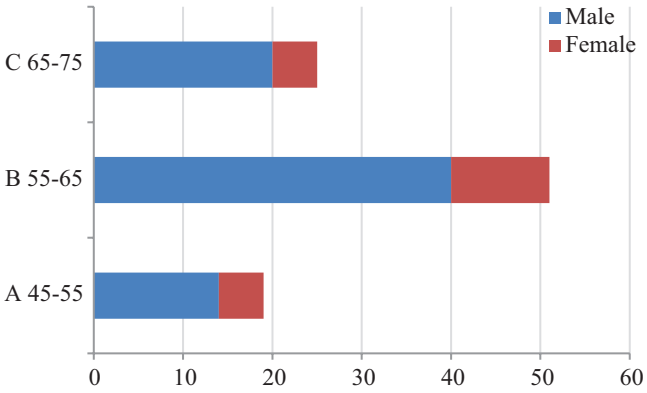

Figure-1: Incidence of stroke

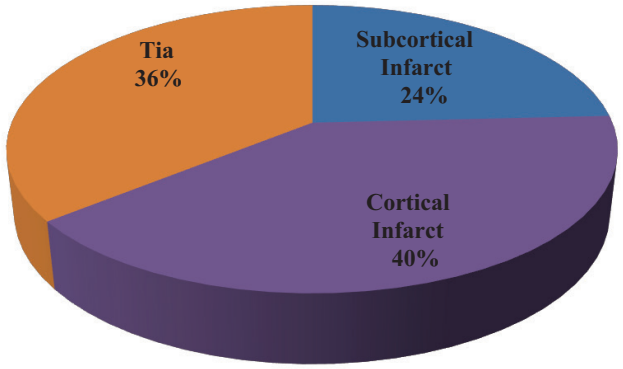

Figure-2: Stenosis percentage

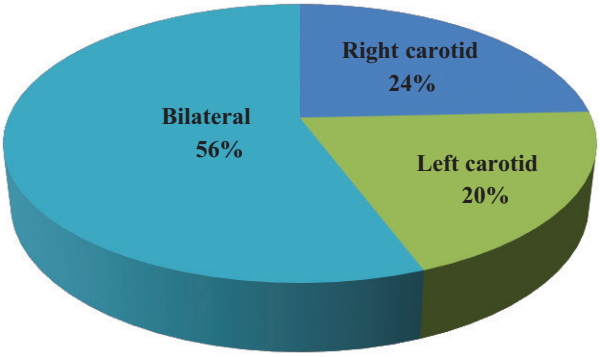

Figure-3: Plaque location

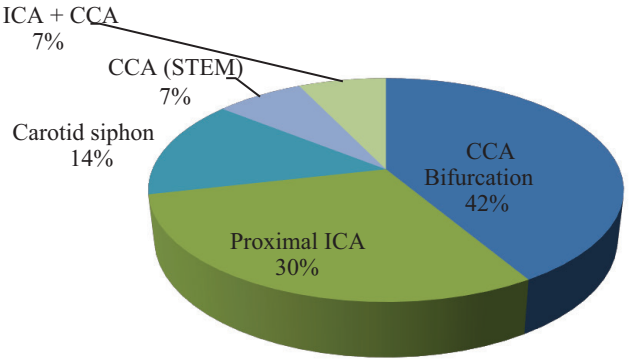

Figure-4: Plaque location

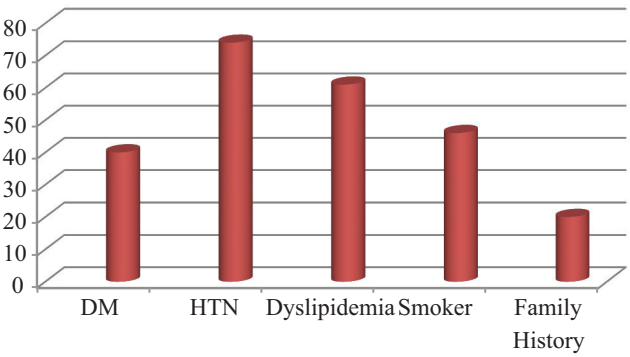

Figure-5: Plaque echogenicity

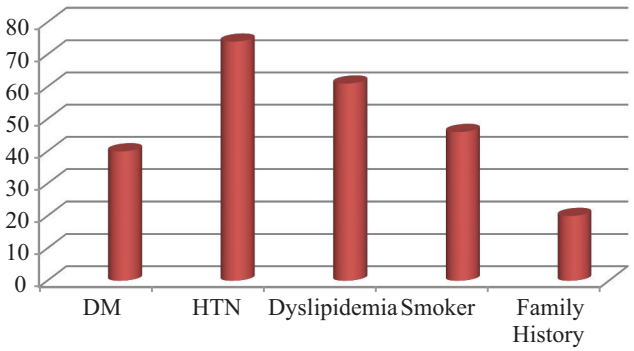

Figure-6: Associated morbidity

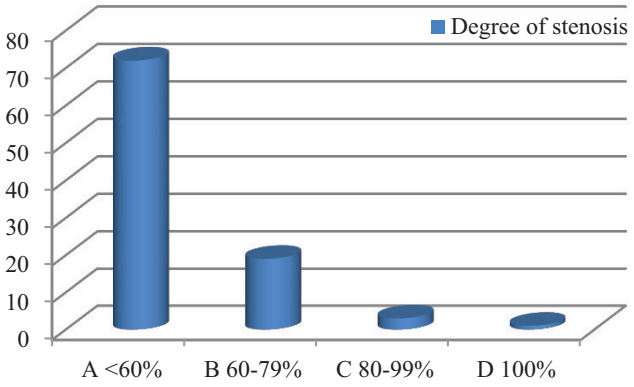

Figure-7: Degree of stenosis

which was 28% (26/95). Iemolo *et al*. showed that only 2.5% of stroke victims were females. In our study, 78% of the patients (74/95) were males.

Lawes *et al*. Studied, out of 188, 000 hypertensive patients 6800 had stroke eventually.[10] In our study, of the 95 patients, 74 (78%) patients were hypertensive out of which 22 (29%) had significant stenosis. Haq et al found that there is a significant correlation between hypertension and PSV.[25] Smoking is an established risk factor for stroke. In an earlier study 22% of stroke was attributable to smoking.[11] Our study found 45 (48%) with a history of smoking. Of them, 14 (32%) had significant stenosis. Diabetes mellitus is another risk factor for atherosclerosis. A study conducted by Lindsberg and Roine found that 66% of all ischemic stroke had diabetes mellitus.[12] In this study, 40 (42%) patients had diabetes mellitus of which 15 (36%) had significant stenosis. Schulz et al. studied that 23% of stroke patients had a positive family history.