

CORRELATION BETWEEN BREAST ARTERIAL CALCIFICATIONS ON MAMMOGRAPHY, CHOLESTEROL LEVELS AND CARDIOVASCULAR RISK

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CORRELATION BETWEEN BREAST ARTERIAL CALCIFICATIONS ON MAMMOGRAPHY, CHOLESTEROL LEVELS AND CARDIOVASCULAR RISK (Abstract): The **objective** of this study is to evaluate the correlation between arterial calcifications observed on mammograms and factors such as age, smoking status, body mass index, personal history of cardiovascular conditions, cholesterol levels (total cholesterol, LDL, HDL), and diabetes mellitus. **Materials and methods:** This retrospective study comprised a cohort of 1102 women, aged between 32 and 85, who underwent mammography at the “Sf. Spiridon” County Clinical Emergency Hospital Iasi from January 2018 to December 2020. Every woman underwent a routine procedure of bilateral four-view mammography. The patient’s clinical and laboratory data were retrieved from the hospital’s internal database. We selected in a random manner 115 age-matched women who did not have arterial calcifications in order to form the control group. **Results:** Out of the patients who received mammography, 95 cases (8.6%) showed the presence of breast arterial calcifications (BAC). As compared to control group, a significantly proportion of women with breast arterial calcifications were found to have a high body mass index (76.84%), elevated total cholesterol levels, cardiovascular diseases (21 cases, 22.10%), diabetes mellitus (15 cases, 15.78%), history of smoking (26 cases, 27.36%). **Conclusions:** The presence of breast arterial calcifications (BAC) on mammography is strongly linked to older age, elevated cholesterol levels, smoking, and diabetes mellitus. These patients also have a personal history of cardiovascular events, indicating a strong connection between BAC and an increased risk of cardiovascular problems. This correlation suggests that detecting BAC on mammography can serve as a marker for identifying women who are at a higher risk for experiencing cardiovascular events. **Keywords:** MAMMOGRAPHY, ARTERIAL CALCIFICATIONS, CARDIOVASCULAR RISK.

Mammography is a widely utilized imaging technique for detecting breast calcifications. During screening mammography,

breast arterial calcification (BAC) is often detected. BAC refers to the benign and incidental medial calcification of the

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mammary arteries. The formation of these calcifications is believed to occur through a complex process involving vascular inflammation, cellular damage, and subsequent mineralization of the arterial wall (1, 2, 3). It is becoming more and more evident that the presence of BAC during routine mammographic screenings could be a sign of increased risk for cardiovascular disease (CVD). Recent research indicates that the detection and severity of breast arterial calcifications can offer valuable insights into an individual's cardiovascular well-being and risk factors (4, 5). For instance, multiple studies have indicated a correlation between breast arterial calcifications and an increased risk of developing cardiovascular disease (6, 7, 8, 9).

Research on the relationship between breast arterial calcifications on mammography and systemic markers of cardiovascular risk, such as cholesterol levels, is gaining momentum. Studies have found a correlation between elevated cholesterol levels and a higher likelihood of developing breast arterial calcification. Previous studies have discovered a correlation between elevated total cholesterol levels in women and the presence of breast arterial calcifications on mammography. Furthermore, certain studies have found a connection between the existence of breast arterial calcifications and elevated triglyceride and low-density lipoprotein levels. It is evident that breast arterial calcifications can serve as a valuable indicator of the overall atherosclerotic process, giving clinicians an extra means of evaluating cardiovascular risk (10, 11, 12, 13).

In addition, the presence of breast arterial calcifications has been associated with a higher risk of cardiovascular events, including myocardial infarction, stroke, and

cardiovascular death. It has been observed that patients with breast arterial calcifications tend to have a greater amount of coronary artery calcification and atherosclerosis, which in turn raises their chances of experiencing negative cardiovascular outcomes (14, 15, 16, 17, 18).

There is compelling evidence indicating a connection between breast arterial calcifications observed on mammography, cholesterol levels, and the potential for cardiovascular disease. Studies have shown that certain cardiovascular risk factors, including hypertension, smoking, and obesity, can potentially raise the risk of developing breast arterial calcifications (19, 20, 21). According to a systematic review conducted by Osman *et al.*, it was discovered that women with hypertension have a higher likelihood of having breast arterial calcifications on mammography compared to women without hypertension (22).

