

Comparison of angiographic with myocardial perfusion scintigraphy findings in cardiac syndrome X (CSX)

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Abstract. – **Objective:** Cardiac syndrome X (CSX) is defined by an angina-like chest pain, a positive response to stress testing and normal or near normal coronary angiogram. We evaluated the angiographic findings in patients with cardiac syndrome X and compared it with myocardial perfusion scintigraphy findings.

Patients and Methods: The study included 39 females aged 40-58 years (mean, 49.79 ± 4.69 [SD] and 13 males ranging from 40 to 54 years (mean, 47.54 ± 3.76 [SD] with CSX. By reviewing the angiographic film, some variables including stenosis (less than 30% of vessel diameter), delay run off, delay wash out, calcification and tortuosity were evaluated. Thirty-two had been undergone on myocardial perfusion imaging (MPI).

Results: The most frequent abnormal angiographic finding in three territories was stenosis item. Overall, 22 of 32 (68.75%) CSX patients had ischemia on MPI. The result of the myocardial perfusion imaging was not concordant with five angiographic findings.

Conclusion: We suggest that the presence of angiographic coronary findings such as stenosis, delay run off, delay wash out, calcification and tortuosity are not invariably associated with atherosclerosis, and also seen in CSX patients.

Key Words:

Cardiac syndrome, Angiography, Myocardial perfusion imaging.

LBBB = Left Bundle Branch Block

CHD = Congenital Heart Disease

LEAP = Low-Energy All Purpose

ECG = Electrocardiogram

CSX = Cardiac Syndrome X

CAD = Coronary Artery Disease

MVP = Mitral Valve Prolapse

LAD = Left Anterior Ascending

LCX = Left Circumflex

RCA = Right Coronary Artery

Introduction

Cardiac syndrome X (CSX) is defined by an angina-like chest pain, a positive response to stress testing and normal or near normal coronary angiogram¹⁻⁴. Patients with coronary artery spasm (Prinzmetal's or variant angina), left ventricular hypertrophy, systemic hypertension, and valvular heart disease are not included in this syndrome⁵. None of the noninvasive diagnostic modalities, including the exercise treadmill test (ETT) or single-photon emission computed tomography (SPECT), can convict the physicians and patients, so a substantial number of patients would finally undergo coronary angiography, which has been considered the "gold standard" for the diagnosis⁶. However, up to 30% of patients who underwent coronary angiography to evaluate the causes of chest pain may have angiographically normal coronary arteries⁶.

The patients often go through various diagnostic testing and therapeutic approaches.

The exact pathophysiological mechanisms underlying this condition are not well understood, and many mechanisms for the chest pain have

Abbreviations

MPI = Myocardial Perfusion Imaging

SPECT = Single Photon Emission Computed Tomography

ETT = Exercise Treadmill Test

CHF = Congestive Heart Failure

been suggested⁷. In some studies, microvascular dysfunction has been proposed as the cause⁸ whereas, in others inflammatory process have been demonstrated⁹. Noninvasive imaging has been performed to detect the possible ischemia. Some limited invasive studies have been performed which have demonstrated a relative reduction in coronary flow in a proportion of CSX patients¹⁰.

This study assessed the angiographic characteristics of CSX cases and compared them with myocardial perfusion imaging (MPI) finding.

Patients and Methods

Participants and Study Design

Fifty-two patients with angina-like chest pain who were referred to carry out cardiac catheterization to rule out a possible coronary artery disease were enrolled in our study. The patients were recruited from the Cardiology Clinic at our Hospital from May 2004 to September 2005. All patients had normal or near normal coronary angiography (less than 30%) and also no inducible spasm on ergonovine-provocation test. In addition, none of them had diabetes, hypertension, left ventricular hypertrophy (defined as a value above 35 mm for the sum of the heights of the S wave in lead V1 and R wave in lead V5), valvular heart disease, congestive heart failure (CHF), history of myocardial infarction, mitral valve prolapse, left bundle branch block(LBBB), congenital heart disease (CHD), cardiomyopathy, ejection fraction less than 55% in echocardiography or demonstrated any remarkable change in clinical condition during the investigations. Thirty-two had been undergone on MPI (myocardial perfusion imaging). The findings on the myocardial single photon emission computed tomography with 99mTc-MIBI using 17 left ventricular segments model were compared with related

artery territory on angiography which was concordant or not. The study was approved by the institutional Ethics Committee of Tehran University of Medical Science and all patients gave written informed consent.

Coronary Arteriography

Coronary arteriography was performed with a monoplane imaging system and recorded on Digital Versatile Disc (DVD). By reviewing the angiographic film, some variables including stenosis, tortuosity, delay run off, delay wash out and calcification were evaluated. Angiographic films were evaluated by two cardiologists who were blind to scintigraphic data.

Statistical Analysis

Data are presented as the mean \pm standard deviation. Chi square and *t* tests were also applied. A *p* value <0.05 was considered to be statistically significant.

Results

The study included 39 females aged 40–58 years (mean 49.79 ± 4.69) and 13 males ranging from 40 to 54 years (mean, 47.54 ± 3.76) who had CSX. There were no differences in age of CSX in two genders (*p* value=0.45).

