Relationship between Echocardiography and Angiography Stress Results in Patients with Cardiac Pain

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ABSTRACT

Objective: This study is aimed at determining the relationship between the results of angiography and echocardiographic stress test in patients with coronary pain. **Methods:** In this cross-sectional study, patients referred to the emergency unit of Imam Ali, Imam Reza, and Farshchian hospitals in Hamedan with coronary pain complain were evaluated. After obtaining a history and an initial examination, echocardiography stress test was conducted on patients. After that, non-invasive angiography was done on patients. Eventually, the results from the echocardiography stress and angiography tests were compared and analyzed using SPSS software. **Results:** Results indicate that 75% of angiography and 70% of echocardiography stress patients were diagnosed with LAD. Values for sensitivity, specificity, positive and negative predictive value, and accuracy of echocardiography stress test in diagnosing LAD were 93.1%, 100%, 100%, 82.9%, and 94.8% respectively. Angiography showed that 50% of the patients suffer from RCA and it was 55 for echocardiography. Sensitivity, specificity, positive and negative predictive value, and accuracy of echocardiography test in diagnosing RCA were 100%, 89.7%, 90.5%, 100%, and 94.8%, respectively. Angiography showed that 34% of patients suffer from LCX involvement. This percent was 50 for echocardiography stress test. Sensitivity, specificity, positive and negative predictive value, and accuracy of the echocardiographic stress test in diagnosing LCX involvement in patients were 100%, 76.4%, 68.6%, 100% and 84.4% respectively. **Conclusion:** Based on results, using echocardiography stress test in patients with coronary pain is beneficial. This method can evaluate the coronary pain with a high sensitivity, specificity, and precision.

Key Words: Echocardiography Stress, Angiography, Coronary pain.

HOW TO CITE THIS ARTICLE: Farzad Sahebjami, Javad Azimivaghar, Fariba Mohammadi, Etrat Javadirad, Mohammad Roozbahani, Zhaleh Soheilikhah (2019). "Relationship between Echocardiography and Angiography Stress Results in Patients with Cardiac Pain", International Journal of Pharmaceutical and Phytopharmacological Research, 9(6), pp.116-120.

INTRODUCTION

The risk factors of coronary artery diseases are increasing in Iran as well as many other countries of the world. Cardiovascular diseases are reported to be responsible for 40% of deaths in Iran. Therefore, the diagnosis and treatment of coronary artery disease (CAD) patients can reduce the mortality rate and complications related to these

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diseases. Utilizing the available screening methods with high diagnostic accuracy and minimal complications can help rapid diagnosis and treatment of suspected patients of coronary diseases. The most suitable methods for this purpose include echocardiography stress test with exercise or dobutamine.

Echocardiography stress test with dobutamine is a low-cost and precise method with the least side effects in patients who are not able to perform an exercise test or have difficulty doing the test.

Linda et al. investigated the echocardiography stress test with dobutamine as a screening method for coronary artery disease patients and evaluated its association with angiography. They concluded that echocardiography is an excellent screening method which can evaluate the occurrence, extent and distribution of coronary artery disease.

Stiven J et al. assessed the relationship between echocardiography stress test using dobutamine with angiographic results in women. The results showed that echocardiography stress test is a useful method for screening coronary artery disease in women with non-diagnosable ECG and exercise tests.

Anwar (2013) studied 25 patients with CAD in Shakur, Egypt and stated that the sensitivity, specificity, and precision of eco-stress test in diagnosing LAD involvement of CAD patients were 57.1%, 90% and 51.7%, respectively [1].

Alizadehasani et al. (2013) studied 303 patients with heart disease and concluded that the sensitivity, specificity and accuracy of echocardiography stress test in diagnosing LAD involvement in patients with coronary pain were 83%, 74.6% and 79.5% respectively % [2].

Dobutamine echocardiography stress test is a very suitable method for non-invasive cardiac imaging that is quick to perform, widely usable, cost-effective, and highly adaptable which can be used in a variety of environments. The procedure of this method includes creating a ventricular motion impairment via stress while recording it, which is a non-invasive method for ducting myocardial ischemia.

Heilmaier et al (2009) studied 50 patients with a history of coronary stenting and concluded that the sensitivity, specificity, and accuracy of echocardiography stress test in diagnosing the involvement of LAD in patients with coronary stenting history were 100%, 93% and 94%, respectively [3].

Khan et al (2013) studied 50 CAD patients. The echocardiography findings of their study showed that 68%, 46% and 38% of patients were suffering from LAD, RCA, and LCX , respectively [4].

