Correlation between Coronary Calcium Score and risk of Artery Disease in presence of Conventional Cardiac Risk Factors

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ABSTRACT

Purpose: Purpose of this study is to investigate the relationship between calcium score and risk of coronary artery disease in presence of conventional cardiac risk factors. Introduction: Coronary Artery Disease (CAD) remains the number one cause of mortality in both men and women worldwide. Literature review: Literature review reveals that Coronary arteries supply oxygen-containing blood to the heart muscles. When calcified plaques narrows /blocks arteries, an oxygen rich blood cannot reach the heart muscles. It can cause angina and heart attacks. This blockage even can lead to sudden death if immediate treatment is not given to those patients. A cardiac Computed Tomography (CT) scan for coronary calcium is a non-invasive way of obtaining information about presence, location and extent of these calcified plaques in the coronary arteries. Methods: Convenient based sampling procedure was adopted at National Medical Centre, Karachi. Questionnaires were distributed among five hundred patients. Among those, only thirty patients whose coronary calcium score was zero were selected for the research. However, they had more than one risk factor. Results: While CT angiography of those thirty patients was done it was observed that only two patients had blockage in their coronary arteries. Rest of them have absolutely normal coronaries. Conclusions: The study concludes by accepting null hypothesis, which states that low calcium score correlates with low risk of coronary artery diseases despite of presence of conventional risk factors and by rejecting alternatives. The amount of calcium detected on cardiac CT scan is a helpful prognostic tool for CAD. There is a general concept that only those patients can develop CAD who have conventional cardiac risk factors, for example high blood pressure, diabetes, high cholesterol, smoking and positive family history of CAD. However, as for as observation are concerned this is not always true. Many patients have more than one risk factors some times all, but their coronary arteries are normal and many patients have no risk factors at all but they have significant blockage in their coronary arteries.

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1.   INTRODUCTION

1.1   Background

Coronary Artery Disease (CAD) remains the number one cause of mortality in both men and women world wide (CDC 1993). Coronary arteries wrap around the heart and supply oxygen –containing blood to the heart muscles. Calcified plaques result when there is a deposition of fat and other substance under inner layer of artery. This material can calcify which causes atherosclerosis that is also called Coronary Artery Disease (CAD). When coronary arteries are narrowed or blocked, oxygen-rich blood cannot reach the heart muscles. This can cause angina and even heart attack. Angina is chest pain or chest discomfort that occurs when not enough oxygen rich blood is flowing to an area of heart muscles. Angina may feel like pressure or squeezing in your chest. The pain may also occur in shoulders, arms, neck, jaws and even back. A heart attack occurs when blood flow to an area of heart muscles is completely blocked. This prevents oxygen –rich blood from reaching that area of heart muscles and causes it to die without quick treatment. A heart attack can lead to serious problems and even sudden death. Unfortunately, signs and symptoms of CAD sometimes are noted in advanced state of a disease. Most of individuals show no evidence of disease for decades. As the disease progress before the first onset of symptoms, often a sudden heart attack arises that finally lead to sudden death without immediate and proper management. Methods of detecting CAD prior to fatal events are needed so that appropriate measures can be taken to reduce the risk of above events.

A Computed Topography Scan (CT scan) for coronary calcium is a non-invasive way of obtaining information about presence, location and extent of calcified plaques in coronary arteries called calcifications. Calcification is an early sign of heart disease. The scan can show before other signs and symptoms occur, whether you are at increase risk for a heart attack. Measurement of coronary calcium predicts CAD independently of traditional risk factors. There are few risk factors for CAD for example high blood pressure, diabetes, high cholesterol, smoking, and positive family history of heart disease. There is a general concept that only those patients have or can develop CAD who has risk factors, but as for as observation are concerned this is not always true. Many patients have more than one risk factors some times all, but their coronary arteries are absolutely normal and many patients have no risk factors at all but they have significant blockage in their coronary arteries. It is observed that presence of calcium in coronary arteries is an early sign of developing heart disease. The amount of calcium detected on a cardiac CT is a helpful prognostic tool. The findings on cardiac CT scan are expressed as a Calcium-Score. Score can range from "0" to more than 400. Any score over 100 means that person is likely to have heart disease.

