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ORIGINAL ARTICLE

Normal Coronary Arteries: Our Experience at Ibrahim Cardiac Hospital & Research Institute

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ABSTRACT

Background & objectives: Patients of acute coronary syndrome (ACS), stable angina or chest pain may have normal or near normal coronary arteries in angiogram, which are five times more common in female. Cardiac conditions where chest pain occurs in absence of obstructive coronary artery disease are Prinzmetal's angina, Cardiac syndrome X, female pattern coronary artery disease (CAD) and myocardial bridge. The present study was undertaken to see the clinical profile of the patients with normal coronary angiogram.

Methods: This cross-sectional study was done to see the clinical profiles of patients who had chest pain but normal angiographic findings and to compare them with those who had chest pain with abnormal angiographic findings. The study was conducted on 6708 patients who underwent coronary angiogam at Ibrahim Cardiac Hospital & Research Institute in between February 2005 to June 2009.

Result: Of the total 6078 patients, 626 (9.4%) patients had normal coronary arteries which were higher in female population than in male population (12.7% vs. 8.2%). Abnormal angiogram was found more in patients who presented with acute coronary syndrome and also in patients with normal ECG (in one-fifth of the cases). Among traditional risk factors only diabetes was revealed to be significantly associated with abnormal coronary angiogram.

Conclusion: Patients presenting with chest pain may have normal coronary angiogram which is more common in women than in men.

Key words: Normal coronary angiogram, acute coronary syndrome, male and female.

Introduction

A proportion of patients who presented with acute coronary syndrome (ACS), stable angina or for chest pain evaluations are found to have normal or near normal coronary arteries. Chest pain with normal or near normal coronary arteries is five times more common in women,[1] and is not uncommon to practicing cardiologists. Such chest pain may be of cardiac or non-cardiac origin. Cardiac conditions where chest pain occurs in absence of obstructive coronary artery disease are Prinzmetal's angina, Cardiac syndrome X and 'female pattern' coronary artery disease (CAD). Myocardial bridge may also give rise to angina.[2] In Prinzmetal's angina coronary artery vasospasm occurs with signs and symptoms of ischemia along with episodic ST segment elevation. Pain occurs predominantly at rest, usually with preserve effort tolerance. Diagnosis is confirmed by angiographic demonstration of spasm (spontaneous or following provocative tests).[3] Overall, 2% to 3% of patients with chest pain undergoing coronary angiography appear to have variant angina.[4]

Cardiac syndrome X is characterized predominantly by effort induced angina, ST segment depression suggestive of myocardial ischaemia during spontaneous or provoked angina, normal coronary arteries at angiography, absence of spontaneous or provoked epicardial coronary artery spasm and absence of conditions like hypertrophic or dilated

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cardiomyopathy. Syndrome X is associated with two major abnormalities i) coronary microvascular dysfunction and ii) abnormal cardiac pain sensitivity. This occurs due to involvement of small (< 500 mm), invisible (not visible on coronary angiography) coronary arteries.[5] In female-pattern of CAD, the process of atherosclerosis does not form localized plaques, that is, the localized blockages are absent. Instead, the plaques in these women are more diffuse, involving, to some extent, the entire circumference of the artery so that the lining of the artery becomes thickened throughout and the entire artery is just narrowed. On cardiac catheterization these coronary arteries appear smooth-walled and normal, though they may look "small" in diameter. This female-pattern of CAD may even cause myocardial infarction by erosion/rupture of the plaques with superimposed thrombus formation which may be successfully dissolved with thrombolytic drugs. The subsequent heart catheterization usually shows "normal" coronary arteries. The prognosis with female-pattern CAD is thought to be better than with typical CAD, but this is not a benign condition.[6] Occasionally, compression of a portion of a coronary artery by a myocardial bridge can be associated with clinical manifestations of myocardial ischemia during strenuous physical activity and may even result in myocardial infarction or initiate malignant ventricular arrhythmias. The functional consequences of myocardial bridging may be better characterized with the use of IVUS.