Arnold et al. (2008) studied 32 patients with coronary pain and concluded that the sensitivity and specificity of echocardiography stress test in diagnosing of LAD involvement in patients with coronary pain was 76% and 86% respectively [5].

In addition, dobutamine echocardiography stress test can be used to determine the risk in patients of non-cardiac surgery, early stages after myocardial infarction, and patients with persistent chest angina which can successfully detect myocardial viability.

Therefore, the use of interventional and diagnostic cardiology is increasing rapidly. Angiography is known as the golden standard in evaluating coronary artery diseases and its application is spreading widely. However, before performing any invasive interventions, the most common method for screening suspected patients of coronary heart disease is Exercise Treadmill Test (ETT). Thus, we examined the relationship between the results of echocardiography stress test with angiography in patients with coronary pain in this research.

METHOD

The statistical population of this cross-sectional descriptive-analytic study included all patients referred to the heart clinic of Imam Ali and Imam Reza Hospitals of University of Medical Sciences of Kermanshah and Farshchian Hospital of Hamadan with a complaint of chest pain. The sampling method was based on availability and according to the confidence level of 95%, 135 people were selected the sample population.

In this study, the history of the patients with chest pain was obtained initially by a physician and based on the type, nature, and location of the pain, full thoracic echocardiography was performed on patients under the supervision of the physician. All echocardiography images were taken two-dimensionally by a M-MODE.2D Doppler in four paracentral views (longitudinal and transverse axis) and apical (4 & 2 chambers) in the basic position, as well as left lateral position while leaning. All images were recorded digitally.

Dobutamine was infused according to the standard protocol, starting from 5 μg per kg body weight per minute, and in case of resistance, continued to up to a maximum dose of 40 μg per kilogram of body weight with 3 minutes intervals. In the cases in which 75% of the maximum heart rate was not reached with an infusion of 20 mcg / min Dobutamine after 3 minutes of infusion, or heart rate remained less than 100 minutes, Atropine was injected at 0.5 mg / kg dose up to 2 milligrams. Simultaneously, echocardiography images were recorded by controlling heart rate, blood pressure rhythm, and recording the ECG as well. If no side effects were observed, dobutamine injection continued up to the maximum acceptable dose (40 mcg /kg /min), and echo stress test was performed.

The reasons for stopping the test included movement impairment in a new ventricle, intolerance of patients to

reach the maximum expected heart rate, severe angina and shortness of breath, significant ventricular and supraventricular tachyarrhythmia, severe hypertension, symptomatic reduction of systolic blood pressure (greater or equal to 40 mmHg baseline, severe and symptomatic obstruction of the left ventricle, sinus arrest, severe nausea and shivering, and reactions caused by the activation of the parasympathetic system.

The concurrent incidence of ECG alternations, chest pain or basic motor disorders increased the sensitivity of the test but was not necessarily used as a positive interpretation of the test. (CAD) was defined as stricture of at least one of the major epicardial coronary arteries (stricture of at least 50% of the artery diameter). Demographic characteristics and the frequency of risk factors for coronary artery diseases including gender, age, BMI, diabetes (fasting blood glucose higher than 126 mg / dL and randomized blood glucose higher than 200 mg / dL), Hypertension (blood pressure higher than 140.41 mmHg, and increased blood pressure during treatment) in all patients. Exclusion criteria included volunteer angiography. Based on the type of test result, angiography was requested for the patients, and eventually, the results from both tests were recorded in a data sheet. The data were analyzed by SPSS software version 22.

To determine the relationship between the results of echocardiography stress test and angiography, Kappa agreement coefficient and McNemar tests were implemented. In addition, in order to calculate the sensitivity and specificity, receiver operating characteristic curve (ROC) was used. The significance level was considered 0.05.

RESULTS

The results of the study indicate that the range of patients' age was between 47-77 years, with a mean and standard deviation of 61.65 ± 8.66 years. 87 (64.4%) patients were males and 48 (35.6%) were females. 71 (52.6%) patients had a history of diabetes and 64 (47.4%) had no history of diabetes. 70 patients had a history of high blood pressure and 65 had no history of high blood pressure. 71 patients had a history of smoking, and 64 had no history of smoking.

Based on echo stress, 34 patients had LAD involvement, 20 had LCX involvement, 7 had RCA involvement, 7 had LAD and LCX involvement, 27 had LAD and RCA involvement, 14 had LCX and RCA involvement, and 26 had LAD, LCX and RCA involvement.

