The correlation of femoral and carotid intima-media thickness (IMT) to the prevalence of clinical cardiovascular disease.

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Purpose

Cardiovascular diseases (CVDs) are the most prevalent cause of death worldwide and responsible for 17.1 million deaths per year according to the World Health Organization. Risk factors for the development of CVD have been extensively studied, however more accurate measurements of increased risk for developing these diseases are sought in order to improve the detection of high risk patients and their stratification according to risk of developing CVDs. Among these measurements, the measurement of the intima media thickness (IMT) of large arteries such as the carotid and femoral arteries using UltraSound has been proven as a surrogate marker of atherosclerosis and therefore as a good indicator of the risk of acquiring CVDs. In this aspect, the mean and maximum IMT of the distal common carotid artery (IMTcc) and the carotid bifurcation (IMTbif) have been associated with cardiovascular events, and the same has been proven for the presence and number of plaques. The aim of this study was to obtain the above non invasive measurements of atherosclerosis of carotid and femoral arteries focusing on IMT cc, maximum IMTbif - "IMTmax", the presence and number of plaques at the common femoral and carotid arteries, the number of bifurcations with plaque and the size of plaques in both carotid and common femoral bifurcations (total plaque thickness TPT), and examine their association with the prevalence of CVD in an ongoing cross-sectional population-based study.
Methods and Materials

Population: We used three random locations in Cyprus and recruited a total of 767 individuals from these sites. This study is a part of a larger prospective cohort study, the "Cyprus Study" which examines 2000 individuals for cardiovascular events; we however will focus on the population presented in the present study. The Ethics Committee approved for the study to be held. For each patient we recorded some baseline characteristics using his/her medical history and previous examinations together with hospital records; these are presented in TABLE 1 for the reader's convenience.

Measures of Disease presence: The Cardiovascular events were clinically reported after examining each patient: The diagnosis of angina was based on medical history, and investigations such as ECG and thallium tests. The diagnosis of myocardial infection was based on history and hospital documentation including information on coronary artery intervention. Myocardial ischemia was diagnosed in the presence of ST-segment depression (horizontal or down-slopping of at least 0.05 mV) or symmetrical T-wave inversion (isoelectric, negative or biphasic in leads V3-V6, aVL (if R>0.5mV), I and II). Old myocardial infarcts were diagnosed in the presence of pathological Q-waves.

Cerebrovascular events such as ischemic stroke, transient ischemic attack (TIA) or transient monocular blindness was based on the patient's history, hospital records and reports from neurologists diagnosing the event. Intermittent claudication was diagnosed from the history of recurrent pain on walking at fixed distances in the presence of weak or absent pulses and an ankle/branchial blood pressure index < 0.9.

Ultrasound measurements: A duplex scanner (the exact device can be found in the published study) was used under preset constant settings for 2-D map, post-processing curve (linear), dynamic range (170db), persistence (low) and frame right (high). Participants were examined in the supine position with the neck extended and carotid bifurcations were examined longitudinally and transversely at both sides, 1.5-2.0 proximal to the carotid bulb and both at the near and far walls of the common carotid artery. The mean of the measurements at both sides was used in the analysis (IMTcc). An example of the IMT measurement can be seen in FIGURE 1.

The presence of plaque at an arterial bifurcation was defined as the focal thickening>0.2 mm that did not uniformly involve the whole arterial wall as can be seen in FIGURE 2. The maximum plaque thickness (IMTmax) was measured in longitudinal and transverse sections with the use of color flow to assist the readings. IMTcc was used in the absence of plaques. The measurement of plaques and their thickness was the same for both the femoral artery bifurcations. TPT was defined as the sum of the maximum plaque measurements at all four the bifurcations examined. Each examination was recorded on video tape.
The reproducibility of the readings was measured for two ultrasonographers performing examinations in 35 participants each, and resulted for IMTcc in -0.03mm inter-observer mean difference, 0.12 mm within-subject standard deviation and 0.79 intra-class correlation coefficient. These values were respectively 0.02 cm, 0.26 cm and 0.94 cm for IMTmax.
Results

The baseline characteristics of the population are available in TABLE 1. In total, 113 out of 767 individuals presented CVD (58 myocardial infarction, 43 angina, 9 neurological events and 3 lower ischemia cases). The odds ratios of the ultrasonic measurements (IMTcc, IMTmax and TPT) and the presence of CVD are presented in TABLE 2. IMTmax and TPT were associated with CVD in a greater degree than IMTcc and this association was preserved for the 3rd and 4th quartile of TPT and the 4th quartile of IMTmax after adjusting for age, sex, pack years, systolic blood pressure, cholesterol, lipid-lowering therapy, and anti-hypertensive therapy.

The association between the number of bifurcation with plaque and the presence of CVD is shown in TABLE 3. The presence of carotid plaques increased CVD prevalence and this was more evident in the case of femoral plaques, the risk increasing with the number of plaques in these vessels. The combined number of plaques was also associated with increased prevalence of CVD with a high prevalence of CVD (42%) when four vessels presented plaques. The association of TPT with CVD provided a cut-off point of 0.52 cm for total plaque thickness above which the 247 (32%) individuals contained 85 (75%) of the 113 individuals with CVD as shown in TABLE 4. Similar results were observed for both men and women.
Conclusion

IMT has been established as a measurement strongly associated with CVD risk by previous studies. Our study has included carotid and femoral measurements at the same population, and our data suggest a stronger association of the presence of plaques in both these vessels than the IMT itself with the incidence of CVD. The presence of plaques at three or four bifurcations (both carotid and femoral arteries) and TPT seem to be more strongly associated with CVD than IMTcc and IMTmax measurements. Our study is a cross-sectional study and the results of the long term follow up of the population should be sought to provide more clear associations. Non invasive measurements like IMT and plaque measurements with Ultrasounds could provide a valuable screening tool for the stratification of individuals according to risk of developing CVD with or by replacing the standard risk factors currently used by clinicians.
References


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More information on the study can be sought from the presenter author or the authors of the published paper on the study (see first reference).