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Original Research Paper

Radio-Diagnosis

ASSESSMENT OF CAROTID INTIMA-MEDIA THICKNESS IN ISCHEMIC STROKE: STUDY AT A CENTRAL INDIAN TERTIARY CARE INSTITUTE.

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ABSTRACT Stroke includes one of the leading causes of morbidity and mortality globally. Carotid intima-media thickness (CIMT) is correlated with most of the major cardiovascular risk factors. IMT was correlates with CAD and enhances the predictive power for stroke and Cardiovascular events. We determined the presence of significant CIMT in patients with acute ischemic stroke of anterior circulation and matched it with controls. Sixty-six patients with ischemic stroke diagnosed by CT brain and fifty controls matched by age, gender, diabetes, hypertension and dyslipidemia were taken. Subjects were scanned with Doppler studies (Alpinion machine) using a high frequency (10-12 MHz) linear probe in B-mode. CIMT was measured, presence of plaques noted. The mean age in the patient group was 56.4 years reflecting a relatively younger population with a male predominated (80.3%) pattern. The average CIMT in the patient group was 0.796 mm while it was 0.546 mm in the control group (P <0.0001). Patients with carotid plaque showed a significant IMT (0.98 +- 0.21) when compared to patients without plaques (0.68 +- 0.20) (P <0.001). CIMT was significantly related with advancing age (P < 0.05). CIMT showed independent association with plaques.

KEYWORDS : Carotid intima media thickness, Ischaemia, Carotid Doppler, Carotid plaque, Diabetes, Hypertension, Smoking, Dyslipidemia

INTRODUCTION

Stroke is one of the leading causes of morbidity and mortality in India, with majority being ischaemic and involving the anterior circulation. Among various imaging modalities carotid Doppler ultrasonography is an excellent non-invasive, safe, reproducible, non-expensive, readily available tool to assess the status of extra cranial carotid vasculature. In primary prevention the carotid ultrasound is used not only to diagnose the carotid disease, but also to estimate the risk of atherosclerosis progression in general.[1] The incidence of stroke increases with increasing age. The European Guidelines on cardiovascular disease prevention [2] suggest that imaging methods for atherosclerotic burden are relevant especially in individuals with moderate risk to further distinguish their cardiovascular risk. In most of the ischemic strokes the underlying pathophysiology is atherosclerosis. This site of bifurcation is particularly vulnerable to plaque formation [3] due to flow dynamics. The risk factors for stroke can be modifiable or non-modifiable. The modifiable risk factors include diabetes, hypertension, smoking, and hyperlipidemia.[4]The European Guidelines on cardiovascular disease prevention [5] suggest that imaging methods for atherosclerotic burden are relevant especially in individuals with moderate risk to further distinguish their cardiovascular risk. For instance, patients, whose cardiovascular risk is intermediary according to the Score tables, could be reclassified to a higher risk category based on a positive result, and appropriate medical treatment would be initiated. In the absence of an atherosclerotic plaque the intima-media thickness (IMT) is usually used for risk assessment. The carotid intima-media thickness (CIMT) is emerging as an independent predictor of neurological as well as cardiovascular events.

MATERIALS AND METHODS

Study Area And Target Population

- The study was carried out in Department of Radiodiagnosis, Netaji Subhash Chandra Bose Medical College & Hospital, Jabalpur (M.P.) from June 2023 to October 2023.
- All patients presenting with history of sudden onset of neurological illness subjected to CT brain, among them those who suffered ischaemic stroke in the anterior circulation, and consented to participate; matched controls were taken.

Methods

1. CT-brain to confirm ischaemia as the cause of stroke, involvement of anterior circulation, site affected.
2. Acquired detailed history, noted risk factors involved - age, gender, hypertension, diabetes mellitus, dyslipidemia, smoking, previous stroke/ TIA.
3. Recorded values of Laboratory investigations -blood sugar, serum total cholesterol.
4. Performed Carotid Doppler Ultrasonography- B mode, 7 – 10 MHz probe
5. IMT and plaque assessed.

Technique (carotid Intima Media Thickness)

IMT is defined as a double-line pattern visualised by echo 2D on both walls of the common carotid artery (CCA) in a longitudinal view. Two parallel lines (leading edges of two anatomical boundaries) form it: lumen-intima and media adventitia interfaces. IMT is measured as the distance between lumen-intima (yellow line) and media-adventitia (pink line) interfaces.

