



Carotid Intima – Media Thickness and Plaque Can Predict The Occurrence of Ischemic Stroke

Authors

Dr Asgad A. Abdalgbar¹, Dr Hanan K. Altalhi², Dr Ali Areef Fadhlullah³

^{1,2,3}Assistant Prof, Department of Internal Medicine

Faculty of Medicine University of Omar El Mukhtar, Albayda –Libya

¹hnangk@yahoo.com ²aabdalgar@yahoo.com ³ali.aref67@yahoo.com

Telephone: 00201090064146 (Dr Ali Areef)

Abstract

B-mode ultrasound is a non-invasive method of examining the wall of the peripheral arteries And provides measures of the intima – media thickness (IMT) at various sites (common carotid artery, internal carotid artery), and plaques that may indicate early pre symptomatic diseases; therefore, estimating the intima-media thickness and plaque is important in term of evaluating patients with higher risk of cardiovascular and cerebrovascular disease.

Objectives: *We investigated whether carotid intima-media thickness and plaque measured by noninvasive B-mode Ultrasonography predicts ischemic stroke.*

Methods and Patients: *This is a case - control study of patients admitted to hospital with diagnosis of ischemic CVA ; and patients without ischemic infarction; the diagnosis of cerebral infarction was confirmed by new CT of the brain. All participants underwent the standard examination and testing as well as carotid B-Mode ultrasound (Ultrasound measurements of right and left common carotid artery IMT and internal carotid artery IMT were made) and arteries were examined for plaques 1.5 cm a above and below the flow divider.*

Result: *52 patients were included in the study, 26 patients with ischemic stroke(case subjects) and 26 patients (control subjects).Mean maximum common carotid artery IMT , internal carotid artery IMT and the prevalence of plaque were significant higher in CVA group ($P < 0.05$, $p = 0,001$, $p < 0.001$, respectively), other risk factors showed no significant difference between groups.*

Conclusion: *The present study demonstrated increased maximum IMT of the common carotid artery, internal carotid artery. And Plaque in ICA are strong predictors for ischemic stroke.*

Key word: *Stroke, Intima - media thickness (IMT), Ultrasonography, Plaque, Common carotid artery (CCA), Internal carotid artery (ICA).*

Introduction

Carotid ultrasonography has been used to obtain measurement of thickness of intima - media of the carotid artery (IMT), presences of plaques and presences of stenosis (Belcaro G, et al. 1996; Veller, MG et al .1993).

The IMT corresponds to the intima-media complex, which comprises endothelial cells, connective tissue , and smooth muscle and is the site of lipid deposition in plaque formation (Salonen JT .1993) .

In healthy adults, IMT ranges from 0.25 to 1.5 mm (Veller MG, et al.1993; Bost ML, et al. 1993). and values >1.0 mm are often regarded as abnormal (Solnen JT, et al . 1993)

IMT has been proposed as quantitative index of atherosclerosis of value in monitoring disease progression and the effects of treatment and as a surrogate end points in clinical trial (Crouse JR III , et al. 1995).

Aim of the work

We investigated whether carotid intima-media thickness and plaque measured by noninvasive B-mode Ultrasonography predicts ischemic stroke.

Patients and Methods

This is a case control study of patients admitted to the hospital with diagnosis of ischemic cerebrovascular accident (CVA) and patients without ischemic infarction admitted for other reasons to the hospital were included as control subjects. The diagnosis of cerebral infarction was confirmed by new Computer-Tomography (CT) of the brain.

The exclusion criteria subjects with history of stroke, atrial fibrillation , valvular heart disease, Cardiomyopathy, atrial Myxoma, intra cardiac thrombus, pulmonary vein thrombosis, acute coronary syndrome, infections.

All participants underwent the standard examination and testing , Carotid ultrasound to be done using a 7.5 MHz linear- array transducer, single trained physicians conducted the ultrasound and interpreted the results . On longitudinal, two - dimensional ultrasound image of the carotid artery , the anterior (near) and the posterior (far) walls of the carotid artery are displayed as two bright white lines separated by a hypoechogenic space. The distance between the leading edge of the first bright line of the far wall (lumen - intima interface) . and the leading edge of the second bright line (media - adventitia interface) indicates the intima - media thickness.

For the near wall , the distance between the trailing edge of the first bright line and the trailing edge of the second bright line at the near wall provides the best estimate of the near- wall intima- media thickness. In accordance with the Rotterdam study ultrasound protocol (Bots ML, et aL. 1991).

The ICA was defined as including the carotid bulb, identified by loss of parallel wall present in the CCA , and 10 mm segment of the ICA distal to the tip of the flow divider.

To quantify the degree of thickening of carotid artery walls, we assessed the maximum IMT.

Maximum IMT of CCA and ICA was defined as single thickest wall of near and far right or left wall of the CCA.

Plaque in the ICA wall was defined as a focal wall thickness > 1.5 mm and was categorized according to the several surface characteristic (smooth, irregular), morphology (homogenous or heterogeneous) and density (calcified ,un calcified) in case with multiple plaques only the thickest plaque was evaluated and the size or extended of the lesion was not quantified (polka JF , e t al. 1998).

Other Various Risk Factors

Blood pressure measurement in the right arm, cigarette smoking to be quantified based on daily consumption and duration of smoking, blood biochemistry analysis was made i.e., fasting blood glucose (FBS), total cholesterol, LDL, HDL, TG.

