

Diagnostic and predictive value of coronary artery calcification in coronary artery stenosis

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Abstract

BACKGROUND: Early diagnosis of coronary artery diseases (CADs) may lead to more efficient treatments. Coronary artery calcification is considered as a valuable index in detecting CAD using a noninvasive technique. This study was conducted to determine the correlation between coronary artery calcification and coronary artery stenosis in patients with typical chest pain.

METHODS: This cross-sectional study was conducted on 760 patients suffering from typical chest pain, in Chamran Hospital, Isfahan, Iran. The patients were all candidates for coronary angiography and were studied for the calcification of coronary artery by fluoroscopy. All patients signed a consent form after the whole procedures were fully explained to them. A fluoroscopic movie was taken from patients (after exposing, and before inserting the angiographic catheter), then the angiography was conducted using Judkins technique. The results of fluoroscopy and angiography were recorded by two cardiologists separately. The presence of any significant stenosis greater than 75% was considered as a sign of severe CAD. The data was analyzed by chi-square test.

RESULTS: Abnormal angiogram was found in 402 patients (59.2%). Positive and negative predictive values for calcification were 81.8% and 26%, respectively. Positive and negative predictive values were respectively 87.1% and 63.4% in females, and 79.7% and 47.3% in males. The highest predictive value (100%) was seen in patients under 40 years old. Coronary calcification in patients with abnormal coronary angiogram was found to be 5.4 times greater than those with normal angiogram.

CONCLUSION: Considering the high predictive value of coronary artery calcification in fluoroscopy, it can be used as a replacement for screening coronary involvement.

Keywords: Calcification, Coronary Vessels, Coronary Disease, Diagnosis.

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Introduction

Coronary artery disease (CAD) is the primary cause of mortality in most industrial countries.¹ CAD is the end-stage of a pathological process that presents itself by calcification and coronary stenosis and does not have a certain treatment at this stage. Since maintenance treatments, balloon angioplasty, and surgery are not cost-effective, early diagnosis of the disease is important.^{2,3} Studies have shown the survival of patients with calcification and atherosclerotic plaque to be less than that for patients without coronary artery calcification.⁴ Furthermore, autopsy studies have indicated a relationship between coronary artery calcification and the severity of

coronary artery stenosis.⁵ Noninvasive imaging methods like helical and electron beam computed tomography (CT) may be applied as ways of diagnosing coronary artery calcification to evaluate and follow-up patients if they have an acceptable predictive value for coronary artery calcification.⁶

There are different methods for diagnosing coronary artery calcification such as electron beam tomography as the most precise method and spiral computed tomography.⁷ Since these methods are not cost-effective, diagnostic value of fluoroscopy in detecting stenosis of coronary artery is under study. Therefore, this study examined the sensitivity and specificity of fluoroscopy to determine coronary

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artery calcification in comparison with angiography in patients with angina pectoris.

Materials and Methods

This cross-sectional study was performed on 760 patients suffering from typical chest pain, in Chamran Hospital (affiliated to Isfahan University of Medical Sciences, Isfahan, Iran). As candidates for coronary angiography, the patients were studied for the calcification of coronary artery by fluoroscopy. Patients with heart attack in the past, kidney failure, calcium metabolism disorders, including hyperparathyroidism, were excluded from the study. Patients were asked to provide their demographics such as age and sex, and also risk factors like smoking, previous illness and angina, blood pressure and serum lipid profile, and family history for early-onset heart disease. Following the approval of Ethics Committee, the patients were requested to sign a written consent form for coronary artery fluoroscopy. Patients who did not consent to sign the form were not allowed to participate in the study.

Fluoroscopy procedure was conducted when the patients were lying back and taking deep breaths. Coronary artery angiography was then performed according to the standard method of Judkins.⁸ Prior to dye-injection, the patients were exposed to radiation for determining the place of catheter or guide and recording their anterior-posterior view. In standard angiographic views, main, diagonals, and marginal coronary arteries were determined. The results of fluoroscopy and angiography were separately studied by two cardiologists who were not the patients' physicians. The presence of any stenosis greater than

75% in main arteries including left anterior descending, right coronary, and circumflex was considered as a sign of severe coronary artery involvement. Fluoroscopy results were evaluated to see if there was any coronary artery calcification. Moreover, in cases that the place of calcification was identical to the place of severe stenosis, calcification was taken into account. If the results provided by the cardiologists were different, the opinion of a third cardiologist was applied. Prognostic value of the fluoroscopic results was determined based on the standard angiography.

