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Original Article

Correlation between Angiographic Findings and Pain and Its Palliative Factors in Patients with Chest Pain Referring to Rajaie Cardiovascular, Medical and Research Center

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ABSTRACT

Background: In patients referred for an evaluation of chest pain, the incidence of cardiac disease may be as low as 11–27%. Furthermore, the incidence of normal coronary anatomy in patients investigated invasively varies widely, between 11% and 37%, at different cardiac centers. In this study, we evaluated the correlation between angiographic findings and pain and its palliative factors in patients with chest pain referring to Rajaie Cardiovascular, Medical and Research Center.

Methods: All patients with chest pain who were admitted to the Emergency Department of Rajaie Cardiovascular, Medical and Research Center between September 2013 and March 2014 and needed coronary angiography were enrolled. Demographic data and the results of physical examinations and characteristics of pain and its palliative factors and the chest pain score based on a check list were collected. Thereafter, angiography was performed and correlations between angiographic findings and pain (characteristics and score) and its palliative factors were assessed.

Results: Totally, 194 patients with the average age of 58±10 years were investigated. Of the 194 patients, coronary arteries were normal in 57 (29%) patients. Of these patients, 37 patients were women and 20 patients were men. Single-vessel disease was observed in 53 (40%), 2-vessel disease in 39 (30%), and 3-vessel disease in 40 (30%). Left main stenosis was observed in 1 (0.5%) patient, and 3-vessel disease accompanied with the left main was documented in 4 (2.1%). Also, slow flow was observed in 5 (2.6%) patients. Regarding the localization of the involved vessel, left main involvement was observed in 5 (3.1%) patients, left anterior descending in 82 (24.3%), left circumflex in 62 (32%), and right coronary artery in 54 (27.8%). A pain score of 0 was present in 24 (12%) patients, pain score of 1 in 47 (24%), pain score of 2 in 73 (37%), and pain score of 3 in 50 (25%). The sensitivity value of the pain score in our research was calculated to be 80% by taking advantage of a chest pain score of 0 as the negative predictor of the coronary vessel disease and a chest pain score of 1 to 3 as the positive predictor of coronary vessel disease.

Conclusions: In the present study, there was no relationship between pain characteristics and the results from the involved vessel and the final angiographic results.

The pain score is greatly useful in patients with a higher risk of coronary artery disease, whereas in patients with an intermediate pain score, it is important to perform other

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examinations such as scan or treadmill tests for correct decision-making. ***(Iranian Heart Journal 2015; 16(4): 47-56)***

Keywords ■ Chest pain characteristics ■ Pain score ■ Angiography ■ Risk stratification

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Cardiovascular diseases are among the chief reasons for mortality around the world. In developed countries, cardiovascular diseases account for 50% of the death toll or 5 million of 12 million deaths are due to cardiovascular diseases annually.[1] Mortality is also increasing in developing countries, and cardiac diseases are deemed the main cause of 15 to 25% of deaths.[2] Mortality in the time interval from 1990 to 2006 rose from 27 to 37% in Iran. According to the statistics provided by the Health Department, about 39% of all of the referrals to health-treatment centers belong to blood circulation diseases.[3] Also, cardiovascular diseases are the major cause of disabilities around the world. It is estimated that about 81 million Americans are diagnosed with coronary heart diseases.[4]

In Iran as well this disease is an important cause of death in individuals older than 35 years of age.[5] It is estimated that the disease load is over 1.5 million per year.[6] Nonetheless, studies have shown that only 30% of the patients admitted to the coronary care unit (CCU) have had myocardial infarction and 50-60% are known to have had myocardial ischemia. Also, studies have suggested that 16-20% of the population in England and the United States[9] have had a history of chest pain and in most of the cases this has been benign[10] and from among the patients referred to cardiovascular specialists only 11-27% are diagnosed with heart diseases.[11,12] Some studies have indicated that 11 to 37% of the patients who have undergone angiography due to chest pain had normal coronary vessels.[13,14] Therefore, distinguishing cardiac patients from noncardiac patients referring to hospitals with chest pain both reduces unnecessary hospital stays and contributes a great deal to the time of treatment of such patients. Normally, patients with chest pain are screened based on the previous history of heart disease, risk factors, self-report, serial electrocardiography, and measurement of cardiac markers. In patients' self-reports, pain is classified into typical and atypical, and studies have shown that the interpretation of this classification is individual-specific and yields various results even if it is performed based on standardized questionnaires.[15,16]

