Correlation of Wall Motion Abnormality by Stress Echocardiography and Anatomic Site of Coronary Artery Lesions

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Abstract

Background- Stress echocardiography is one of the non-invasive methods to diagnose coronary artery disease. Myocardial wall motion abnormality, caused by pharmacological and non-pharmacological procedures performed upon the patients suffering from coronary artery disease, is observed and analyzed by this method.

Patients and Material- One hundred and three cases, who had undergone stress echocardiography, were researched on over one year in the stress echocardiography unit of Rajai Heart Center. We compared the results of the stress echocardiography and the results of the angiography. The patients' ages varied from 32 to 73 years (mean 48.9). The two methods of exercise stress echocardiography and dobutamine stress echocardiography were adopted.

Results- In this analysis, the sensitivity and specificity for the diagnosis of CAD were respectively 89.4 and 82.5 percent. The sensitivity and specificity for the diagnosis of LAD lesions were 79.6 and 87, for RCA lesions 80.6 and 82.3 and for LCX lesions 58.1 and 89 percent respectively. The sensitivity and specifity for the diagnosis of the posterior circulation system (RCA and LCX territories) were 90% and 75% respectively. During the study, no severe complications (VF, MI, death) occurred; however, one case suffering severe ischemia ended up in CCU. Moreover, arrhythmia in 3 patients (2.9%), hypertension in 9 patients (8.8%), for one of whom the test was interrupted due to severe hypertension, hypotension in one patient (1%), and non-cardiac complications such as vertigo, nausea and headache in 13 patients (12.6%) were reported.

Conclusion- Considering the results gained in this study, and also the low rate of complications and similar results with radionuclide scanning, which has proved more expensive and apt to make patients exposed to radiation, this test as a non-invasive test before coronary angiography is recommended. (***Iranian Heart Journal.*** **2002; 2(4)&3(1): 26-27**)

Key words: stress echocardiography < coronary artery disease < wall motion abnormality < dobutamine

Coronary artery disease (CAD) is well known as one of the most fatal diseases in Iran. There are multiple diagnostic methods for CAD, but coronary angiography is considered as the gold standard method. There are various methods to diagnose a patient suffering from CAD such as exercise test, radionuclide scanning and stress echocardiography.

Stress echocardiography is one of the best methods. In this test, the mismatch

between the blood supply and myocardial demand in the patient suffering from CAD and the creation of segmental ischemia, could be seen through wall motion abnormality and loss of contractility. Although exercise test is more available and less expensive, it has shown less sensitivity and specifity. Moreover, locating the site and determining the size of the ischemic area by exercise test is remotely possible. Radionuclide scanning can do so but costs more and exposes the patient to radiation. Stress echocardiography, which enjoys similar results considering sensitivity and specifity to radionuclide scanning with less cost and more availability, can also enable us to analyze ventricular function.

Stress echocardiography is generally done in two ways: exercise stress echocardiography and non-exercise stress echocardiography, which could be performed by pacing and pharmacological procedures.

In pharmacological stress echocardiography, the drugs either increasing myocardial demands (dobutamine, arbutamine) or decreasing myocardial blood supply with steal mechanism (dipyridamole) are used.

In the research done, the two methods of exercise echocardiography and dobutamine stress echocardiography were performed.

Choosing either of them was determined by the patient's condition and the test asked for when the patient was introduced to the center.

In view of the fact that comparing the results of the two methods did not show any considerable differences, we analyzed all the data ignoring the methods.

Material and Methods

Patients were sampled from either our outpatient units or inpatients referred for coronary angiography in Rajai Heart Center.

The patients mostly complained of chest pain or equivalent angina.

One hundred and three cases were studied. The outpatients, with positive stress echocardiography underwent coronary angiography. The ones who answered negative, and were under 40 and suffered from atypical chest pain and had less than two risk factors for CAD were supposed to have normal coronary arteries inasmuch as the possibility of CAD in these patient had proved less than 5%. Four patients out of 103 were excluded due to test complications and 79 out of 99 underwent coronary angiography. Nineteen cases of 103 underwent exercise echocardiography and 84-dobutamine-stress echocardiography.

In exercise stress echocardiography, the patients underwent first echocardiography when resting (4c, 2c, long & short axis parasternal views), then exercise with Bruce protocol. After achieving end point (chest pain and target heart rate etc.), we interrupted the test and within 2 minutes the patients underwent echocardiography again. Pre-test and post-test pictures were analyzed side by side, in which anterior, inferior, anteroseptal, septal and lateral walls were studied. Anteroseptal and posterior walls were divided into 2 segments (basal and mid ventricular) and the other walls were divided into 3 segments (basal, mid-ventricular and apical), 16 segments in total.

In dobutamine stress echocardiography, first the patients underwent echocardiography when resting with subsequent injection of 5mcg/kg/min dobutamine with a stepwise increase (every 3 minutes) of up to 40 mcg/kg/min. If the target heart rate (85% maximal heart rate) was not achieved, 0.25 mg of atropine in 4 successive doses was added and echocardiography was performed. Throughout the process, regular monitoring of the cardiac rhythm and blood pressure was performed.

