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Relationship between breast arterial calcification and lipid profile, plasma atherogenic index, Castelli's risk index and atherogenic coefficient in premenopausal women

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ABSTRACT

Objective: The aim of this study was to investigate the relationship between the breast arterial calcification (BAC) and the plasma atherogenic index (PAI), atherogenic coefficient (AC), Castelli risk index-I (CRI-I) and Castelli risk index-II (CRI-II).

Methods: This retrospective study included 60 premenopausal women aged over 40 years with BAC on mammograms and control group of 60 women without BAC. Serum glucose, triglyceride (TG), low-density lipoproteincholesterol (LDLc), high-density lipoprotein-cholesterol (HDLc), and total cholesterol (TC), levels were measured. Lipid indices were calculated using the appropriate formula.

Results: LDLc, non-HDLc levels were significantly higher, HDLc levels were siginificantly lower in patient group compared to the control group ($p = 0.007$, $p = 0.027$, and $p = 0.014$, respectively). Patient group had significantly higher PAI, AC, CRI-I and CRI-II levels than the control group ($p = 0.003$, $p = 0.002$, $p = 0.002$ and $p = 0.003$, respectively). A significant positive correlation was found between BAC and PAI, AC, CRI-I and CRI-II ($r = 0.267$ and $p = 0.003$, $r = 0.282$ and $p = 0.002$, $r = 0.282$ and $p = 0.002$, $r = 0.271$ and $p = 0.003$, respectively). LDLc and non-HDLc were positively correlated whereas HDLc was negatively correlated with the BAC ($r = 0.188$ and $p = 0.039$, $r = 0.202$ and $p = 0.027$, $r = -0.223$ and $p = 0.014$, respectively).

Conclusion: BAC is a valuable tool for the prediction of deranged lipid profile. Dyslipidemia, PAI, AC, CRI-I and CRI-II are risk factors for the development of atherosclerosis. Our results indicate that BAC is potentially useful tool for the detection of dyslipidemia and early atherosclerosis in premenopausal women.

1. Introduction

Breast arterial calcification (BAC) on mammography is uncommon in women less than 50 years old. The prevalence of BAC ranges from 9 to 17% and increases with age [1]. Several studies have found correlations between BAC and hypertension, diabetes mellitus, cardiovascular disease and cardiovascular mortality [2–4]. Similarly, BAC has predictive value for cerebral, carotid and peripheral artery disease [5]. Current guidelines recommend annual mammography screening for all healthy women beginning at the age 40 for early detection of breast cancer. BAC detected during routine mammography may provide potential insights into metabolic disorders responsible for atherosclerosis. Many epidemiological studies have shown that high levels of low-density lipoprotein cholesterol LDLc, TG and low HDLc play an important role in the pathogenesis of atherosclerosis [6]. Although high TG levels correlate with the presence of small, dense LDLc particles and associated with increased risk of coronary artery disease, the risks appear to have neglected in NCEP ATP III target recommendations [6–8].

There are new cardiovascular risk predictors obtained by different combinations of lipid profile parameters. These are; atherogenic index of plasma (PAI); based on two important parameters TG and HDLc, both of which are independent risk factors for coronary artery disease (CAD) [9]. Castelli risk index-I (CRI-I); calculated as (TC / HDLc), Castelli risk index-II (CRI-II); as (LDLc/HDLc) is another fraction which involves independent risk factors for CAD [10,11] and atherogenic coefficient (AC) calculated as {(TC − HDLc) / HDLc} is yet another ratio relying on the significance of HDLc in predicting the risk of CAD [12].

The purpose of this study was to investigate whether BAC has a relation with PAI, AC, CRI-I and CRI-II in premenopausal women over 40 years of age.

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2. Methods

2597 consecutive premenopausal women over 40 years of age that were sent for screening and diagnostic mammography between January and November 2015 were recruited for this retrospective study. The study protocol was approved by the Medipol University Ethics Committee. A Mammomat 3000 Nova equipment (Siemens AG, Germany) was utilized for acquisition of craniocaudal and mediolateral oblique images. If calcifications were present on the right, left, or both projections of the breast, the mammogram was categorized as BAC (+). BAC was defined as two linear calcification depositions in a conical periphery when the arterial wall is imaged longitudinally or as calcific rings when the artery is cut transversely [2]. The women were divided into two groups: those with BAC and those without BAC. 125 women with BAC were included in the study. The women in postmenopausal state or having obesity, past history of hypertension, liver disease, renal disease, diabetes mellitus, thyroid dysfunction, coronary artery disease, valvular heart disease, cerebrovascular disease and malignancy were excluded from the study. A total of 60 women met all study criteria were entered in the study and 60 subjects without BAC accepted as the control group. All women were contacted by telephone and underwent physical examination. All subject underwent 12-lead ECG (Comen CM100B, China) in the supine position. Echocardiographic examinations were performed using Vivid 3 pro equipment (GE Vingmed Ultrasound AS, Horten, Norway) according to the guidelines of the American Society of Echocardiography [13]. All blood samples were taken from antecubital vein in the morning, after overnight fasting. All samples were evaluated on the same day. Serum TC, TG, HDLc levels were assayed on Cobas c311 clinical chemistry analyzer (Roche Diagnostics, Germany). Serum LDLc calculated using Freidwald formula [14]. Non-HDLc is calculated as total cholesterol minus HDLc. The atherogenic ratios were calculated as follows: PAI = log TG / HDLc, CRI-I = TC / HDLc, CRI-II = LDLc / HDLc, AC = (TC − HDLc) / HDLc.