[13] In our study, family history of stroke was present in 20 (21%) patients of which 7 (35%) had significant stenosis. Mary Grace1 et al observed that 43% of stroke patients had dyslipidaemia. In this study 60 patients (64%) had dyslipidaemia. Cardiac diseases were ruled out in our patient since they interfere in the velocity profiles of the carotid system.

PSV ratio is the most accurate predictor of clinically significant ICA stenosis amongst different Doppler parameters as it compensates for both the patient to patient physiological variability and instrument variability. Endarterectomy found to be significantly better than medical treatment in patients with 60% or 70% ICA stenosis, whether symptomatic, or asymptomatic as per North American Symptomatic Carotid Endarterectomy Trial and European Carotid Endarterectomy Trial. Also the endarterectomy trials established 60–70% diameter reduction as clinically significant levels of ICA stenosis.[14]

It has been suggested that PSV ratio of ICA/CCA is more accurate than PSV. PSV ratio 1.5 suggests 50% or greater stenosis. PSV ratio of >1.8 is an indicator of 60% or greater and a ratio of 3.7 is an indicator of more than 80% diameter stenosis.[15] Using this criteria, 23 patients have significant stenosis of which, 16 (70%) had on right side and 7 (30%) had on left side. On the right side, 14 patients had 60–79% stenosis and 2 patients had 80–99% stenosis. On the left side, 5 patients had 60–79% stenosis and 1 patient had 80-99% stenosis.