Out of 52 participants, 24 cases had at least one angiographic variable in left anterior descending (LAD); 13 cases in left circumflex (LCX) and 16 cases in right coronary artery (RCA). The angiographic items were most common in the LAD vessel. In LAD vessel: stenosis, delay run off, delay wash out, calcification and tortuosity were found in 10, 3, 1 and 4 participants respectively (Table I).

In LCX vessel: six, one, and three participants had stenosis, delay run off and tortuosity respectively (Table II). In RCA vessel: stenosis was

Table I. Distribution of variables in LAD vessel.

| Total | Women | Men | Variable |
|-----------|-----------|----------|----------------|
| 10 (19.2) | 7 (13.5%) | 3 (5.8%) | Stenosis < 30% |
| 4 (7.7%) | 3 (5.8%) | 1 (1.9%) | Delay run off |
| 3 (5.8%) | 2 (3.8%) | 1 (1.9%) | Delay washout |
| 1 (1.9%) | 0 (0%) | 1 (1.9%) | Calcification |
| 4 (7.7%) | 2 (3.8%) | 2 (3.8%) | Tortusity |

Table II. Distribution of variables in LCX vessel.

| Total | Women | Men | Variable |
|-----------|----------|----------|----------------|
| 6 (11.5%) | 4 (7.7%) | 2 (3.8%) | Stenosis < 30% |
| 1 (1.9%) | 1 (1.9%) | 0 (0%) | Delay run off |
| 0 (0%) | 0 (0%) | 0 (0%) | Delay wash out |
| 0 (0%) | 0 (0%) | 0 (0%) | Calcification |
| 3 (5.8%) | 2 (3.8%) | 1 (1.9%) | Tortuosity |

seen in 5 cases, delay run off in 2, delay wash out in one and tortuosity respectively in one participant (Table III).

Overall, 22 of 32 (68.75%) CSX patients had ischemia on MPI and 20 cases had no MPI. In addition, none of them had fixed lesion and transient left ventricular dilation (TLV) on MPI.

The location of the myocardial perfusion imaging findings were not concordant with related angiographic vessel involvement.

Discussion

In our study the most abnormal angiographic finding was stenosis in three vessels. The calcification variable was in less than 1% that was similar to the previous studies¹¹⁻¹³. The other variables were reported more in CSX patients relative to the normal individuals in the limited studies as shown in our investigation¹¹⁻¹³.

Coronary blood flow, measured by argon wash out method, showed only a limited increase after pharmacologic coronary arteriolar dilation with dipyridamole in one study¹⁰. Another study measuring great cardiac vein flow by thermodilution method demonstrated a limitation in flow in response to rapid atrial pacing¹⁴. Further, measurement of coronary flow before and after intravenous ergonovine administration, keeping the same pacing rate, showed that increase in flow

was less and coronary vascular resistance higher in those patients who experienced typical pain following ergonovine administration, suggesting that the microvessels were probably more responsive to vasoconstrictor stimuli.

There was a predominance of female to male patients (39/13) referred to our Hospital with a mean age of 49.79 ± 4.69 yrs in females suggesting the most of CSX cases are perimenopausal women as showed in other prior studies¹⁵. A large number of women with syndrome X have been shown to have oestrogen deficiency but the exact role of the female hormone in this disorder remains to be elucidated¹⁵⁻¹⁸.

In our investigation, 68.75% of MPIS showed ischemic pattern without fixed lesion and TLV dilation. In a review of the literature, a number of Authors have reported different results from 27% to 98%^{17,18}. We found 36% of ischemic pattern in CSX patients using Tc-99m MIBI SPECT and discussed more in our previous study¹.

In our study, results of the myocardial perfusion imaging were not concordant with angiographic findings which it may be due to the nature of this disease. In these patients, small areas of hypoperfusion were erratically distributed in different anatomic sites, which is obviously different from that of patients with coronary artery disease, whereas the hypoperfused areas are clustered in the specific anatomic regions^{19,20}. However, it must be noted that this research had some limitations since patients were selected from a

Table III. Distribution of variables in RCA vessel.

| Total | Women | Men | Variable |
|----------|----------|----------|----------------|
| 5 (9.6%) | 3 (5.7%) | 2 (3.8%) | Stenosis < 30% |
| 2 (3.8%) | 2 (3.8%) | 0 (0%) | Delay run off |
| 1 (1.9%) | 1 (1.9%) | 0 (0%) | Delay wash out |
| 0 (0%) | 0 (0%) | 0 (0%) | Calcification |
| 1 (1.9%) | 0 (0%) | 1 (1.9%) | Tortuosity |

referral Hospital so they do not represent as an unbiased group of CSX patients. Further well designed studies are needed to assess these preliminary results.

In conclusion, the discrimination of CAD resulting from atherosclerosis and also CSX are essential due to dissimilar prognosis. It might be suggested that the presence of angiographic coronary findings such as stenosis, delay run off, delay wash out, calcification and tortuosity are not invariably associated with atherosclerosis, and also seen in CSX patients. However, well designed studies are needed to confirm these results.

Acknowledgements

This study was the postgraduate thesis of Dr. Mohammad Yaghoubi for residency of Cardiology and was carried out with the sponsorship of Tehran University of Medical Sciences.

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