

ORIGINAL ARTICLES

Ultrasound evaluation of carotid artery intima-media thickness in patients with risk factors for cardiovascular disease

Ibrahim A. Awad, Hanan Y. Abbas*

Diagnostic Radiology Department, Faculty of Applied Medical Sciences, King Abdulaziz University, KSA

Received: November 18, 2016

Accepted: January 31, 2017

Online Published: March 20, 2017

DOI: 10.5430/ijdi.v4n2p16

URL: <https://doi.org/10.5430/ijdi.v4n2p16>

ABSTRACT

Objective: The study purpose was to assess the change of carotid artery intima-media thickness (CAIMT) in patients with cardiovascular risk factors (CVRF), and determine the main factor that causing the abnormal IMT.

Methods: We collected the data of 89 patients who underwent a carotid artery ultrasound between February 2011 and November 2012 (43 men and 46 women aged between 20-80 years old). All patients included in the study had one of the following cardiovascular risk factors: smoking (n = 40), arterial hypertension (n = 25) or diabetes mellitus (n = 24). The IMT of the common carotid artery was measured and the results were correlated with the recorded risk factor. Correlation with the patient's age and gender was also performed.

Results: The study revealed abnormal IMT (> 1 mm) in a total of 71 (79.8%) patients. These included 22 (88%) patients with hypertension, 19 (79.2%) patients with diabetes mellitus and 30 (75%) patients who were smokers ($p < .05$ for all 3 risk factors). While aging was also associated with increased IMT ($p < .05$), no gender differences were noted ($p > .05$).

Conclusions: The present study showed that ultrasound is an excellent, noninvasive method for evaluation of carotid intima-media thickness. The main risk factors associated with abnormal carotid IMT were hypertension, diabetes mellitus, smoking and patient's age.

Key Words: B-mode ultrasound, Intima-media thickness

1. INTRODUCTION

The carotid artery intima-media thickness (IMT) is increasingly been used as an important parameter in many studies evaluating heart disease and vascular atherosclerosis.^[1] Non-linear relationships between increased carotid artery IMT and increased risk of stroke and cardiac events have been demonstrated.^[2,3] A distinct relationship between the severity of atherosclerosis in one artery and the involvement of other arterial beds has also been shown.^[2] Therefore non-invasive

measurement of intima-media thickness of peripheral arteries, particularly of carotid arteries, is being considered for early detection of arterial disease, including for evaluation of atherosclerotic plaques and arterial wall smooth muscle enlargement. Values of carotid artery IMT above 0.9 mm are considered abnormal and values higher than 1mm correlate with increased incidence of atherosclerosis and cardiovascular events.^[4,5]

The B-mode carotid ultrasonography represents a sensitive

*Correspondence: Hanan Y. Abbas; Email: habbas1@kau.edu.sa; Address: Diagnostic Radiology Department, Faculty of Applied Medical Science, King Abdulaziz University, Jeddah 21589, KSA.

modality used for measuring the thickness of the tunica intima and media of the carotid arteries. The sensitivity and accuracy of the test increase when the measurements are taken in multiple areas of the common carotid arteries.^[4] Although both the near and the far wall images of the carotid artery can be obtained,^[5,6] the thickness of the intima-media complex is reported to be more accurate when measured in the far wall position.^[7]

2. MATERIALS AND METHODS

The data of 99 consecutive patients who underwent a carotid artery ultrasound exam between February 2011 and November 2012 were retrospectively reviewed. From these, 10 patients had more than one cardiovascular risk factor and were excluded from the study. The rest of 89 patients who were included in the study (43 men and 46 women aged between 20-80 years old, the mean age representing 61.0 years) had one of the following cardiovascular risk factors: smoking

(n = 40), arterial hypertension (n = 25) or diabetes mellitus (n = 24). The study demographic data are also shown in Table 1.