Complete carotid occlusion in the duplex imaging is suggested by the absence of Doppler flow signals or weak Doppler signals, absence of arterial pulsation, lumen filled with echogenic material and subnormal vessel size.[16] In this study 1 patient had complete occlusion on the left. PSV is artificially elevated in the presence of severely stenosed contralateral ICA because the effect was greatest in bilateral severe stenosis. Care should be taken while assessment of the degree of ICA stenosis using PSV alone.[17]

Schulte-Altedorneburg *et al*. found steno occlusive carotid lesion in 64% of patients confirmed by autopsy.[18] In this study, 70 (74%) patients had plaques in the carotid artery of which 17 on right side, 14 on the left and 39 bilateral. atherosclerotic plaque is commonly located at carotid bifurcation distal to the origin of the carotid arteries.[19] In our study, plaque most commonly (42%) found at carotid bifurcation (29 patients). 21 patients had plaque in the proximal ICA, 12 in Carotid siphon, 5 in both CCA and ICA, 3 in stem of CCA. 23 patients had calcified plaques, 30 patients with strongly echogenic plaque, 12 had moderate echogenic plaque, and 5 patients showed low echogenic plaque. Soft plaques and heterogeneous plaques more positively correlate with symptoms than with any degree of stenosis and are related to adverse neurological events. Patients with intraplaque haemorrhages, associated with frank ulceration, rapidly progress to severe luminal narrowing.[20] Intraplaque hemorrhage was found in 1 out of the 5 patients with low echogenic plaque. A very old thrombus is markedly echogenic and a fresh thrombus is usually anechoic.[7] We had 30 hyperechogenic plaques mostly very old thrombi.

Calcification in plaque occurs in the areas of hemorrhage and necrosis and generate strong reflections and distal acoustic shadows. Heterogeneous, diffuse, or focal plaques increase the risk of embolization or rapid progression.[21]

We found 23 calcified plaques in our study. Duplex ultrasound criteria of PSV of 230 cm/s or more and end diastolic velocity of 70 cm/s or more, or an ICA: CCA ratio of 3.2 or more reliably predict carotid artery stenosis of 70% or more.[22] In our study, we had 3 patients having PSV of ICA >230 cm/s with more than 80% stenosis. 3 patients had ICA/CCA ratio >3.2. One patient had bilateral complete occlusion where ICA/CCA ratio could not be assessed.

Von Jessen and Sillesen found that duplex scanning in 17% of patients of TIA had stenosis of 50%.[23] We came across 23 patients with significant (>60%) stenosis of which 10 (43%) patients had hemiplegia, 11 (48%) patients had hemiparesis, and 2(9%) patient had TIA.

Seth et al. found that patients with >40% stenosis had a cortical infarct than subcortical. Patients with subcortical infarcts had either normal extracranial carotids or had <40% stenosis.[24] In this study, out of 23 patients with significant stenosis (>60%), 13 (58%) patients had cortical infarct, 2 (8%) patient had subcortical infarct, and 8 (36%) patients showed normal study. Of 72 patients with <60% carotid stenosis, 25 (35%) were found to have cortical infarct, 21 (30%) had subcortical infarct, and 26 (38%) showed normal findings on CT scan study. No histopathological correlation was done in our study because surgery was not done in any of the above patients.

CONCLUSION

From our study we can justify the correlation between the role of carotid Doppler study in assessment of atherosclerotic plaque and risk of progression to Ischaemic CVA.

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