Original Article

Common Carotid Artery Intima-Media Thickness in Patients with Ischaemic and Haemorrhagic Stroke

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ABSTRACT

Objective: An increase in the intima-media thickness of the common carotid after (CCA-IMT) is generally considered as an early marker of atherosclerosis and has been associated with a higher risk of stroke and myocardial infarction.

Study Design: Cross-sectional Study

Place and Duration Study: This study was conducted in Department of Medicine at Karachi Medical and Dental College and Abbasi Shaheed Hospital from June 2011 to December 2011.

Materials and Methods: We determined cross-sectionally the diagnostic ability of CCA-IMT to distinguish between brain infarction and intracerebral haemorrhage. Total 150 patients aged >40 years of both sexes with hemorrhagic and ischaemic stroke were included, while patients with history of endartectomy, head injury, space occupying lesion and on anticoagulation were excluded. All information was recorded on proforma. Thickness of common carotid artery of ≥0.5 mm was considered significant. Analysis was performed through SPSS-10.0. Frequencies and percentages were computed to present categorical variables including stroke type and wall thickness of common carotid artery in terms of (≤ 0.5 mm or > 0.5 mm). Chi-square test was applied to see association of increased CCA-IMT with stroke type. Statistical significance was taken at $p < 0.05$. Among 150 patients of stroke, 13 (8.7%) patients of left and 8 (5.3%) patients of right had increased CCA-IMT. The CCA-IMT was significantly higher in patients with ischemic stroke patients (p=0.001).

Results: The present results demonstrate the possible predictive power of non-invasive measure meant of CCA-IMT with respect to brain infarction versus intracerebral hemorrhage and deserve further investigation

Conclusion: Despite high prevalence of hypertension in patients with haemorrhagic stroke, increased CCA-IMT which is considered as an early marker of atherosclerosis is strongly related to ischaemic stroke than haemorrhagic stroke.

Key Words: Ischaemic stroke, haemorrhagic stroke, carotid arteries, intima-media thickness

INTRODUCTION

Common carotid artery intima-media thickness (CCA-IMT) represents marker for subclinical atherosclerosis and an opportunity for early detection of pre-symptomatic individuals[1]. CCA-IMT has been associated with all modifiable (e.g. hypertension, high blood cholesterol, smoking, diabetes) and no-modifiable risk factors (like age, gender), with all ischaemic stroke subtypes[1, 2] with occurrence of future carotid plaque[1, 3] and with a high risk of incidental myocardial infarction, stroke and vascular death[1, 4]. Therapeutic interventions with anti-hypertensives[1,5] lipid lowering agents[1,6] as well as multifactorial interventions in diabetics[1,7] can slow the progression of or even reduce CCA-IMT[1]. CCA-IMT has been recognized recently as a surrogate marker by which evaluation of therapeutic interventions in atherosclerotic disease[1].

Prospective population based studies in Europe and the United States have documented that CCA-IMT are positively associated with the subsequent incidence of stroke[8].

Stroke is the third leading cause of mortality worldwide. Both ischaemic and haemorrhagic stroke is a common and a devastating disorder. More than 80% deaths are due to stroke in middle income countries[9, 10]. The annual incidence of stroke in developed countries is about 2/1000 population but the exact figure depends on the age structure of the population as the incidence rises steeply with increasing age[11]. According to world health organization (WHO) estimates for the year 2020, stroke will remain the second leading cause of death along with ischaemic heart disease (IHD) both in developing and the developed world[11, 12]. The overall burden of stroke will be greater in developing countries than in the developed world mainly due to aging of population and transition to burden of chronic disease. The hospital based study conducted in Pakistan revealed 31-40% cases of stroke due to cerebral haemorrhage and 60-69% due to ischaemia[11, 13].

MATERIALS AND METHODS

Cases: We studied a consecutive series of 150 patients who were admitted to the department of medicine, Abbasi Shaheed hospital. All patients of more than 40 years of age of both sexes presenting with complete stroke (hemorrhage or infarction) were enrolled in the study. All patients were registered in a pre-tested questionnaire. Details of this study and inclusion criteria have been published elsewhere. Complete history including personal and demographic information including age, gender, past medical history and personal habits like smoking etc. were recorded on the questionaire. An internist examined all patients within the first 3 hours of admission. Patients with history of endartectomy, head injury, space occupying lesion resulting in stroke, patients on anticoagulation resulting in stroke were excluded from the study. All patients were of Asian origin. An initial brain CT scan on admission, a twelve lead electrocardiography and doppler ultrasonography of carotid arteries were performed in all patients on admission. Type of stroke was find out by TOSHIBA XPRESS GX computed tomographic (CT) scanner. The diagnosis of brain infarction was made when hypodense lesions were identified on admission and that of intracerebral hemorrhage was made when hyperdense lesions were identified on admission CT scan. A neuroradiologist blinded to the clinical details of the study population, evaluated the CT films. Risk factors such as hypertension, diabetes mellitus, and hyperlipidaemia were recorded. The definitions of hypertension diabetes have also been published elsewhere.