Table 1. Demographic data of the study population

	Frequency	Percent
Male	43	48.3%
Female	46	51.7%
Total	89	100%

All patients were examined using a high frequency 5-12 MHz linear array transducer (IU22 Philips system). The intima-media thickness (IMT) of the common carotid artery was measured bilaterally by an experienced sonographer and values above 1mm were considered abnormal (see Figure 1). The results were correlated with the recorded risk factor. Correlation with the patient’s age and gender was also performed.

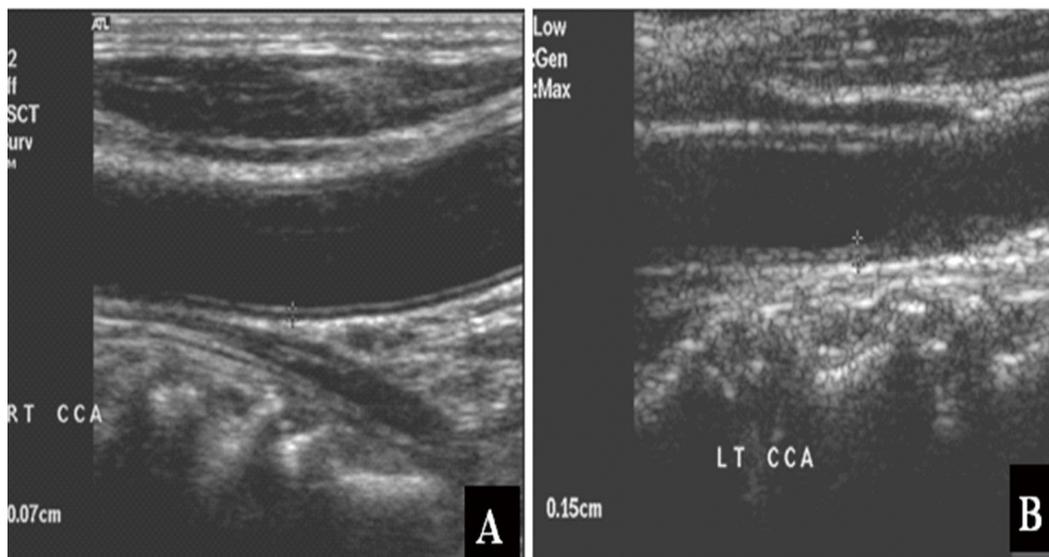


Figure 1. Carotid longitudinal ultrasound images. A. Normal smooth carotid intima-media of 0.07 cm; B. Abnormal moderate intimal thickening of 0.15 cm

Table 2. Distribution of risk factors and carotid IMT data obtained by ultrasonography

Clinical	Abnormal IMT	Normal IMT	Number of patients
SMOKING	30	10	40
DM	19	5	24
HTN	22	3	25
TOTAL	71	18	89

The statistical analysis was performed using an SPSS program for Windows, version 19 software package (IBM Company, New York, USA). Categorical variables were analyzed

using a Chi-square test (X^2) or Fischer’s exact test for small samples. A p -value < .05 was considered significant.

The study was approved by the Research Ethics Committee of the King Abdul-Aziz University, Faculty of Medicine.

3. RESULTS

The study data were evaluated separately for patients presenting with different cardiovascular risk factors. The results revealed significant associations between the present risk factors and abnormal carotid IMT. Thus, abnormal values of intima-media thickness exceeding 1mm were revealed in 75% of smokers (30 from 40 subjects, $p = .004$), 79.2% of

patients with diabetes mellitus (19 from 24 subjects, $p = .013$) and 88% of patients with systemic arterial hypertension (22 from 25 subjects, $p < .001$). A summary of these results is

provided in Table 2 and Figure 2.