1.2   Research Objective

Following are objectives of the study:

To investigate systemically the diagnostic and prognostic value of absence of coronary artery calcium despite of presence of any cardiac risk factor

1.3 Scope of the study

This study will help physicians and cardiologist to decide whether the person who has high calcium score in his coronary arteries may need to take preventive medicines .This can prevent to develop heart disease in future. Persons with high calcium score themselves will be able to take those preventive measure and lifestyle changes that will be beneficial for them to avoid heart diseases. For example, quite smoking improves dietary habits, exercise and reduce weight

1.4 Significance of the Study

The study will help researchers, physicians and cardiologist to understand the importance of correlation between coronary calcium score and CAD, irrespective of presence or absence of cardiac risk factors. Cardiologist can recommend CT scan for coronary calcium to asses the risk of developing CAD in their patients and can start preventive medicines if significant deposition of calcium is present in their coronary arteries.

1.4.1 Hypothesis

Low Coronary Calcium Score does not correlate with low risk for developing Coronary Artery Disease despite of presence of number of risk factors.

Does low Coronary Calcium Score correlate with low risk for developing Coronary Artery Disease despite of presence of number of risk factors?

1.5 Research Questions

Question-1: Is this necessary that only those persons will develop heart disease that has conventional cardiac risk factors?

Question-2: Is this mandatory that patients with coronary artery disease will always have cardiac symptoms for example chest pain at the beginning of developing CAD.

1.6 Research Methodology

This study is based on primary data. To collect data non-contrived convenient sampling is done. This study is quantitative as well as qualitative. Well defined questionnaire were distributed among five hundred patients who visited National Medical Centre for CT coronary angiographies. But only those 30 patients were selected for this study who had more than one cardiac risk factors but there was zero calcium score in their coronary arteries to asses the correlation between coronary calcium and risk of CAD despite of presence of cardiac risk factors

1.7. Limitation

Small sample has been taken because of time constrain, sample might not be representative because of convenient based study. There are few limitations of Cardiac CT Scan itself for example persons who have high heart rate or over weight are not the candidate of this scan therefore they are not included in this study.

1.8 Structure of Paper

Section 2 details literature review. Section 3 details data analysis and interpretation. Section 4 concludes the study.

2. LITERATURE REVIEW

Rumberger, Simons, Fitzpatrick, Sheedy and Schwartz (1995) conducted a histopathological correlation study on coronary artery calcium area by Electron Beam Computed Tomography (EBCT) and coronary

atherosclerosis plaques area. Thirty-eight coronary arteries from 13 autopsy hearts were dissected and scanned with EBCT in 3 mm contiguous increments. This histopathological study confirmed an intimate relation between whole heart, coronary artery, and segmental coronary atherosclerotic plaque area and EBCT coronary calcium area independently with cardiac risk factors.

Kondos et.al (2003) worked on correlation between EBCT Coronary Artery Calcium and cardiac events in asymptomatic patients in relation with conventional risk factors. They have conducted 37 months follow-up study of 8895 patients between 30 to 70 yrs old. Conventional Risk Factors were elicited by use of questionnaire. EBCT was done for those patients. After 37+- 12 months, information on the occurrence of cardiac events collected and confirmed from medical records and death certificates found that conventional CAD Risk factors failed to explain nearly 50% of CAD. In 50% of those patients, either risk factors were absent but in EBCT significant calcium deposit were present in their coronary arteries or finally they developed cardiac events in their futures. In other group, they have risk factors but EBCT showed no calcium deposit and in future, they did not develop cardiac events. After conducting this study, they concluded that conventional risk factors fail to explain nearly 50% of CAD and it was only calcium deposit in EBCT, which predict their CAD.

Shareghi et. al. (oct.2007) worked on prognostic significance of zero coronary calcium scores on cardiac computed topography, concluded that absence of coronary artery calcification by cardiac CT is associated with a low adverse event risk, and therefore could be used as a tool to counsel patients about there risk of such cardiac events.

Detrano. et.al (2008) worked on coronary calcium as a predictor of coronary events in four racial or ethic groups. They collected data on risk factors and performed scanning for coronary calcium in a population based sample of 6722 men and women of whom 38.6% were white, 27.6% were black, 21.9% hispanic and 11.9% were Chinese. The study subjects had no clinical cardiovascular disease at entry and were followed for a median of 3.8 years. When results were collected, there were 162 coronary events of which 89 were major events that is heart attacks or death from CAD in comparison with participants with no coronary calcium. The adjusted risk of a coronary event was increased by a factor of 7.73 among participants with coronary calcium score between 101 and 300 and by a factor of 9.67 among participants with scan above 300 among four racial and ethnic groups. A doubling of coronary calcium increased the risk of a major coronary events by 15 to 35% and the risk of any coronary event by 18 to 39%. The areas under the receiver-operating-characteristic events for the prediction of both major cardiac events were higher when coronary calcium score was added to the standards risk factors. With this study, they concluded that coronary calcium score is a strong predictor of incident coronary heart disease and provides predictive information beyond that provided by standard risk factors in four racial and ethnic groups in the United States.