The existing evidence strongly indicates a connection between breast arterial calcifications detected on mammography, cholesterol levels, and cardiovascular risk. However, further research is required to gain a comprehensive understanding of the intricate relationship between these factors.

This experimental research aims to investigate the potential of mammography as a screening tool for cardiovascular disease, with a specific focus on postmenopausal women.

MATERIALS AND METHODS

Study Design

This retrospective study involved a total of 1102 women, aged 32-85, who underwent mammography at "Sf. Spiridon" County Clinical Emergency Hospital Iasi from January 2018 to December 2020. The patient's clinical history and laboratory

data were retrieved from the hospital's internal database. The study recorded information on various cardiovascular risk factors, such as hypertension, diabetes, smoking status, total cholesterol levels, diabetes mellitus, and personal history of cardiovascular diseases.

The study group consisted of 95 women who were found to have arterial macro and microcalcification through mammography out of the 1,102 cases analyzed.

The control group consisted of 115 women without arterial calcification, who were age-matched with the patients.

The weight of each patient was divided by their height squared to calculate their body mass index (kg/m^2).

Mammography

All women underwent standard bilateral four-view mammography, with medio-

lateral oblique (MLO) and cranio-caudal (CC) views, using between 2018 - 2019 a screen-film mammography system Senographe DMR+ and in 2020 a digital unit Senographe Pristina (General Electric Healthcare, Milwaukee, Wisconsin, USA). Mammographies were reviewed on dedicated screens, with a magnifying glass, looking for linear, parallel high intensity opacities (calcifications) within the arterial walls, on either of the two views. Mammography evaluated the presence of calcifications, type (macrocalcifications $> 1 \text{ mm}$ or microcalcifications $< 1 \text{ mm}$), the number of involved arteries, and the distribution. Arterial calcifications can be easily identified due to their distinct pattern on mammography. They appear as linear, parallel high-intensity opacities within the arterial walls (fig. 1).

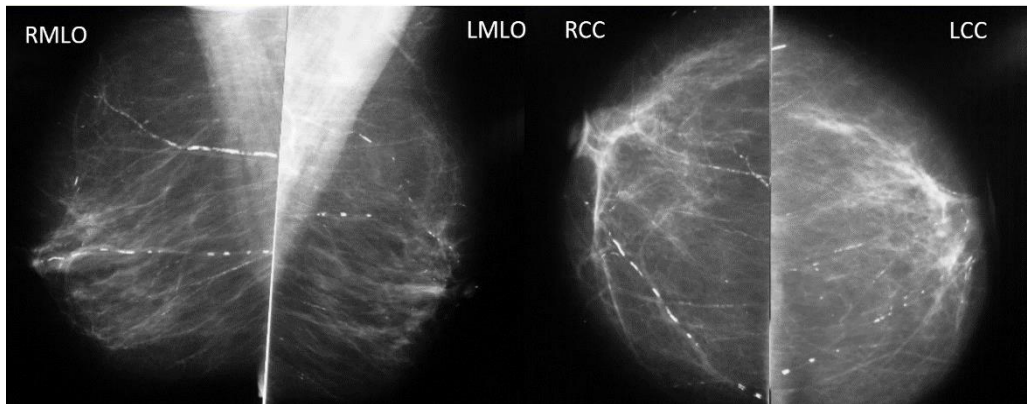


Fig. 1. Screen-film bilateral mammography, MLO and CC views - bilateral arterial calcifications (linear, parallel, high intensity opacities within the arterial walls)

Ethical Considerations

The study was approved by the local Institutional Ethics Committee in keeping with the principles of the Declaration of Helsinki. Data were collected anonymously from the electronic medical records without active patient participation.

Statistical Analysis

The continuous variables were reported as the mean and standard deviation (SD) and the categorical variables were expressed as percentages. Correlations were assessed using Spearman and Pearson coefficients of correlation. Variables between

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study groups were compared using a one-way ANOVA test. P-values < 0.05 have been accepted as statistically significant.