Based on angiography, 34 patients had LAD involvement, 13 had LCX involvement, 7 had RCA involvement, 7 had LAD and LCX involvement, 34 had LAD and RCA involvement, and 26 had LAD, LCX, and RCA involvement.

Table 1: Relationship between the results of echocardiography stress test with angiography in LAD involvement

Echo stress results	Angiography results		Test statistic	Kappa agreement coefficient	p-value
	Positive	Negative			
Positive	34 (100%)	7 (6.9%)	104.19	0.871	P<0.001
Negative	0 (0%)	94(93.1%)			

Based on Table 1, there is a significant relationship between the results of echocardiography stress test and angiography in LAD involvement in patients with coronary pain (P <0.05). In addition, a significant correlation was found between the results of echocardiography stress and angiography in LAD involvement in patients with coronary pain (P <0.05).

Table 2: Relationship between the results of echocardiography stress with angiography in RCA involvement

Echo stress results	Angiography results		Test statistic	Kappa agreement coefficient	p-value
	Positive	Negative			
Positive	34 (89.7%)	0 (0%)	109.64	0.896	P<0.001
Negative	7 (10.3%)	67 (100%)			

Based Table 2, there is a significant relationship between the results of echocardiography stress test and angiography in RCA involvement in patients with coronary pain (P <0.05). Therefore, there is a significant correlation between the results of echocardiography stress test and angiography in RCA involvement in patients with coronary pain (P <0.05).

Table 3: Results of diagnostic value and sensitivity, specificity, positive and negative predictive value, accuracy and area under the ROC curve in echocardiography stress test in predicting LAD involvement

Sensitivity	Specificity	positive predictive value	negative predictive value	accuracy	the area under the ROC curve	p-value
93.1%	100 %	100 %	82.9 %	94.8%	0.96	P<0.001

Based on Table 3, the diagnostic value of echocardiography stress in predicting LAD involvement in patients with coronary pain is significant (P <0.05) (Fig. 1).
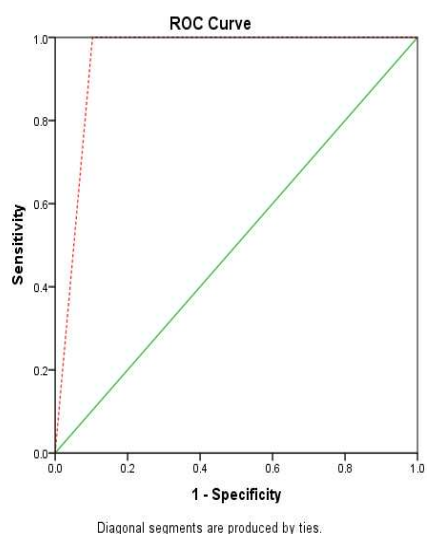
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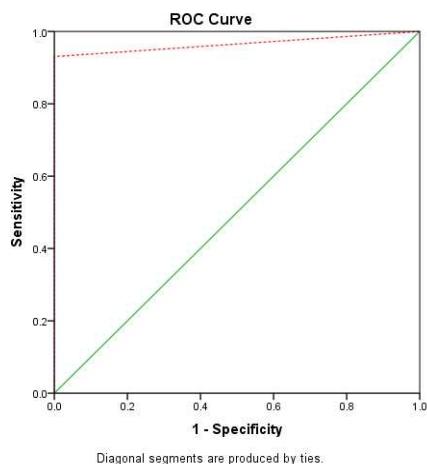
Fig. 1: ROC curve of echocardiography stress in predicting LAD involvement in patients with coronary pain

Table 4: Results of diagnostic value and sensitivity, specificity, positive and negative predictive value, accuracy and area under the ROC curve for RCA echocardiography stress in predicting RCA involvement

Sensitivity	Specificity	positive predictive value	negative predictive value	accuracy	the area under the ROC curve	p-value
100%	89.7%	90.5%	100%	94.8%	0.94	P<0.001

Based on Table 4, the diagnostic value of echocardiography stress in predicting RCA involvement in patients with coronary pain is significant (P <0.05) (Fig. 2).
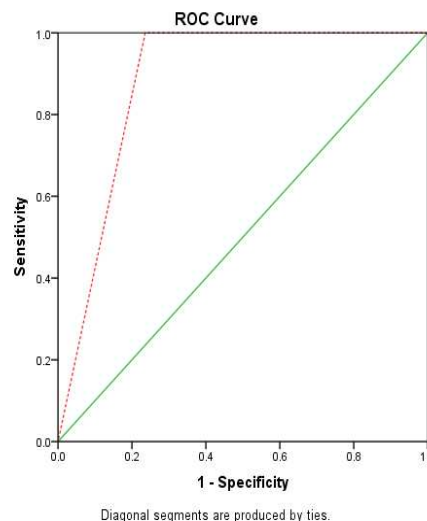