In a common survey, patients with chest pain are examined from different aspects such as quality of pain and risk factors and their noninvasive test results such as the treadmill test and scan. Based on the studies performed, a presented pain score enables us to adopt these results for a timely diagnosis and to distinguish cardiac from noncardiac pains in such patients with a view to reducing the number of unnecessary angiography procedures.[17] In the present study, we examined the patients based on this score as well as heart scan and angiographic results and pain characteristics and the factors influencing it. We compared the patients based on the entire test results.

METHODS

Patients with chest pain who were referred to Rajaie Cardiovascular, Medical and Research Center (between

August 2013 and February 2014) and based on preliminary surveys needed non-urgent angiography and had the qualifications for the study were considered as the study subjects.
In this study, 194 patients comprising 94 women and 100 men were surveyed.
The scales required for inclusion in the present study were as follows:

1. Chest pain >1 month's duration without any previous history of angiography or surgical operation
2. Absence of considerable valve abnormalities and other disorders
3. Uncertainty as to a history of pre-diagnosed cardiomyopathy

Meanwhile, patients who had pathological Q wave or had severe left ventricular hypertrophy or had considerable regional wall motion abnormalities on echocardiography were eliminated from the study.
In the current study, 194 patients met the inclusion criteria. Following the calculation of their pain score, the study population underwent angiography. Among the study subjects, 109 patients underwent heart scan (MPI) prior to angiography. Also, the characteristics and features of pain and the relevant factors were considered.

Clinical Investigations

All the patients were questioned before angiography and were informed of the results via a pre-prepared questionnaire based on the surveyed variables. Also, the pain score was asked from the patients based on 3 questions and the patients' final score was calculated as follows[17]:

1. If you walk uphill 10 times, how many times will you experience the same pain for which you have referred to the hospital (repeatability index)?
2. If you experience the pain 10 times along a path, how many times will you have to stop completely or sit down (rest time index)?
3. How long does the pain last (pain duration index)?

For the first question-index, 10/10 was considered typical pain and the other indices were regarded as atypical. Regarding the second question index, 0/10 and 1/10 were considered typical and the other scores were considered atypical. Concerning the third question, a 5-minute time duration and less was considered typical and the rest of the cases were considered atypical. Eventually, each of the typical variables was assigned a score; therefore, the total score for these 3 questions was a number from 0 to 3. A score of 3 was considered typical chest pain, scores of 1 and 2 were regarded as low intermediate and high intermediate, and 0 was indicative of atypical chest pain.

Patients' Scan

Heart scan along with simultaneous echocardiography is superior to the treadmill test and is indicative of the localization of coronary stenosis. This test has sensitivity of 88% of the involved vessel. Of course, the treadmill test has sensitivity of 68%. This method provides us with critical information and it can also be performed in patients with abnormal resting electrocardiograms such as bundle branch block or digoxin consumption.
Heart scan with pharmacological stress in patients incapable of performing the treadmill test such as old patients, patients with peripheral vessel disease, patients with pulmonary disease, patients with arthritis, and patients with orthopedic disorders is recommended with vasodilators such as adenosine or dipyridamole. This group compromises 40 to 50% of the patients referred for imaging. The diagnostic accuracy of such a method is comparable with that of the scan performed via the treadmill test. The results of the patients' scan are stratified into 4 sets: negative, positive cases without high risk, positive cases with high risk, and

positive cases with intermediate risk.[18] If the patients are in the high-risk group, even if they are symptomless, the probability of 3-vessel disease or left main lesion will be high and there is a need for angiography. The group with a negative test result even in the presence of clinical symptoms has an excellent prognosis and this prognosis does not change considerably with angiography.