Nayor (2008) worked on cardiac CT to assess coronary artery calcium and concluded that coronary artery calcification is absent in normal vessels but are highly correlated with coronary disease vessels. They are therefore path gnomic for atherosclerosis.

Sarwar, et. al. (2009) worked on Diagnostic and prognostic value of absence of coronary artery calcium, searched and concluded that absence of coronary artery calcium is associated with a very low risk of future cardio vascular events.

Taylor, Feuerstein, Cao, Brazaitis, and O'Malley (2009) worked on coronary calcium independently predict incident premature coronary heart disease over measured cardiovascular risk factors. In this study 2000 people with mean age 43 years, were evaluated with measured coronary risk variables and coronary calcium

detected with EBCT. Incident acute coronary syndrome and sudden death were ascertained through annual telephonic contacts with follow-up (mean 3.0 +_1.4 years,) in 99.2 % of cohort. He concluded that in young asymptomatic men the presence of coronary artery calcification provides substantial, cost effective, independent prognostic value in predicting incident CHD that is incremental to measure coronary risk factors.

3. DATA ANALYSIS AND INTERPRETATION

While conducting this research only those thirty patients were selected, out of five hundred patients, whose coronary calcium score was zero at cardiac CT scan but they have more than one risk factors of coronary artery disease which included high blood pressure, diabetes, high cholesterol, smoking and positive family history of heart disease. Out of 30 patients, 13 had high blood pressure, 5 were diabetic, 14 had high cholesterol, 7 were smoker and 17 had positive family history of angina and heart attacks. Most of those patients have more than 1 risk factor and even in some cases all five risk factors were present.

After performing CT angiographies of those selected 30 patients, results were collected. It was observed that out of 30 patients, Angiographies of 17 patients were normal. It means there was no blockage at all in their coronary arteries despite of presence of more than one cardiac risk factors.

In 11 patients, there was no blockage in their coronary arteries but they had very mild non-obstructive plaques in their arteries. These non-obstructive plaques cannot cause any blockage; therefore, these plaques cannot lead to angina or heart attacks. Among these 11 patients, one interesting finding was observed that 54.55% patients had those non-obstructive plaques in Left Anterior Descending Artery, and remaining 45.45% of patients had those non-obstructive plaques at a rate of 9.99% in Posterior Descending Artery, RAMUS, Obturas marginal, Right Coronary Artery and Diagonal arteries respectively. Following Avenue is opened for further research. Only 2 patients had obstructive plaques (blockage) in their coronary arteries. One patient had blockage in proximal Left Anterior Descending Artery and proximal Right Coronary Artery. Other patient had occlusive lesion in Posterior Descending Artery that is a branch of Right Descending Artery. It means that, this second patient also does not have any obstruction in his main coronary artery.
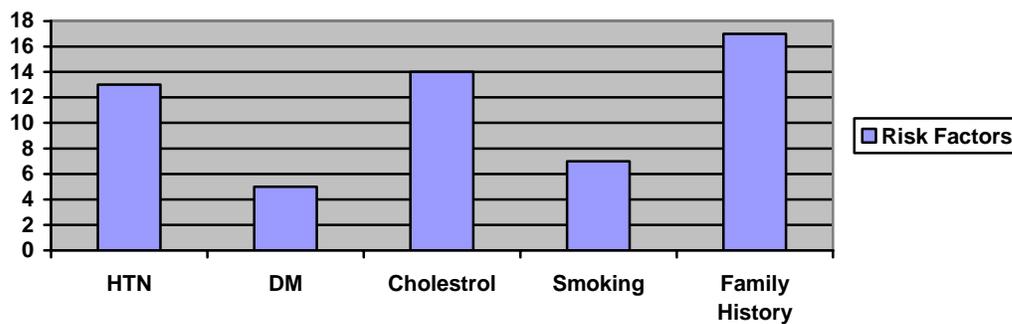

Fig.1

With results of   above data, it was observed that out of thirty patients, only one patient had blockage in his main coronary artery. Rest of patients either had normal coronaries or had non-obstructive lesions that cannot lead to angina or heart attacks.

4. CONCLUSION

Because of above observation and review the study concludes by accepting null hypothesis, which states that low calcium score correlates with low risk of coronary artery disease despite of presence of conventional risk factors, and by rejecting alternatives. It is recommended that every person with cardiac risk factor should take his or her CT Coronary Angiography.

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