There are various causes of non-cardiac chest pain among which gastro-esophageal reflux and psychiatric disorders are the commonest.[7] Initially the prognosis of the patents with chest pain in absence of obstructive CAD was considered as benign, but evidence from the Women's Ishaemic Syndrome Evaluation (WISE) study showed that the symptoms & sign suggestive of myocardial ishaemia without obstructive CAD are at elevated risk for cardiovascular events.[8] Again patients with suspected stable angina with normal coronary arteries and diffuse non-obstructive CAD were associated with significantly increased risk of future major adverse cardiovascular events (MACE) and all-cause mortality compared with a normal population without ischaemic heart disease. Therefore, the present study was conducted to find the prevalence of normal coronary angiogram in patients with chest pain.[9]

Methods

This cross-sectional study was done to see the clinical profiles of patients who had chest pain and normal angiographic findings and to compare them with those who had chest pain and abnormal angiographic findings. The study was conducted on patients who underwent coronary angiogram in Ibrahim Cardiac Hospital & Research Institute between February 2005 and June 2009. The total number of procedures done during the period was 7103. Out of 7103 cases, 6708 cases underwent coronary angiogram (CAG). Major demographic and clinical information were kept along with angiographic findings in the database. The database was in Microsoft Access and was exported to SPSS and analyzed. In our study we used the term normal when there was no visible lesion in any of the major coronary arteries or in their branches on coronary angiogram. Data were analysed using SPSS (Statistical Package for Social Sciences), version 11.5. The test statistics used to analyse the data were Chi-square (χ^2) Probability Test. Level of significance was set at 0.05 and $p < 0.05$ was considered significant.

Result

Of the 6708 patients, who underwent coronary angiogram, normal coronary arteries were found in 632(9.4%) cases (Table I). The patients with abnormal coronary angiogram presented with acute coronary syndrome and old MI were significantly higher (39.5% and 15.2% respectively) than the patients with normal coronary angiogram (34.3% and 12% respectively) ($p = 0.001$) (Table II). Nearly one-third (32.6%) of patients with normal coronary angiogram had normal ECG as opposed to 20.4% of patients with abnormal coronary angiogram. About one-third (32.2%) of the patients with abnormal coronary angiogram exhibited MI on ECG compared to only 8.5% of patients with normal coronary angiogram ($p < 0.001$) (Table III). About 10% of the patients with normal coronary angiogram had positive ETT.

Table I. Distribution of patients by findings of coronary angiogram (n = 6708).

Coronary angiogram	Frequency	Percent
Normal	632	9.4
Abnormal	6076	90.6

Table II. Clinical presentation of patients.

Presentation	Coronary angiogram		p-value
	Normal (n=632)	Abnormal (n=6076)	
Stable angina	110(17.4)	1039(17.1)	
ACS (UA & AMI)	217(34.3)	2399(39.5)	0.001
Old MI	76(12.0)	925(15.2)	
Other conditions with atypical chest pain	229(36.2)	1713(28.2)	

Figures in the parentheses denote corresponding percentage.
Data were analysed using Chi-square (χ^2) Test.

Table III. ECG findings of patients with normal and abnormal coronary angiogram.

ECG findings	Coronary angiogram		p-value
	Normal (n=632)	Abnormal (n=6076)	
Normal	206(32.6)	1238(20.4)	
MI	54(8.5)	1956(32.2)	
ST-changes	218(34.5)	1831(30.1)	0.001
BBB	60(9.5)	301(5.0)	
Others	94(14.9)	750(12.3)	

Figures in the parentheses denote corresponding percentage.
Data were analysed using Chi-square (χ^2) Test.

The demographic characteristics of the patients show that normal angiogram was more common among patients below the age of 50 years than those among 50 or > 50 years old (11.2 vs. 8.5%, $p < 0.001$) (Table IV) and in female population than that in male population (12.7 vs. 8.2%, $p < 0.001$) (Table V). Of the six traditional risk factors like obesity, dyslipidaemia, diabetes, hypertension, smoking habit and family history ischemic heart diseases (IHD) only diabetes was revealed to be significantly associated with abnormal coronary angiogram ($p < 0.001$) (Table VI).

Table IV. Patients' demographic characteristics and coronary lesion.