In the current study, the individuals who underwent MPI before angiography were allocated to low-risk, intermediate-risk, and high-risk groups based on the given criteria.[18] In the present study, 109 patients were scanned previously and 10 (9%) of these patients had normal scan, 30 (27%) had low-risk scan, 43 (39%) had an intermediate-risk scan, and 26 (24%) had high-risk scan.

Angiographic Results

Angiography was performed on all the patients, and the existing stenosis (stenosis ≥50%) in 1 of the epicardial vessels was considered. A stenosis of 30-50% was considered minimal coronary artery disease, and a stenosis <30% was nonsignificant.

Data Analysis

The mean and the standard deviation of the variables were calculated, and they were used to evaluate the variables. The chi-square test was utilized to compare the different groups. The Pearson correlation and regression test were used to compare pain characteristics between the different groups. A P value <0.05 was considered significant.

RESULTS

Of the 194 patients, coronary arteries were normal in 57 (29%) patients. Of these normal patients, 37 patients were women and 20 patients were men. The average age did not differ considerably between the men and women. Single-vessel disease (SVD) was observed in 42 (21.6%) patients, 2-vessel disease (2VD) in 27 (13.9%), 3-vessel disease (3VD) in 28 (14.4%), left main stenosis in 1 (0.5%), and 3VD accompanied with left main disease in 4 (2.1%). Additionally, slow flow evidence was present in 5 (2.6%) patients. Also, from the perspective of the involved vessel, left main involvement was observed in 5 (3.1%) patients, LAD in 82 (24.3%), LCX in 62 (32%), and RCA in 54 (27.8%).

A pain score of 0 was present in 24 (12%) individuals, pain score of 1 in 47 (24%), pain score of 2 in 73 (37%), and pain score of 3 in 50 (25%).

The sensitivity value of the pain score investigated in our research was 20% by taking advantage of a chest pain score of 0 as the negative predictor of coronary vessel disease and a chest pain score of 1 to 3 as the positive predictor.

Other Factors

In the current study, the chest pain score in the individuals diagnosed with completely normal coronary vessels on angiography differed considerably from the pain score obtained from the other individuals studied in the study. Other variables which differed considerably between the 2 groups of individuals with normal angiography and the other individuals studied in the current study include the following cases:

The female gender and the intensification of pain subsequent to stress or excitement (normal angiography cases were greater in the women) and improvement by massage and pain relief by consuming anti-acid or milk were observed more frequently in the individuals with normal angiography, while pain intensification accompanied with activity, lower ejection fraction, pain improvement with TNG, higher risk score, and smoking were observed in the individuals with abnormal angiography.

From the aspect of chest pain features such as radiation, location, and duration, there were considerable differences between the 2 groups (Table 1). Also, there was no significant relationship between the location of stenosis

and pain characteristics between the various groups. The regression analysis indicated that gender (P<0.001), the pain score (P=0.01) (Figure 3), scan results (P=0.001) (Figure 2), and the ejection fraction results of the patients (P=0.02) differed independently between the 2 groups. Furthermore, smoking (P=0.01), improvement in pain with rest (P=0.001), pain exacerbation with activity (P=0.001), intensification of pain by consuming food (P=0.001), and improvement in pain by drinking milk (P=0.001) differed considerably between the 2 groups (Figure 4). Contrary to the results of similar studies in this field, there were no significant relationships between age, diabetes prevalence, hypertension, and pain location between the 2 groups (Figure 1).