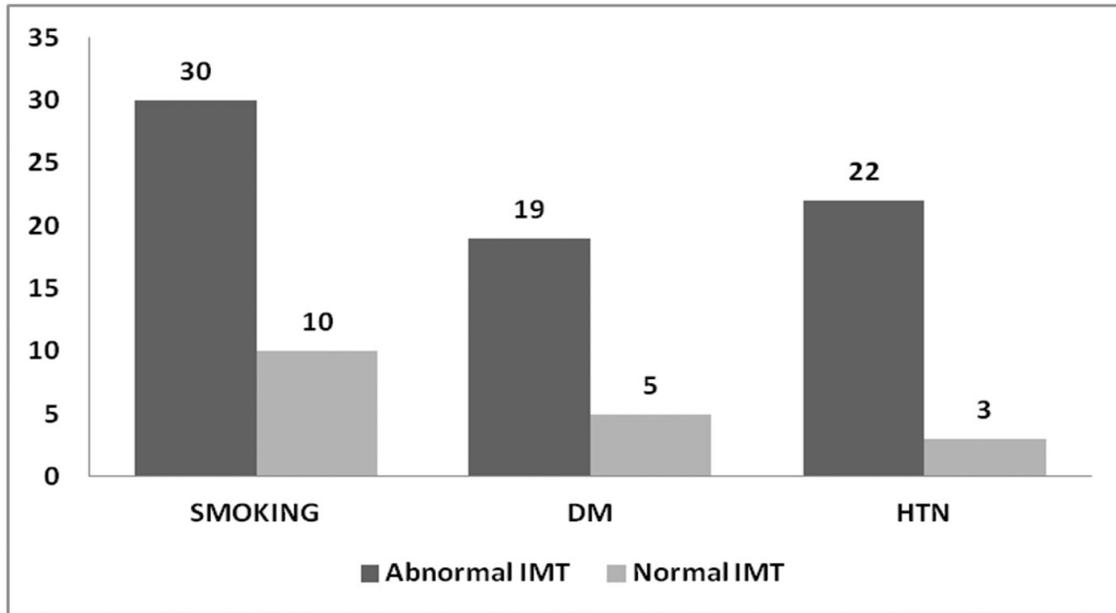


Figure 2. Distribution of the study population (n = 89 patients) according to the present risk factors and carotid IMT data obtained by ultrasonography. The figures above the columns reflect the number of patients

A separate analysis of the obtained data revealed additional correlations between carotid IMT and patient’s age. Thus, subjects younger than 40 years represented less than 6% of patients with abnormal IMT, while subjects older than 50 years represented over 80% of patients with abnormal IMT (see Table 3). At the same time, no significant gender differences were noted ($p > .05$).

Table 3. Recorded abnormal IMT values in different age groups

Age groups	Number of patients	Percentage
20-40 yrs	4	5.6%
41-50 yrs	9	12.7%
51-60 yrs	18	25.3%
61-70 yrs	19	26.8%
71-80 yrs	21	29.6%
Total	71	100%

4. DISCUSSION

The carotid thickness of the intima-media layer is an important marker for atherosclerosis and can indicate the presence of a disease process. Being an independent predictive marker of stroke and cardiovascular events, IMT can play an important role in assessing the risk for cardiovascular disease.^[8]

Although different risk factors may affect the intima-media thickness, our results suggest that systemic arterial hyperten-

sion, smoking, and diabetes have the greatest impact. Thus, in our study as many as 88% of patients with arterial hypertension demonstrated abnormal carotid IMT. The results are in agreement with previous reports indicating that IMT is positively correlated with blood pressure variability in patients with hypertension.^[9,10]

Even though a number of previous studies also report potential gender differences in the distribution and the determinants of atherosclerosis,^[11-13] our data revealed no significant differences between males and females. This may be related to the particularities of our study population, including ethnical characteristics as well as to a relatively small sample size.

5. CONCLUSION

The present study showed that ultrasound is an excellent, noninvasive method for evaluation of carotid intima-media thickness. The main risk factors associated with abnormal carotid IMT were hypertension, diabetes mellitus, smoking and patient’s age. No gender differences were noted; however, this may be related to the particularities of our study population and new studies including larger cohorts of different ethnical background may bring further clarifications.

CONFLICTS OF INTEREST DISCLOSURE

The authors have declared no conflicts of interest.