Measurement-

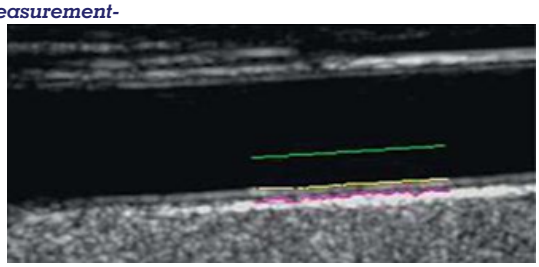

Figure 1 Ultrasonographic image showing Intima-media thickness.

- Inclusion of carotid bifurcation in the image plane serving as a landmark to provide accurate serial measurements; The point of measurement was taken 1 cm proximal to the carotid bulb at the site of maximal thickness.
- IMT measurement along a segment of the artery free of atherosclerotic plaque with clearly defined lumen-intima and media-adventitia interfaces
- 10-mm-in-length straight arterial segment is required;
- IMT measured in triplicate;
- The far wall of the common carotid artery is preferred.
- The presence and number of plaques was quantified in both the carotids. A plaque was defined as a focal thickening of 50% greater *[Figure 1]* than the surrounding area or greater than 1.5 mm.

Study Design
Case-control, hospital-based study.

Inclusion Criteria
- Patients who suffered ischaemic stroke in the anterior circulation of the brain as confirmed by CT scan of brain, consenting to participate in the study.

Exclusion Criteria
- Patients who suffered stroke due to intracerebral hemorrhage.
- Patients who suffered stroke due to head injury.
- Presence of Space Occupying Lesion in the brain.
- Involvement of posterior circulation.

Data Collection Method
- All the records were recorded by using structured schedule (Patient Proforma and Carotid Doppler Report) and entered in Microsoft Excel Sheet.

Ethical Issues
- This study was conducted after getting informed consent from the patients in their local language.
- Approval received from institutional ethics committee.

Statistical Analysis
Data was compiled using Microsoft Excel and analysed using SPSS software version 20. Categorical variables were expressed as frequency and percentage, whereas continuous variables were expressed as mean. Student t-test was employed for case – control analysis. The CIMT was compared between the cases and controls using the Mann-Whitney test. Univariate analysis was done to determine the relationship of individual risk factors. IMT was separately calculated in the groups of patients with and without the risk factor and then compared using Mann-Whitney test. P value < 0.05 was considered statistically significant.

RESULTS

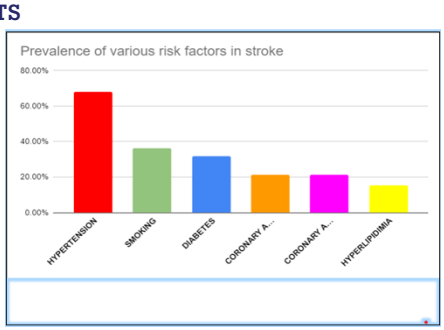

Table 1: Baseline Characteristics of patient and controls		
Parameter	N = 66%	N = 50
• Number of males	53(80.3)	29(58)
• Number of females	13(19.7)	21(42)
• Mean age (yrs)	56.4(26-85)	60.5(47-78)
• Number with diabetes	21(31.8)	10(20)
• Number with hypertension	45(68.2)	8(16)
• Number of smokers	24(36.4)	10(20)
• Previous h/o CAD	14(21.2)	4(8)
• Number with dyslipidemia	10(15.2)	3(6)

Table 2: IMT distribution among patients and controls			
IMT in mm	Cases	Controls	p value
Overall IMT	*0.796 +- 0.20*	*0.546 +- 0.093*	*0.0001*
IMT in patients with diabetes	0.814 +- 0.19 n = 11	0.61+- 0.08 n = 12	0.0163
IMT in patients with hypertension	0.86 +-0.26 n = 10	0.62 +- 0.11 n = 7	0.012
IMT in smokers	0.87 +- 0.11 n = 20	0.58 +- 0.07 n = 11	0.0001
IMT in patients with CAD	0.89 +- 0.12 n = 3	0.658 +- 0.05 n = 4	0.469
IMT in patients with dyslipidemia	0.86 +- 0.28 n = 10	0.6 n = 3	0.016