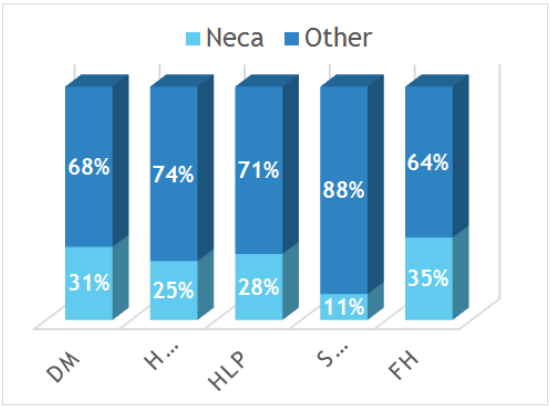

Figure 1. Prevalence of classic risk factors in NECA and others

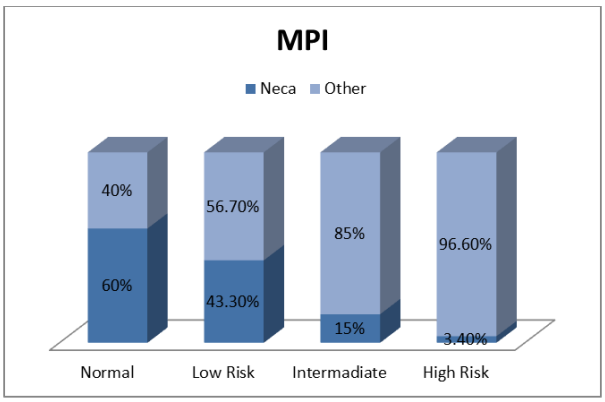

Figure 2. Prevalence of the scan results in various risk groups

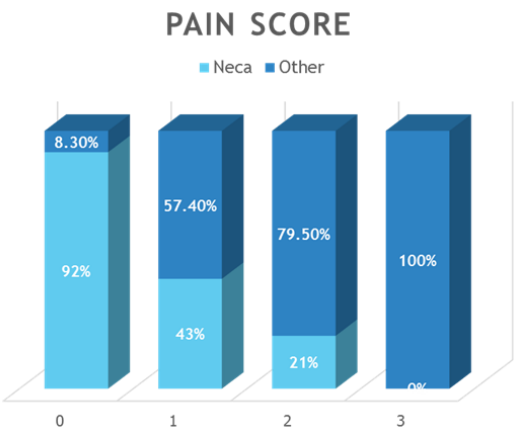

Figure 3. Prevalence of the pain score between NECA and others

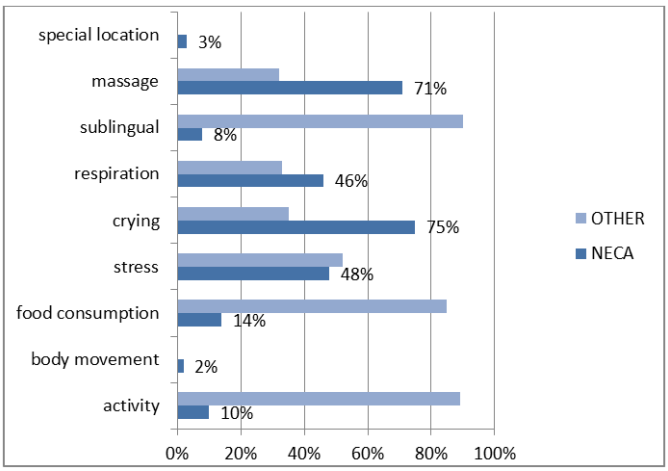

Figure 4. Comparison of the factors that relieved or intensified pain between the 2 groups

Table 1. Relationship between pain characteristics and the scan results and the pain score in the comparison between the 2 groups of normal angiography and with coronary artery disease (other patients)