3. Statistical analysis

Continuous variables are expressed as mean ± SD. Categorical variables are expressed as percentages. To compare parametric continuous variables, Student's t-test was used; and to compare categorical variables, the Chi square-test was used. Pearson's correlation analysis was used for relation between BAC lipid parameters. All variables are showing significant values < 0.05. Two-tailed P values less than 0.05 were considered significant and the confidence interval was 95%. All statistical studies were carried out using the SPSS program (version 22.0; SPSS Inc., Chicago, Illinois, USA).

4. Results

2597 consecutive premenopausal women that were sent for screening and diagnostic mammography were evaluated and 60 women with BAC who met entry criteria were enrolled in the study. (An example of breast arterial calcification is shown in Fig. 1). 60 subjects without BAC accepted as the control group. The demographic characteristics of both groups including age, height, weight, body mass index (BMI), blood pressure were similar. Both groups had BMI > 25 kg/m^2 indicating overweight. Serum LDLc and non-HDLc levels of the patient group were significantly higher than the control group (p = 0.007 and p = 0.027, respectively), whereas serum HDLc level of the patient group was lower than the control group (p = 0.014) PAI, AC, CRI-I and CRI-II were found to be increased significantly in the patient group as compared to their values in the control group (p = 0.003, p = 0.002, p = 0.002 and p = 0.003, respectively) (Table 1). Pearson bivariate correlations analysis results showed that BAC was positively correlated with non-HDLc and LDLc levels (r = 0.202, p = 0.027 and r = 0.188, p = 0.039, respectively) and negatively correlated with HDLc levels (r = 0.223, p = 0.014). There was a significant positive correlation between BAC and PAI, AC, CRI-I and CRI-II (r = 0.267 and p = 0.003, r = 0.282, and p = 0.002, r = 0.282 and p = 0.002, r = 0.273 and p = 0.003, respectively) (Table 2).

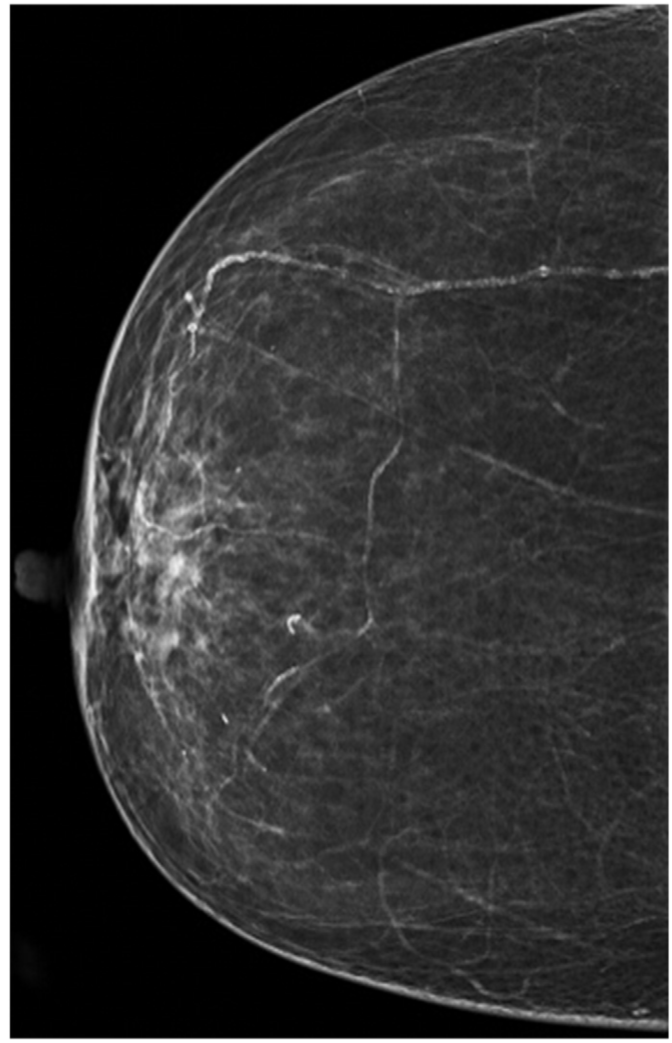

Fig. 1. Example of breast arterial calcification.

Table 1
Patient's clinical, lipid profile and ratios among study groups.

Parameters	BAC + (N:60)	BAC − (N:60)	P
Age	45.1 ± 3.1	45.6 ± 3.6	0.3
BMİ (kg/m^2)	27.4 ± 1.4	26.2 ± 1.8	0.5
Systolic tension (mm Hg)	127.1 ± 8.3	126.3 ± 9.3	0.7
Diastolic tension (mm Hg)	72.5 ± 9.8	70.1 ± 7.3	0.6
Lipid profile (mg/dl)			
TC	207.7 ± 22.9	201.8 ± 18.4	0.135
HDLc	46.5 ± 7.2	49.6 ± 5.8	0.014
LDLc	133.2 ± 23.2	122.8 ± 18.3	0.007
TG	150.8 ± 12.3	146.9 ± 12.2	0.093
Non HDLc (TC − HDLc)	161.1 ± 23.5	152.2 ± 18.8	0.027
Lipid ratios			
Atherogenic index of plasma	0.51 ± 0.07	0.47 ± 0.06	0.003
Atherogenic coefficient	3.55 ± 0.83	3.12 ± 0.60	0.002
Castelli's risk index-I	4.55 ± 0.83	4.12 ± 0.60	0.002
Castelli's risk index-II	2.89 ± 0.75	2.52 ± 0.53	0.003

P value ≤ 0.05 is considered statistically significant, BAC: breast arterial calcification, BMI: Body mass index, TC: total cholesterol, HDLc: high density lipoprotein cholesterol, LDLc: low density lipoprotein cholesterol, TG: triglyceride.