Statistical Analysis

Statistical analysis were performed by using SPSS software (version 11), difference among groups were analyzed by one way unstack ANOVA and P values 0.05 were considered significant.

Result

Characteristics of study subjects

52 patients were included in the study, 26 patients with acute ischemic infarction were

confirmed by imaging studies comprising 19 lacunar infarcts and 7 large artery occlusion infarction and 26 patients (control subjects). There is significant increase in mean age and number of diabetic patients in CVA group. Table 1: shows characteristics and variation of study population.

Table 1: Study population characteristics and variations

	CVA group	Control group	P value
Age mean ±SD	68.96 ± 15.46	52.96 ± 16.39	0.001
Rang	40 - 90	30 -75	
Number	26	26	
Male	14 (53.8%)	17 (65.4%)	0.406
Female	12 (46.2%)	9 (34.6%)	0.406
Diabetic	16 (61.5%)	7 (27%)	0.007
Hypertension	8 (30.8%)	4 (15.4)	0.724
Smoking	9 (34.6%)	11 (42.2%)	0.724

Table 2: Clinical laboratory and ultrasound date of study groups.

	CVA group	Control group	P value
Initial SBP	149.15 ± 36.65	148.08 ± 37.31	0.917
Initial DBP	92.69 ± 25.07	88.27 ± 16.31	0.454
FBS	150 ± 61.69	127.20 ± 76.98	0.254
Cholesterol	169.08 ± 49.69	160.23 ± 37.70	0.588
Triglycerides	91.33 ± 25.88	102.14 ± 42.12	0.299
Maximum CCA IMT ,mm	1.22 ± 0.35	1.02 ± 0.21	0.05
Maximum ICA IMT ,mm	1.97 ± 0.93	1.57 ± 0.76	0.002
Plaque,%	19 (73%)	7 (27%)	<0.001

Mean maximum IMT of the CCA, ICA and prevalence of plaque were significantly higher in CVA groups than among the control (P=0.05, P= 0.002, P= 0.001 , respectively) . Other risk factors measured mean systolic blood pressure as well as diastolic blood pressure level, FBS, total serum cholesterol, Triglyceride, showed no significant difference between groups.

Table 3-Risk of stroke According to Characteristics of Plaque in the ICA

		CVA group no(%)
Plaque	Plaque (+)	19 (73%)
	Plaque (-)	7 (27%)
Surface	Smooth surface plaque	7 (37%)
	Irregular surface plaque	12 (63%)
Morphology	Homogenous Plaque	10 (53%)
	Heterogamous Plaque	9 (47%)
Calcification	un calcified plaque	14 (74%)
	Calcified plaque	5 (26%)

Risk of ischemic stroke were higher among patients with increasing surface irregularity than among patients with smooth surfaces (63% versus 37%).

These excess risks were similar among patients with homogenous plaque and those with heterogeneous plaque (53 % versus 47%). The excess risks were higher among patients with an un calcified plaque than among patients with a calcified plaque (74% VS. 26% , respectively) .

Discussion

There is significant difference in age between CVA group and control group, being older in CVA group (P 0.001) and number of patients with history of diabetes is significantly increased among CVA group (P 0.007). There is no significant differences in sex distribution and frequency of hypertension among group. All smokers were males without significant difference among groups.

The present study demonstrated that increased maximum IMT of the CCA and ICA and plaque in the ICA are strong predictors for risk of stroke.

Three other studies investigated the relation between stroke and IMT .in atherosclerotic risk in communities study (Burke GL et al. 1995), the prevalence of cerebrovascular disease was

cross-sectional with an increased IMT. Our study demonstrated significant association between plaque surface irregularity and stroke ,although the medical research Council (MRC) European carotid surgery trial showed that patients with irregular plaque had high risk of stroke than did those with smooth plaque (European carotid surgery trial lists 1998).

In case control study rested in the Rotterdam study (Bots ML, et al. 1994) and in the cardiovascular health study (OLEary DH , et al. 1991; Pierre JT , et al. 2000) an increase IMT was associated with an increased risk of stroke.

Three other studies also showed that increased carotid IMT and plaques in internal carotid artery was associated with increased risk of stroke (Shah EB, et al. 1999; Akiko KI, et al. 2004).

The Cardio Vascular Health Study (CHS) reported a non-significant relative risk for incident stroke with calcified plaque (Polak JF, et al. 1998), we did not have significant excess risks of ischemic stroke associated with calcified plaque, plaque accompanied by calcification may be stable and therefore not increased the stroke risk too much

The Atherosclerosis Risk in Community Study (AIRC) showed that carotid artery lesion without calcification were predictive of ischemic stroke (Hunt KJ, et al. 2001).

Our stroke cases comprised a higher proportion of definite lacunar infarction (73%) and compared with large artery occlusion infarction (27%), increased carotid IMT may be strong marker for atherosclerotic lesion in internal cranial small vessels, our finding are supported by the result of Rotterdam study which showed that carotid plaque were associated with lacunar infarction (Holander M , et al. 2002).

The Cardio vascular Health Study (CHS) showed a positive association between carotid plaque surface irregularity and the prevalent lacunar infarction detected by MRI (Manolio TA, et al. 1999).

The addition measurements of IMT to the cardiovascular risk equation may help identify high risk persons (asymptomatic) who would benefit from aggressive preventable measures.

Conclusion

We conclude that wall thickening of the CCA, ICA and un calcified plaque formation in the ICA as assessed by noninvasive Ultrasonography are positively associated with an increased risk of ischemic stroke in elderly patients .

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