Fig. 2: ROC curve showing echocardiography stress in predicting RCA involvement in patients with coronary pain

Table 5: Results of diagnostic value and sensitivity, specificity, positive and negative predictive value, accuracy and area under the ROC curve for RCA echocardiography stress in predicting LCX involvement

Sensitivity	Specificity	positive predictive value	negative predictive value	accuracy	the area under the ROC curve	p-value
100 %	76.4 %	68.6 %	100 %	84.4%	0.88	P<0.001

Based on Table 5, the diagnostic value of echocardiography stress test in predicting LCX involvement in patients with coronary pain is significant (P <0.05) (Fig. 3).

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Fig. 3: ROC curve showing echocardiography stress in predicting LCX involvement in patients with coronary pain

DISCUSSION

Based on the results of this study, there is a significant relationship between the results of echocardiography stress test and angiography in terms of LAD, RCA, and LCX involvement in patients with coronary pain. The results of echocardiography stress test show that 75% of patients had LAD involvement. Angiography results showed that 70% of patients had LAD involvement.

Values of sensitivity, specificity and accuracy in LAD echocardiography stress for diagnosing patients with coronary pain was 93%, 100%, and 94.8%, respectively which was significant.

Results of echocardiography showed that 55% of patients had RCA involvement. On the other hand, angiography showed that 50% of the patients had RCA involvement. Values of sensitivity, specificity and accuracy of the

echocardiography stress test in diagnosing RCA involvement in patients with coronary pain were significantly equal to 100%, 89.7%, and 94.8% respectively.

In this study, echocardiograph results showed that 50% of the patients had LCX involvement. Angiography showed that 34% of the patients had LCX involvement. Values for sensitivity, specificity, and accuracy of echocardiography stress test results for diagnosing LCX involvement in patients with coronary pain were 100%, 76.4%, and 84.4%, respectively.

The results of Arnold et al. (2012), Khan et al. (2013), and Heilmaier et al. (2009), all three entitled studying the relationship between echocardiography stress and angiography were consistent with the results of our study [3-5]. In addition, the average sensitivity of echocardiography stress for diagnosis of LAD, RCA, and LCX involvement was 92%, 86% and 85%, respectively. Furthermore, the mean was reported to be 89%, 87%, and 73%, respectively.

The results from the study showed that the sensitivity and specificity of the echocardiography stress test are related to the rate and extent of coronary artery diseases, which is higher in patients with multiple arteries involvement so that in patients with involvement of all three arteries, LAD + RCA has the most sensitivity and specificity.

In the present study, patients with a positive echocardiography stress result and showed no significant sign of obstruction in angiography were mostly women and patients who had posterior arterial involvement and motor disorders in the basal segments.

Anwar et al. (2013) [1] concluded that the sensitivity, specificity, and accuracy of echo stress in diagnosing LAD involvement in CAD patients were 57.1%, 90%, and 51.7% respectively. These results are in line with our results.

In our study, the sensitivity, specificity, and accuracy of echocardiography stress in diagnosing RCA involvement in CAD patients were 57.3%, 88% and 69.6%, respectively.

In addition, the sensitivity, specificity, and accuracy of echocardiography stress in diagnosing LCX involvement in CAD patients were 53.3%, 86%, and 66.4%, respectively.

Eventually, we can state that echocardiography stress is a non-invasive, safe, cost-effective, and available method which is acceptable by patients and can be used as a screening method for patients with suspected coronary heart disease. In addition, due to the proper association of this test with the results of angiography, it can be used in evaluating patients with coronary pain with high sensitivity, specificity, and accuracy.

CONCLUSION

Considering the benefits, side effects, and the excellent relationship between the results of echocardiography stress test with angiography, echocardiography stress test can be considered as a method for inducing stress without exercise. This method is completely accessible, safe and low-risk, with the least cost and complications, which is very useful for patients who are unable to do athletic exercise or their test interpretation is not useful due to basic ECG problems. This method is recommended for all patients who are candidates for myocardial ischemic disorder or require prognosis and determination of ischemia proven risk, risk assessment of non-cardiac surgery, determination of myocardial survival in patients who are candidates for cardiac surgery, or and are not capable of exercising for any other reasons.

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