Carotid Ultrasonography Studies: Ultrasound Doppler was done by an experienced sonologist on TOSHIBA ECOCEE with probe frequency of 10 mhz. No preparation or premedication was required for sonographic examination. Evaluation of intima media thickness was performed on the basis of the 2004 mannheim IMT consensus. IMT was assessed with B-mode ultrasound (Toshiba ECOCEE with probe frequency of 10mhz). The patients were examined in supine position, with the head turned at 45 degrees from the site being scanned. Both carotid arteries were scanned in longitudinal projections with the focus depth adjusted to the far wall of the artery. The best images of the far wall that could be obtained were used to determine the CCA. Measurements were made on frozen images, magnified to standard size. The reference point was the beginning of the carotid bulb. Plaques were defined on the basis of the 2004 Mannheim IMT consensus as focal structures encroaching into the arterial lumen at least > 0.5 mm in the course of common carotid artery will be taken as significant[14]. Subjects were examined by experienced sonographers who were unaware of any clinical or radiological information about the study population.

Statistical Analysis: Data analysis was performed through SPSS version-10.0.

Frequencies and percentages were computed to present categorical variables including stroke type and wall thickness of common carotid artery in terms of (≤ 0.5 mm or > 0.5 mm).

Fisher's exact test was applied to compare the difference of proportions of increased wall thickness of common carotid artery between ischemic and haemorrhagic stroke patients. Statistical significance was taken at $p < 0.05$.

Relative risk (RR) was also computed through Epi-info version 6.0 to analyze the association of sex and stroke types with increased wall thickness of common carotid artery.

RESULTS

The studied population fulfilling all the above-mentioned inclusion criteria consisted of 150 first-ever stroke patients (mean age 59.54 ± 12.1 years range= 41 to 65 years). Ischaemic stroke were diagnosed in 89 patients (59.33%) while 61 patients (40.66%) presented with hemorrhagic stroke. Both ischaemic and hemorrhagic stroke patients had a higher prevalence of hypertension (53.9 and 75.4%) respectively. Male predominance was observed in our study as there were 83 (55.3%) male and 67 (44.7%) female patients with M: F = 1.23: 1. Among 150 patients of cerebrovascular accident, 13 (8.7%) had an increased left wall thickness of common carotid artery (> 0.5 mm) out of which 12 (13.5%) had ischaemic stroke and one (1.6%) had haemorrhagic stroke (table-1) while 137 (91.3%) had the normal measurement (≤ 0.5 mm). An increased right wall thickness of common carotid artery > 0.5 mm) was found in 8 (5.3%) patients and all 8 (9%) were of ischaemic stroke none of them had hemorrhagic stroke (table-1) while 142 (94.7%) had normal measurement. The proportion of an increased left wall thickness of common carotid artery (> 0.5 mm) in ischemic stroke patients was significantly higher than haemorrhagic stroke patients (13.5% vs. 1.6%, $p = 0.015$, RR = 8.22). The same pattern was observed in case of right wall thickness of common carotid artery (i.e. 9% vs. 0%, $p = 0.001$). This data revealed a significant association of increased wall thickness of common carotid artery. Data revealed significant association of wall thickness of common carotid artery with cerebrovascular accident $p < 0.05$.

Table No.1: Association of Wall Thickness of the Left Common Carotid Artery with Type of Stroke

Stroke Type	Right CCA-IMT (>0.5 mm)	Left CCA-IMT (>0.5 mm)
Ischaemic	8 (9%)	12 (13.5%)
Haemorrhagic	0 (0%)	1 (1.6%)

Male sex (58.4%), hypertension (53.93%), diabetes mellitus (31.46%), smoking (24.71%) followed by

hyperlipidemia (22.47%) and coronary artery disease (14.60%) were seen in patients presenting with ischaemic stroke. Patients having ischaemic stroke, 8.9% had atrial fibrillation, 4.4% had valvular heart disease and none of them had a history of taking oral contraceptive pills.

