RESEARCH ARTICLE

IS BREAST ARTERIAL CALCIFICATION A RELIABLE INDICATOR OF CORONARY ARTERY DISEASE?

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Manuscript Info	Abstract

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Background:- The objective of this study is to detect if the presence of breast artery calcification (BAC) on mammograms is associated with an increased risk of coronary artery disease.

Materials and Methods:- This is a retrospective study performed in the period from January, 2011 until January, 2015. Females included in the study were those who had Computed Tomography Coronary Angiography (CTCA) done within one year of mammography, which showed breast arterial calcification (BAC).Breast artery calcification (BAC) was classified into mild, moderate, or severe. The presence of coronary artery calcification(CAC) and the calcium score were determined for all females. With respect to coronary artery stenosis, patients were classified into three groups: normal (no stenosis), non-significant stenosis (less than 50% of luminal narrowing), or significant stenosis (equal to or more than 50% of luminal narrowing) (15). The correlation between BAC site and severity, CAC scoresand coronary artery stenosis was determined.

Results:- Forty-four females had breast arterial calcification (BAC), and Computed Tomography Coronary Angiography (CTCA) done within one year of mammography. The mean age of those females was 63.41 ± 8.12 years.15% of the females with BAC and coronary artery calcification had unilateral BAC, while 85% of them had bilateral BAC, the correlation of which was statistically significant. There was also a significant difference between females with BAC and coronary artery calcification (59%) and those with BAC and no coronary artery calcification (41%). On the other hand, females with severe BAC and non-significant coronary artery stenosis were less than those with moderate BAC and coronary artery stenosis (25% and 37.5%, respectively). In addition, there was no significant correlation between the severity of BAC and CAC scores (r: 0.08, P: <0.05).

Conclusion:- The presence of BAC is associated with a high incidence of coronary artery calcification. However, the severity of BAC has no significant correlation with CAC scores or coronary artery disease on CTCA.

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Introduction:-

Acute myocardial infarction is the leading cause of death among women over the age of 40 years (1, 2). Calcium deposition in the vascular wall is a common feature of degenerative atherosclerotic disease (3, 4, 5, 6). Computed tomography coronary angiography (CTCA) is a non-invasive imaging method used to estimate coronary artery calcification,with coronary artery calcium (CAC) score being the indicator of subclinical atherosclerosis and risk of coronary artery disease (7).

The prevalence of breast arterial calcifications (BAC) ranges from 9% to 17% for the female population and exceeds 50% among females aged 65 years and above (8). Several investigations have suggested BAC as a marker of arterial disease that could be associated with increased risk of cardiac events (9, 10). On the other hand, other studies have reported no significant association between BAC and cardiovascular diseases (11, 12,13).

The objective of this study is to detect if the presence of breast artery calcification (BAC) on mammograms is associated with an increased risk of coronary artery disease.

Materials and methods:-

This is a retrospective study performed in the period from January, 2011 until January, 2015. Females included in the study were those who had Computed Tomography Coronary Angiography (CTCA) done within one year of mammography, which showed breast arterial calcification (BAC). Approval for this study was obtained from the Research Ethics Committee.

Patients with previous cardiac surgery or coronary artery stenting were excluded from the study.
All CTCA studies were performed using a single multi-detector 64-slice CT scanner (Optima CT 660, GE Healthcare, South Carolina, USA). Coronary arterial calcification (CAC) score and the severity of coronary artery stenosis, if present, were determined for each patient. Regarding CAC score, all regions with a density over 130 Hounsfield units were considered significant (14).

With respect to coronary artery stenosis, patients were classified into three groups: normal (no stenosis), non-significant stenosis (less than 50% of luminal narrowing), or significant stenosis (equal to or more than 50% of luminal narrowing) (15).

All mammograms were revised by a single breast-imaging radiologist; with 15 years' experience in breast imaging, who was blinded to the results of CTCA.

Breast arterial calcification (BAC) wasdefined as the presence of parallel linear calcified deposits along the course of a vessel that was seen on mammography,either unilateral or bilateral. BAC was classified into three categories, according to its' severity: Mild BAC (arteries with little calcification with distances greater than 10 mm between calcified areas), moderate BAC (arteries clearly outlined by calcifications over a considerable proportion of their course), or severe BAC (arteries extensively affected, seen to have almost continuous columns of calcification) (16).

Statistical analysis was performed using SPSS 20.0. Univariate analysis was used to calculate odds ratios for relationships between BACsite and severity, CAC scores and incidence and severity of coronary artery stenosis. *P*-values less than 0.05 were considered statistically significant.

Results:-

In the study period, 1,495 females were referred to our department for mammography. Forty-four of those females (2.9%) had breast arterial calcification (BAC), and Computed Tomography Coronary Angiography (CTCA) done within one year of mammography. The mean age of those females was 63.41 ± 8.12 years.

Breast arterial calcification was unilateral in 6 females (13.6%) and bilateral in 38 females (86.4%), Table 1. The grades of BAC were either moderate or severe. Moderate BAC was present in 22 females (50%), while severe BAC was present in 22 females (50%), Table 2.