Coronary Angiogram	Age (yrs)		p-value
	< 50 (n=233)	⩾ 50 (n=4370)	
Normal	261(11.2)	371(8.5)	
Abnormal	2077(88.8)	3999(91.5)	<0.001

Figures in the parentheses denote corresponding percentage.
Data were analysed using Chi-square (χ^2) Test.

Table V. Patients' demographic characteristics and coronary lesion.

Coronary Angiogram	Sex		p-value
	Male (n=4924)	Female (n=1784)	
Normal	405(8.2)	227(12.7)	< 0.001
Abnormal	4519(91.8)	1557(87.3)	

Figures in the parentheses denote corresponding percentage.
Data were analysed using Chi-square (χ^2) Test.

Table VI. Association between risk factors and angiographic lesion.

Risk factors	Coronary angiogram		p-value
	Normal (n=632)	Abnormal (n=6076)	
BMI (kg/m²)*			
< 25 (normal)	346(54.7)	3405(56.0)	0.533
⩾ 25 (overweight & obese)	286(45.3)	2671(44.0)	
Dyslipidaemia*			
Present	314(50.1)	3285(54.0)	0.136
Absent	318(49.9)	2791(46.0)	
Diabetes mellitus*			
Present	292(46.2)	3675(60.5)	< 0.001
Absent	340(53.8)	2401(39.5)	
Hypertension*			
Present	398(63.0)	3810(62.7)	0.894
Absent	234(37.0)	2266(37.3)	
Smoking*			
Present	60(9.5)	682(11.2)	0.346
Absent	572(90.5)	5394(88.8)	
Family history of IHD*			
Present	50(7.9)	368(6.1)	0.320
Absent	582(92.1)	5708(93.9)	

Figures in the parentheses denote corresponding percentage.
*Data were analysed using Chi-square (χ^2) Test.

Discussion

In our study, out of 6078 patients who presented with atypical chest pain, stable angina, acute coronary syndrome or old MI, 632 patients (9.2%) had normal coronary arteries on angiogram which is much lower than the studies conducted abroad. In one study more than half of the women with stable angina who underwent coronary angiography had no obstructive CAD, as compared with only one-third in men.[10,11] In another study Jespersen et al[9] demonstrated that patients suspected of stable angina pectoris frequently have no obstructive CAD (65% in women and 32% in men).

The phenomenon of normal coronary angiogram was more prevalent in women in our center (12.7% vs. 8.2%) which is consistent with the studies mentioned above. However, it is lower than a study conducted in the US, where 50% of the women with chest pain undergoing coronary angiographies had normal or near-normal coronary arteries, as compared with only 15% of men.[9] In our study the patients with normal angiogram presented with atypical chest pain more frequently than the patients with abnormal coronary angiogram (36.2% vs. 28.2%), while the patients with abnormal coronary angiogram presented more with acute coronary syndrome than the patients with normal findings (39.5% vs. 34.3%). Johnson et al[12] in his study on women with non-obstructive CAD demonstrated different symptom profiles to be associated with various long-term outcomes. But in our study we could not collect follow-up data to see further cardiac events. As observed in other studies, abnormal angiograpgic findings in our study were also more in patients aged over 50 years and in male gender. We found diabetes to be significantly higher in patients with abnormal coronary angiogram group ($p < 0.001$). In another comparative study of risk factors between patients of myocardial infarction (MI) with normal coronary arteries and MI with obstructive CAD, prevalence of smoker was similar in both groups, but higher prevalences of diabetes, hypertension, dyslipidaemia & family history of IHD were found in MI patients with obstructive CAD than in patients of MI with normal coronary angiogram.[13]

Conclusion

In our observation normal coronary arteries appear in about 10% of CAGs. Normal coronary arteries are found more in younger female patients with atypical chest pain than those in older male patients with typical chest pain and acute coronary syndrome. However, presentation of the patients with normal angiogram may not always be associated with atypical chest pain. Presence of diabetes appeared to be less common with normal coronary angiogram. Other Risk factor analysis and exercise testing are of limited value in predicting coronary artery disease especially in women.

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