All collected data was analyzed by chi-square test at a significance level of $P < 0.05$ using SPSS (SPSS Inc., Chicago, IL, US).

Results

Among the 760 participants, 69 people (9%) were under 40 years old, 407 people (53.5%) were between 40 to 60 years old, and 358 people (47.1%) were over 60 years old. Normal and abnormal angiograms were found in 358 patients (47.1%) and 402 patients (52.9%), respectively (Table 1).

Fluoroscopy of 110 patients showed coronary artery calcification, of which 90 patients (81.8%) had positive angiograms and 20 patients (18.2%) had negative angiograms. The sensitivity and specificity of the test was estimated as 22.3% and 94.4%, respectively. The positive predictive value for the calcification as an involvement index of coronary artery was estimated as 81.8% and its negative predictive value as 26% (Table 2). Coronary artery calcification in patients with normal and positive angiograms was 5% and 27%, respectively.

Table 1. Frequency of angiographic and fluoroscopic results in the studied patients according to their age and sex

		Positive angiography	Positive fluoroscopy
		n (%)	n (%)
Sex	Man	253 (63%)	79 (10.4%)
	Woman	149 (37%)	31 (4.1%)
		p	< 0.01
age	< 40 years old	18 (26.1%)	3 (4.3%)
	40-60 years old	204 (50.1%)	54 (13.3%)
	> 60 years old	180 (63.4%)	53 (18.7%)
		p	< 0.0001

Table 2. Prognostic value of calcification test for the studied patients according to their age and sex

		Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
Sex	Men	24.9	91.4	79.7	47.3
	Woman	13.9	98.6	87.1	63.4
Age	< 40 years old	16.6	100	100	77.2
	40-60 years old	22.5	96	85.2	55.2
	> 60 years old	22.7	88.4	77.3	39.8

Discussion

In this study, the probability of the disease for each patient in case of positive fluoroscopic result was 81.8% which increased to 100% for patients less than 40 years of age and 87.1% for women. When calcification was not found in fluoroscopy, the probability for being healthy was 26% which improved to 77.2% for patients under 40 years old and 63.4% for women. A similar study estimated the positive predictive value based on stenosis greater than 50% as 37.7% and 91.9% in men and women, respectively.⁹

A study performed on male pilots with the mean age of 40 to 60 years showed that the positive and negative predictive values in pilots less than 60 years of age were higher than those over 60 years old. The results of the above study conformed to the results of the present study and other similar studies which reported higher percentage of coronary artery calcification in old age.¹⁰ Furthermore, the present study showed a higher percentage of coronary artery calcification in men than women which affirmed the results of similar studies.¹⁰

Another study showed that coronary artery calcification caused involvement of coronary artery and peripheral arteries in diabetic patients 5 to 13 times more than other patients.¹¹ In the present study, the probability for the involvement of coronary artery in patients with calcification was 5.4 times for all patients.

Considering the stronger relationship of coronary artery calcification with stenosis of these arteries, especially the higher positive predictive value in women and patients under 40 years old, noninvasive procedures like CT scan and fluoroscopy with sensitivity of 80-100% in diagnosing calcification can be simply used in determining the involvement status of patients before doing invasive procedures.^{12,13}

Moreover, in high risk patients over 60 years of age with less sensitivity of the coronary artery calcification presence and predictive value, fluoroscopy can be used to evaluate the probability for the involvement of coronary artery. Therefore, in high risk patients, a noninvasive fluoroscopic procedure prior to an invasive method can determine coronary artery calcification index as a suitable predictor for angiographic results which can be used in clinical decision-making. This procedure can thus be used for high risk patients because of its noninvasive nature.

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Conflict of Interests

Authors have no conflict of interests.

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