Table 1:- Number of cases with Breast Arterial Calcification (BAC) as per site:

Site of Breast Arterial Calcification (BAC)	Number of Cases
Unilateral	6
Bilateral	38

Table 2:- Number of cases with Breast Arterial Calcification (BAC) according to severity:

Severity of Breast Arterial Calcification (BAC)	Number of Cases
Moderate	22
Severe	22

Coronary arterial calcification (CAC) score was 1 to130 Hounsfield units in 12 cases (27%), between 130 and 400 Hounsfield units in 14 cases (32 %) and there was no coronary calcification (Zero score) in 18 cases (41%), table 3. Non-significant coronary artery stenosis was detected in 8 cases (18.2%), while the rest of the cases showed no stenosis on CTCA; (81.8%), Table 4.

Table 3:- Coronary Artery Calcification (CAC) Scores of the study cases:

Coronary Artery Calcification (CAC) score	Number of Cases
No CAC (Zero score)	18
1-130 Hounsfield Units	12
130-400 Hounsfield Units	14

Table 4:- Incidence of Coronary Artery Stenosis:

Coronary Artery Stenosis	Number of Cases
No stenosis	36
Non-significant Stenosis	8

33.3% of females with unilateral BAC had no coronary artery calcification on CTCA, while the rest (66.7%) had 130-400 Hounsfield units CAC score. 25% had no coronary artery stenosis, while 75% had non-significant stenosis.

42.1% of females with bilateral BAC had no coronary artery calcification on CTCA, 31.6% had less than 130 Hounsfield units CAC score, while 26.3 % had 130-400 Hounsfield units CAC score. 77% of those females had no coronary artery stenosis, while 37.5% had non-significant stenosis, Table 5.

Table 5:- Correlation of the site of Breast Arterial Calcification (BAC) and Coronary Artery Calcification (CAC) score and Incidence of Coronary Artery Stenosis:

Site of Breast Arterial Calcification (BAC)	Total Number of Cases	No Coronary Artery Calcification (Zero CAC score)	CAC score 1-130 Hounsfield Units	CAC score 130-400 Hounsfield Units	No Coronary Artery Stenosis	Non-significant Coronary Artery stenosis
Unilateral	6	2	0	4	1	3
Bilateral	38	16	12	10	17	5

60% of females with moderate BAC had no coronary artery calcification on CTCA, 9% had less than 130 Hounsfield units CAC score, while 27 % had 130-400 Hounsfield units CAC score. 62.5% of those females had no coronary artery stenosis, while 30% had non-significant stenosis.

25% of females with severe BAC had no coronary artery calcification on CTCA, 41.7% had less than 130 Hounsfield units CAC score, while 33.3 % had 130-400 Hounsfield units CAC score. 75% of those females had no coronary artery stenosis, while 25% had non-significant stenosis, Table 6.

Table 6:- Correlation of the severity of Breast Arterial Calcification (BAC) and Coronary Artery Calcification (CAC) score and Incidence of Coronary Artery Stenosis:

Severity of Breast Arterial Calcification (BAC)	Total Number of cases	No Coronary Artery Calcification (Zero CAC score)	CAC score 1-130 Hounsfield Units	CAC score 130-400 Hounsfield Units	No Coronary Artery Stenosis	Non-significant Coronary Artery stenosis
Moderate	22	14	2	6	5	3
Severe	22	6	9	7	12	4

15% of the females with BAC and coronary artery calcification had unilateral BAC, while 85% of them had bilateral BAC, the correlation of which was statistically significant. There was also a significant difference between females with BAC and coronary artery calcification (59%) and those with BAC and no coronary artery calcification (41%). On the other hand, females with severe BAC and non-significant coronary artery stenosis were less than those with moderate BAC and coronary artery stenosis (25% and 37.5%, respectively). In addition, there was no significant correlation between the severity of BAC and CAC scores (r: 0.08, P: <0.05).

Discussion:-

Screening mammography is recognized as the most important tool for the detection of breast cancer (17, 18).It has been suggested that breast arterial calcification (BAC) seen on mammography could be an indicator of generalized vascular disease (19, 20).

In this study, the incidence of coronary artery calcification was more among females with bilateral BAC than those with unilateral BAC, the correlation of which was statistically significant. There was also a significant difference between females with BAC and coronary artery calcification (59%) and those with BAC and no coronary artery calcification (41%).Maas et al found that BAC was related to the development of coronary artery calcification; which could be attributed to the fact that a systemic vascular process is expected to occur in the patients with more BAC. However, due different etiologies of BAC and coronary artery calcification, they concluded that mammograms might not be used in CAD risk assessment (14).

On the other hand, there was no significant correlation between the severity of BAC and the CAC scores in this study. Moradiet al also did not find any statistically significant correlation between CAC score and the severity of BAC (21).

In addition, females with severe BAC and non-significant coronary artery stenosis were less than those with moderate BAC and coronary artery stenosis. Zgheib et al found no correlation between BAC and coronary artery disease (CAD), even when CAD severity was considered (13). Penugonda et al also demonstrated that BAC was not positively associated with CAD or acute cardiovascular event (12).

On the contrary, Pecchi et al found a significant association between BAC severity and coronary artery calcification (22). Also, Oliveiraet al stated that the presence of vascular calcifications seen via mammography was an independent risk factor for coronary artery disease (23).

In my opinion, the discrepancy in results between different studies is that there are many variables in these studies that affect the development of CAD; like the difference in age groups and the presence of other systemic disease e.g. hypertension. Further investigation is still recommended to achieve accurate results.

In conclusion, the presence of BAC is associated with a high incidence of coronary artery calcification. However, the severity of BAC has no significant correlation with CAC scores or CAD on CTCA.

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