The statistical analyses were performed using *Statistical Package for Social Sciences for Mac version 29* (SPSS Inc., Chicago, IL, USA).

RESULTS

Out of the 1,102 cases that were examined, a small percentage of 95 patients (8.6%) displayed the presence of arterial macro and microcalcification on mammography, specifically BAC (+) cases. The average ages of the BAC (+) and BAC (-) groups were 65.7 ± 5.2 years and 59.4 ± 6.3 years, respectively ($p < 0.001$). In the 60-69 age group, the highest percentage of BAC (+) was observed, reaching 64.21%.

The postmenopausal periods for the two groups were 9.3 ± 2.6 years and 6.4 ± 1.9 , respectively ($p=0.04$). Most of the BAC (+) cases were observed in menopausal women (90 cases, 94.73%, $p < 0.05$).

In the group with breast arterial calcifications, the mean body mass index (BMI) was higher (28.79 kg/m^2) compared to the group without arterial calcifications (26.86 kg/m^2 , $p < 0.05$).

The study revealed a clear link between age and the presence of breast arterial calcifications, with older patients being more likely to have calcifications. Additionally, a slight association was observed between BMI and calcifications, suggesting that higher BMI may be related to calcifications, although it is not a significant predictor (fig. 2).

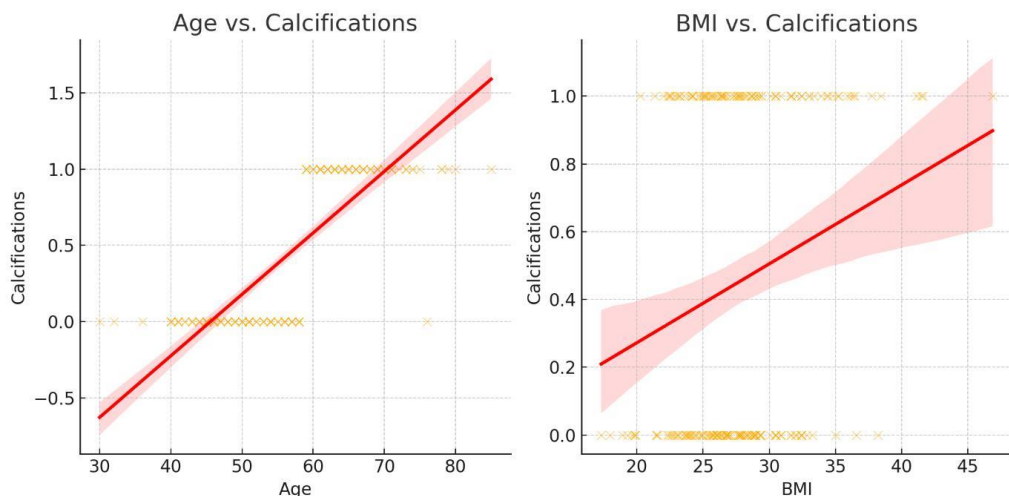


Fig. 2. Scatter plots and regression lines correlating, age, BMI and the presence of breast arterial calcifications.

Further research was conducted on the correlation between breast calcifications and obesity. Out of the individuals with arterial calcifications, only 22 cases (23.15%) had a BMI below 25 kg/m², indi-

cating a normal weight.

The first table provides a summary of the relationship between the presence of arterial calcifications on mammography and BMI in both, the BAC (+) and BAC (-) groups.

TABLE I.
Relationship between the presence of arterial calcifications
and the BMI in BAC+ and BAC- groups

BMI (kg/m ²)	< 25 (normal)	25.1-30 (overweight)	> 30.1 (obese)	> 25 (overweight + obese)
Patients, BAC +	22 (23.15%)	41 (43.16%)	32 (33.69%)	73 (76.84%)
Patients, BAC -	35 (30.43%)	55 (47.83%)	25 (21.74%)	80 (69.57%)

The presence of arterial calcifications on mammography was associated with higher mean total cholesterol (256 mg/dL) and LDL cholesterol levels (162 mg/dL) in women, compared to those without breast arterial calcifications (182 mg/dL and 125 mg/dL respectively). Additionally, BAC (+) cases with breast arterial calcifications

had a mean HDL cholesterol value of 40 ± 8 mg/dL, while BAC (-) had a mean HDL cholesterol value of 52 ± 10 mg/dL.