REFERENCES

- [1] Filippo M, Jasjit SS, Chirinjeev K. *Atherosclerosis Disease Management*. Berlin: Springer, ISBN; 2010: 1-4419-7221-8.
- [2] O'Leary DH, Polak JF, Kronmal RA, et al. Carotid-artery intima and media thickness as a risk factor for myocardial infarction and stroke in older adults. *Cardiovascular Health Study Collaborative Research Group. N Engl J Med.* 1999; 340: 14-22. PMID:9878640 <https://doi.org/10.1056/NEJM199901073400103>
- [3] Chambless LE, Heiss G, Folsom AR, et al. Association of coronary heart disease incidence with carotid arterial wall thickness and major risk factors: the Atherosclerosis Risk in Communities (ARIC) Study, 1987-1993. *Am J Epidemiol.* 1997; 146: 483-494. PMID:9290509 <https://doi.org/10.1093/oxfordjournals.aje.a009302>
- [4] Simon A, Garipey J, Chironi G, et al. Intima-media thickness: A new tool for diagnosis and treatment of cardiovascular risk. *J Hypertens.* 2002; 20: 159-69. PMID:11821696 <https://doi.org/10.1097/00004872-200202000-00001>
- [5] Wikstrand J, Wendelhag I. Methodological considerations of ultrasound investigation of intima-media thickness and lumen diameter. *J Intern Med.* 1994; 236: 555-9. PMID:7964433 <https://doi.org/10.1111/j.1365-2796.1994.tb00845.x>
- [6] Wong M, Edelstein J, Wollman J, et al. Ultrasonic-pathological comparison of the human arterial wall. Verification of intima-media thickness. *Arterioscler Thromb.* 1993; 13: 482-6. PMID:8466883 <https://doi.org/10.1161/01.ATV.13.4.482>
- [7] Wikstrand J. Methodological considerations of ultrasound measurement of carotid artery intima-media thickness and lumen diameter. *Clin Physiol Funct Imaging.* 2007; 27(6): 341-5. PMID:17944655 <https://doi.org/10.1111/j.1475-097X.2007.00757.x>
- [8] Aguilar-Shea AL, Gallardo-Mayo C, Garrido-Elustondo S, et al. Carotid intima-media thickness as a screening tool in cardiovascular primary prevention. *Eur J Clin Invest.* 2011; 41: 521-6. PMID:21155766 <https://doi.org/10.1111/j.1365-2362.2010.02440.x>
- [9] Pall D, Settakis G, Katona E, et al. Increased common carotid artery intima media thickness in adolescent hypertension: results from the Debrecen Hypertension study. *Cerebrovasc Dis.* 2003; 15: 167-172. PMID:12646774 <https://doi.org/10.1159/000068834>
- [10] Mancia G, Parati G, Hennig M, et al. Relation between blood pressure variability and carotid artery damage in hypertension: baseline data from the European Lacidipine Study on Atherosclerosis (ELSA). *J Hypertens.* 2001; 19: 1981-1989. PMID:11677363 <https://doi.org/10.1097/00004872-200111000-00008>
- [11] Stensland-Bugge E, Bønaa KH, Joakimsen O. Age and sex differences in the relationship between inherited and lifestyle risk factors and subclinical carotid atherosclerosis: the Tromsø study. *Atherosclerosis.* 2001; 154: 437-448. [https://doi.org/10.1016/S0021-9150\(00\)00486-X](https://doi.org/10.1016/S0021-9150(00)00486-X)
- [12] Tan TY, Lu CH, Lin TK, et al. Factors associated with gender difference in the intima-media thickness of the common carotid artery. *Clin Radiol.* 2009; 64: 1097-1103. PMID:19822243 <https://doi.org/10.1016/j.crad.2009.06.009>
- [13] Kablak-Ziembicka A, Przewlocki T, Tracz W, et al. Gender differences in carotid intima-media thickness in patients with suspected coronary artery disease. *Am J Cardiol.* 2005; 96: 1217-1222. PMID:16253585 <https://doi.org/10.1016/j.amjcard.2005.06.059>