Patients presenting with intracranial haemorrhage, 50.81% were males. Hypertension (75.4%) was considered to be the major risk factor in intracranial hemorrhage. Hypertension was followed by smoking (14.75%) and diabetes mellitus (13.11%). Coronary artery disease was seen in only 4.91% and 3.27% each had valvular heart disease and history of taking oral contraceptive pills. Only 1.63% had atrial fibrillation. On multivariate logistic regression analysis there was a statistically significant relationship between the independent variables (age, hypertension and valvular heart disease and stroke ($p < 0.05$) (table-2).

Table No.2: Likelihood Ratio Tests

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	91.494a	.000	0	
Gender	92.117	.623	1	0.430
Age group	95.876	4.382	1	0.036
CCA-IMT	95.050	3.556	1	0.059
HTN	97.955	6.461	1	0.011
DM	92.000	.506	1	0.477
smoking	92.147	.653	1	0.419
Hyperlipidemia	91.922	.428	1	0.513
AF	92.667	1.173	1	0.279
IHD	94.408	2.914	1	0.088
VHD	96.136	4.642	1	0.031
Obesity	93.381	1.887	1	0.169
Ocp	92.899	1.405	1	0.236

There was a statistically significant relationship between the independent variables (age group, hypertension and valvular heart disese) and the dependent variable ($p < 0.05$).

DISCUSSION

In the present study we found that CCA-IMT is an important factor which is able to discriminate ischaemic stroke from intracranial hemorrhage. It has been shown that CCA-IMT is strongly associated with prevalent stroke[15] and stroke incidence[16], whereas internal carotid artery intima media thickness (ICA-IMT) and plaque are directly related to the prevalence of ischaemic heart disease[15] as well as the prediction of myocardial infarction[17]. Similarly it was reported by Tsivgoulis et al that increased CCA-IMT values were an independent risk factor favoring lacunar infarction over intracranial haemorrhage[18]. The appearance of silent cerebral infarcts in the basal ganglia has been related to the progression of atherosclerosis manifested in the carotid and coronary arteries[19]. Furthermore, increase CCA-IMT values have shown strong and consistent associations with white matter hyper intensities and leukoaraiosis[17]. Nagai et al after comparing CCA-IMT and plaque score for the risk assessment of different stroke subtypes, have reported that CCA-IMT has higher in patients with large artery atherosclerotic stroke and lacunar infarcts than in controls but similar between intracranial hemorrhage and non-stroke patients[19].

Iit has been seen by Vemmos et al that CCA-IMT is an independent factor for discrimination of ischaemic stroke and intracranial haemorrhage. The risk of brain infarction versus intracranial hemorrhage increased continuously with increasing CCA-IMT[20]. This association remained after adjustment for cardiovascular risk factors[20].

In our present study, male sex, hypertension, diabetess mellitus, smoking, hyperlipidaemia and coronary artery disease were the major risk factors of ischaemic stroke. Patients with intracranial hemorrhage hypertension were the major risk factor followed by diabetes, coronary artery disease and valvular heart disease. Similarly Alam et al reported that hypertension was the most common risk factor for stroke followed by diabetes, smoking and hyperlipidaemia[11]. It has also been documented in Greece[21] that hypertension has a high prevalence among stroke patients and its major effect is observed in intracranial haemorrhage, large artery atherosclerotic stroke and lacunar stoke[20].

In our study when we compared the crebrovascular risk profile of patients with infarction and haemorrhagic stroke, it was seen that CCA-IMT was strongly associated with ischaemic stroke versus intracranial haemorrhage. Similarly it was seen by Vemmos et al that the difference in CCA-IMT between cases and controls was significant in all patients with brain infarction after adjusting for cardiovascular risk factors[19]. It was also reported that and increase in CCA-IMT was associated with ischaemic stroke, both overall and in the main subtypes[2].

The limitation of our study was that all the risk factors such as C- reactive protein[22] and blood viscosity[23] were not included. The duration and severity of smoking was not seen which are of high importance.

CONCLUSION

In conclusion, despite high prevalence of hypertension in patients with haemorrhagic stroke, increased CCA-IMT which is considered as an early marker of atherosclerosis is strongly related to ischaemic stroke than haemorrhagic stroke.

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