Diagnostic Protocol

Rest	Low dose	High dose	Diagnosis
Normal	Normal	Hyperkinesia	Normal
Normal	Normal, except severe CAD	Hypokinesia Comparing rest or tardokinesia	Ischemia
Hypokinesia or Akinesia	Improvement	Sustained improvement	Viable patent artery.

Exclusion Criteria

The patients suffering heart failure, unstable angina, history of recent myocardial infarction (MI), congenital heart disease, valvular heart disease, cardiomyopathy, serious arrhythmia, uncontrolled hypertension and the ones who refused to undergo the test were excluded.

Ethic considerations

The patient showing negative stress echocardiography with less than 2 risk factors did not undergo coronary angiography. The patient's consent was a sine qua non.

Results

103 cases, aged between 32 to 73, were studied. 26 women and 77 men comprised the group, 26 of whom were without risk factors and 77 with risk factors.

53 patient had no history of MI but 50 patients did have a history of MI. 19 patients underwent exercise echocardiography and 84 dobutamine stress echocardiography. 24 patients showed negative stress echocardiography with no risk factors, so no coronary angiography was performed. 8 patients had normal coronary angiography. So totally 32 patients were considered to have normal coronary arteries.

34 patients indicated single vessel disease (34.2%), 17 patients with 2VD (17.2%) and 16 patients had 3VD (16.2%).

4 patients were excluded due to complications and the interruption of the test.

50 patients showed normal Lad and 49 had LAD lesion.

68 patients showed normal LCX and 31 had LCX lesion.

63 patients showed normal RCA and 36 had RCA lesion.

During stress echocardiography 56 cases showed normal stress echocardiography in LAD territories, but 43 patients had wall motion abnormality in those areas.

77 cases showed normal stress echocardiography in LCX territories and in the same areas 22 patients showed wall motion abnormality.

62 cases showed normal stress echocardiography in RCA territories and in the same areas 37 patients showed wall motion abnormality.

62 patients had no wall motion abnormality during rest but had it while resting. In 39 patients, mild complications in 23 and severe complications in 6 patients were noted. Arrhythmia in 3 patients (2.9%), hypertension in 9 patients (8.8%), for one of whom the test was interrupted due to severe hypertension, hypotension in one patient (1%) and non cardiac complications such as vertigo, nausea and headache in 13 patients (12%) were noted.

No severe complications (VF, MI, death) were present; although, one case suffering severe ischemia ended up in CCU.

In this analysis, the sensitivity and specifity of stress echocardiography for the diagnosis of LAD lesions were 79.6% and 87% respectively, for LCX lesions 58.1% and 89% and for RCA lesions 80.6% and 82.3% respectively. The sensitivity and specificity of the test for the diagnosis of CAD were 89.5% and 82.5%, respectively.

Discussion

The sensitivity and specificity of stress Echocardiography for the diagnosis of CAD in this study were 89.5% and 82.5%, respectively. This figures changed to 79.4% and 87.9% in patients who did not

have wall motion abnormality at rest. These results have been reportedly different in some other centers. However, the last statistics usually take about 89% sensitivity and 85% specificity.

In our study, the sensitivity and specificity for the diagnosis of LAD lesions were 80% and 87%, respectively, for RCA lesions 81% and 82% and for LCX lesions 58% and 89%.

The sensitivity of the test for the diagnosis of CAD in Cleveland Clinic in patients suffering from LAD and LCX and RCA lesions have been reported as 77%, 67%, 70%, respectively.

These figures in multi-vessel disease patients with MI history similar to the patients in our study were 90%, 78%, and 81%. However, Armstrong has estimated LCX lesion as 22% of cases and Pozzoli as 45%, which might have been due to unsuitable lateral wall endocardium resolution.

As mentioned before, the sensitivity of the diagnosis of the LCX lesion in this study was 58%. It should be mentioned that because of variation in the blood supply of posterior walls between RCA and LCX, in many centers these two vessels, which supply blood, are considered as posterior circulation system. Thus, considering posterior circulation system, sensitivity and specificity for diagnosis in these areas in this study would respectively be 89% and 75%.

Conclusion

In view of the sensitivity and specificity of stress echocardiography for the diagnosis of CAD and its few complications, we think this non-invasive test can be a very suitable method to diagnose CAD, to analyze and evaluate the amount of ischemia in the patients suffering from CAD, to diagnose restenosis in post-PTCA patients and to evaluate the patients scheduled to undergo non-cardiac surgery.

It will cost less than radionuclide scanning and has good sensitivity and specificity – aside from the fact that in some cases it can have even more accurate results such as in women, renal failure, LVH, and LBBB and is comparable to radionuclide scanning.

References

1. Braunwald, E.: "Heart Disease", 5th edition, and W.B. Saunders company 1996.

2. Schlant, R.: "The heart" 9th edition, Mc Graw hill, USA, 1998.

3. Marwick, T.: "Stress echocardiography", 1994.

4. Feigenbaum, H: "Echocardiography", 5th edition, Williams & Wilkins, USA, 1994.

5. Crawford, M. "Stress echocardiography" Cardiology clinic. Volum 17, Number 3. W.B.Saunders Co. USA. August 1999.

6. Sagar, K. "Echocardiography: A Jml. Of CV Ultrasound & Allied Tech", Volume 16, No 8, Jul. 1999.