		NECA		Other		P Value
		n.	%	other	%	
Pain location	Upper right	0	0	1	0.7	0.40
	Upper middle	6	10.5	7	5.1	
	Upper left	6	10.5	6	4.4	
	Middle right	3	5.3	4	2.9	
	Mid external	18	31.6	60	43.8	
	Left hemithorax	9	15.8	16	11.7	
	Lower right	1	1.8	1	0.7	
	Epigastric	8	14	26	19	
	Lower left	6	10.5	16	11.7	
Radiation	Non	24	42.1	32	23.4	0.001
	Back	14	24.6	23	16.8	
	Neck	0	0	25	18.2	
	Left arm	9	15.8	40	29.2	
	Right arm	4	7	7	5.1	
	Leg	2	3.5	0	0	
	Abdomen	1	1.8	1	0.7	
	Point tenderness	3	5.3	1	0.7	
	Left to right	0	0	8	5.8	
Pain quality	pressing	5	8.8	61	44.5	0.001
	cutting	10	17.5	3	2.2	
	Tingling	39	68.4	40	29.2	
	Feeling heaviness	3	5.3	33	24.1	
Pain duration	Minute	15	26.5	98	71.5	0.001
	Hour	32	56.1	39	28.5	
	Day	10	17.5	0	0	
Pain repetition	Daily	11	19.3	44	3.12	0.03
	Weekly	36	63.2	84	61.3	
	Monthly	10	17.5	8	5.8	
	Yearly	0	0	1	0.7	
Pain score	Atypical	22 (91.7%)		2 (8.3%)		0.001
	Lower than intermediate	20 (42.6%)		27 (57.4%)		
	Higher than intermediate	15 (20.5%)		58 (79.5%)		
	Typical	0		50 (100%)		
Body mass index	18-24	1 (5.3%)		18 (94.7%)		0.56
	24-29	41 (34.7%)		77 (65.3%)		
	30-35	13 (25%)		39 (75.0%)		
	>35	2 (40%)		3 (60%)		
MPI	Nl	6 (60%)		4 (40%)		0.001
	Low risk	13 (43.3%)		17 (56.7%)		
	Intermediate	6 (15%)		34 (85%)		
	High	1 (3.4%)		28 (96.6%)		
Ejection fraction	Normal	25 (50%)		25 (50%)		0.02
	<30	3 (13.6%)		19 (86.4%)		
	30-45	7 (24.1%)		22 (75.9%)		
	45-50	4 (15.4%)		22 (84.6%)		
	50-55	18 (26.9%)		49 (73.1%)		
Age		56.56±9.47		59.2±10.36		0.08

Table 2. Comparison of the number of the involved vessels and pain characteristics between the different groups

CATH		NECA		mCAD		SVD		2VD		P Value
		n.	%	n.	%	n.	%	n.	%	
Pain location	Upper right	0	0	0	0	0	0	0	0	0.91
	Upper middle	6	10.5	2	6.7	0	0	1	3.7	
	Upper left	6	10.5	3	10	0	0	1	3.7	
	Middle right	3	5.3	2	6.7	1	2.4	1	3.7	
	Mid external	18	31.6	14	46.7	17	40.5	13	48.1	
	Left hemithorax	9	15.8	2	6.7	5	11.9	4	14.8	
	Lower right	1	1.8	1	3.3	0	0	0	0	
	Epigastric	8	14	5	16.7	11	26.2	4	14.8	
	Lower left	6	10.5	1	3.3	8	19	3	11.1	
Radiation	None	24	42.1	10	33.3	7	16.7	8	29.6	0.001
	Back	14	24.6	6	20	10	23.8	1	3.7	
	Neck	0	0	2	6.7	4	9.5	4	14.8	
	Left arm	9	15.8	6	20	17	40.5	11	40.7	
	Right arm	4	7	4	13.3	1	2.4	1	3.7	
	Leg	2	3.5	0	0	0	0	0	0	
	Abdomen	1	1.8	1	3.3	0	0	0	0	
	Point tenderness	3	5.3	1	3.3	0	0	0	0	
	Left to right	0	0	0	0	3	7.1	2	7.4	
Pain quality	Pressing	5	8.8	8	26.7	19	45.2	15	55.6	0.001
	Cutting	10	17.5	0	0	2	4.8	1	3.7	
	Tingling	39	68.4	17	56.7	11	26.2	3	11.1	
	Feeling heaviness	3	5.3	5	16.7	10	23.8	8	29.6	
Pain duration	Minute	15	26.3	16	53.3	32	76.2	19	70.4	0.001
	Hour	32	56.1	14	46.7	10	23.8	8	29.6	
	Day	10	17.5	0	0	0	0	0	0	
Pain repetition	Daily	11	19.3	6	20	12	28.6	13	48.1	0.21
	Weekly	36	63.2	20	66.7	29	69	12	44.4	
	Monthly	10	17.5	4	13.3	1	2.4	1	3.7	
	Yearly	0	0	0	0	0	0	1	3.7	