The study found a significant difference regarding age, BMI, cholesterol levels (total cholesterol, LDL, HDL), in the study compared with the control. This information is presented in table II.

TABLE II.
Relationship between age, BMI, cholesterol levels and breast arterial calcifications

Characteristics	BAC + (n = 95)	BAC - (n = 115)	p-value
Mean age (years)	65.73 \pm 5.21	49.38 \pm 6.31	< 0.0001
Mean BMI	28.79 \pm 5.06	26.86 \pm 3.83	< 0.002
Total Cholesterol (mg/dL)	256 \pm 42	182 \pm 32	< 0.001
LDL Cholesterol (mg/dL)	162 \pm 32	125 \pm 26	< 0.001
HDL Cholesterol (mg/dL)	40 \pm 8	52 \pm 10	< 0.05

Our study revealed a notable disparity in the occurrence of calcifications in the breast arteries between women who smoke (27.36%) and non-smoking women (14.78%) with similar calcium deposits ($p < 0.05$).

There was a higher prevalence of cardiovascular diseases (22.10%, $p < 0.05$) and diabetes mellitus (15.78%, $p < 0.05$) among women with breast arterial calcifications compared to those without calcifications on mammography. In contrast, the group without calcifications had a lower incidence of cardiovascular conditions (6.95%) and diabetes mellitus (4.34%). There appears to be a strong correlation between these abnormalities.

The study also included 27 patients diagnosed with cirrhosis. Among them, 10 (10.52%) showed arterial calcifications on mammography, while 17 (14.78%) did not have these lesions. The statistical analysis showed that there was no significant difference between the two groups ($p = 0.343$, NS). There is a negative weak correlation between cirrhosis and breast arterial calcifications, as indicated by the data. It is worth mentioning that the weak correlation is affected by the age of the patients, particularly due to the fact that only 11 of them were over the age of 55.

Associated lesions worth mentioning were fibroadenomas (4 - 4.21% cases in the study group and 6 - 5.21% in the control

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group and malignant tumors (23 cases - 24.21% and 17 - 14.78% respectively).

DISCUSSION

The findings of this study reveal a noteworthy connection between BAC and an increased likelihood of an elevated cardiovascular risk. This information derived from mammography suggests that arterial calcifications can indicate a higher risk of cardiovascular problems compared to the general female population, as it suggests that other arteries could also be affected. Although breast arterial calcifications are situated in the media of the arteries rather than the intimal atherosclerotic calcifications found in other arteries, they still pose a considerable risk (23). In addition, BAC on mammography is strongly linked to older age, elevated cholesterol levels, a history of smoking, and diabetes mellitus. This information highlights the dual benefits of detecting arterial calcifications on mammography. It not only serves as a screening tool for breast cancer but also helps identify women at a higher risk for cardiovascular events.

There is a notable correlation between the occurrence of BAC and age. The age group between 60 and 69 years had the highest frequency of observed calcifications among all the patients included. The findings align with the current body of research, indicating that mammography is

more likely to detect arterial calcifications in older women (18).

There is a random association between BAC and fibroadenomas and malignant tumors, which are commonly found in the general population. It is quite common for individuals aged 15 to 35 to be diagnosed with fibroadenomas, which are non-cancerous growths. On the other hand, woman over the age of 40 are more prone to being diagnosed with malignant tumors.

This study highlights the coincidental correlation between the presence of BAC and fibroadenomas, which can be attributed to their high prevalence in the general population.

CONCLUSIONS

The underreporting of arterial breast calcification is a common occurrence, as it is generally considered to be a benign condition. However, its association with cardiovascular conditions emphasizes the need for a comprehensive evaluation of patients. Additional research is needed to confirm whether mammography can effectively serve as a screening tool for cardiovascular disease, especially in postmenopausal women.

CONFLICT OF INTEREST AND FUNDING

The authors declare no conflict of interest. This research received no external funding.

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