Table 3: Relation of IMT to smoking, diabetes, and hypertension among patients and controls			
Group	Cases n=66	Controls n=50	p value
• Smokers	0.87 +- 0.11	0.58 +- 0.07	0.0001
• Nonsmokers	0.76 +- 0.11	0.595 +- 0.10	0.0001
• Diabetics	0.814 +- 0.19	0.61+- 0.08	0.0179
• Nondiabetics	0.775 +- 0.19	0.585 +- 0.1	0.001
• Hypertensives	0.86 +- 0.26	0.62 +- 0.11	0.013
• Normotensives	0.762 +- 0.172	0.59 +- 0.096	0.0001

Table 4: Distribution of plaques among patients and controls		
Patient groups having plaques	Cases (n=66) (%)	Controls (n=50) (%)
• Overall number	42/66 (63.6)	9/50 (18)
• Diabetic patients	9/21 (42.8)	2/10 (20)
• Hypertensive patients	18/45 (40)	1/8 (12.5)
• Smokers	16/24 (66.6)	1/10 (10)

In the duration of the study, 66 patients were included, presenting with (acute) ischaemic stroke of the anterior circulation. *Age-* Carotid Doppler ultrasound was used to study the status of Carotid arteries.32 out of 66 (48.5%) subjects belonged to age – group 55-65 years.18 out of 66 (27%) were from 25-55 years age group, representing relatively younger population. Age of the youngest and eldest study subject were 26 and 85 years respectively. The study group comprised of 53 (80.3%) males and 13 (19.7%) females, thus showing a male predominance. 33 (50%) subjects had involvement of the left side while 32(48.5%) of the right side and 1 (1.5%) had bilateral involvement.

Mean CIMT of 0.796 +- 0.20 was noted in patient group, while 0.546 +- 0.093 in the controls (P <0.0001). This was also reflected in the risk factor analysis *[Table 2]*. The IMT was significantly increased among the cases compared to controls *[Table 3]*. Plaque was found in 42(63.6%) patients with stroke when compared to 9(18%) in controls (P = 0.067). Carotid bulb was the most common site of the plaque with 20 (47.6%) plaque seen on left bulb and 19 (45.2%) in right side bulb. Internal Carotid Artery was the second most common site in the study group with 13 (30.9%) in the Right ICA and 7 (16.6%) in the left ICA. Majority of the plaques were hyperechoic 17 (40.7%), Calcified 13 (30.9%), Hypoechoic 11 (26.3%) and mixed echogenecity 3 (7%).

The number of plaques was higher among patients: diabetes (42.8%), hypertension (40%), and smoking (66.6%). Presence of plaques in controls: (20%) diabetic, (12.5%) hypertensive, and (10%) smokers *[Table 4]*. The difference between the two groups was significant in regard to hypertension (P = 0.019). (66.6%) patients had concomitant plaque and significant IMT. Patients with carotid plaque had IMT (0.98 +- 0.21) when compared to patients without plaques (0.68 +- 0.20) (P <0.001)

which was significantly increased. Of the 66 patients, 12 patients had an IMT above 0.9 mm while 54 had an IMT below this cut-off value. Among the various risk factors; 45 (68.2%) subjects had hypertension, 24 (36.4%) had history of smoking, 21 (32%) had diabetes, suggesting that the three most prevalent risk factors in the study group included hypertension, smoking and diabetes.

DISCUSSION

Carotid Intima media thickness, being an independent predictor of coronary artery disease. 38 (57.5%) subjects showed significant IMT of greater than 0.9 mm, The mean IMT in our study was 0.792 mm, which is similar to the values reported in other Indian studies [6] but lower than the reported value from the developed countries. [7,8] Mean IMT was 1.22 mm among patients with plaque. 28 (66.6%) patients had concomitant plaque and significant IMT.

IMT was significantly correlated with hypertension, diabetes (p value <0.05). In the study by **Pruissen et al.** [8] the mean IMT was 1.08 mm and the age of the patient population was 63 years. They have also found a significant difference in the IMT value between patients with large vessel disease and small vessel disease. **Onbas et al** [9] reported increased mean IMT in the artery ipsilateral to the brain infarct when compared to the contralateral artery. 14 (21.2%),10 (15%) and 9 (13.6%) had artery disease, dyslipidemia and previous stroke/ Transient Ischaemic Attack respectively. Studies suggest that higher total and low-density lipoproteins (LDL) cholesterol levels are associated with an increased risk of ischaemic stroke. [10]

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