Table 3. Comparison of the number of the involved vessels and pain characteristics between the different groups

CATH		3VD		LM		LM-3VD		Slow Flow		P Value
		n.	%	n.	%	n.	%	n.	%	
Pain location	Upper right	1	3.6	0	0	0	0	0	0	0.91
	Upper middle	3	10.7	0	0	1	25	0	0	
	Upper left	1	3.6	0	0	0	0	1	20	
	Middle right	0	0	0	0	0	0	0	0	
	Mid external	12	42.9	1	100	1	25	2	40	
	Left hemithorax	4	14.3	0	0	1	25	0	0	
	Lower right	0	0	0	0	0	0	0	0	
	Epigastric	4	14.3	0	0	0	0	2	40	
	Lower left	3	10.7	0	0	1	25	0	0	
Radiation	None	6	21.4	0	0	0	0	1	20	0.001
	Back	4	14.3	0	0	0	0	2	40	
	Neck	12	42.9	0	0	3	75	0	0	
	Left arm	4	14.3	1	100	1	25	0	0	
	Right arm	1	3.6	0	0	0	0	0	0	
	Leg	0	0	0	0	0	0	0	0	
	Abdomen	0	0	0	0	0	0	0	0	
	Point tenderness	0	0	0	0	0	0	0	0	
	Left to right	1	3.6	0	0	0	0	2	40	
Pain quality	Pressing	13	46.4	1	100	2	50	3	60	0.001
	Cutting	0	0	0	0	0	0	0	0	
	Tingling	7	25	0	0	0	0	2	40	
	Feeling heaviness	8	28.6	0	0	2	50	0	0	
Pain duration	Minute	22	78.6	1	100	4	100	4	80	0.001
	Hour	6	21.4	0	0	0	0	1	20	
	Day	0	0	0	0	0	0	0	0	
Pain repetition	Daily	10	35.7	0	0	1	25	2	40	0.21
	Weekly	17	60.7	1	100	3	75	2	40	
	Monthly	1	3.6	0	0	0	0	1	20	
	Yearly	0	0	0	0	0	0	0	0	

Also, no significant relationship was identified between the involved vessel and pain characteristics and its accelerating factors. From the point of view of the number of the involved vessels and the radiation characteristics and quality and duration of pain, there was a significant relationship between the different groups (Table 2 and Table 3). For example, in 42% of the patients with completely normal angiography, the patients' pain was propagated to no special locality. On the other hand, the radiation of pain to the neck was present in 42% of the individuals with 3VD and in 75% of the individuals with left main/3VD, while this amount was 0% in the individuals with normal angiography and was not a considerable amount in the other groups.

The radiation of pain to the left arm was mostly observed in the individuals with the involvement of 2 or 3 vessels, and the radiation of pain to the leg was observed only in the individuals with normal angiography, while the feeling of pain in the form of a pressing pain or feeling of heaviness in the chest (angina pectoris) was mostly seen in the individuals with the involvement of 2 or 3 vessels as 46% of the patients with 3VD reported pain as a pressing pain, whereas this amount in the individuals with normal angiography was only 8%.

DISCUSSION

The present study showed that the pain score could be advantageous in indicating the individuals with a higher probability of coronary artery involvement and that its sensitivity and specificity could be similar to the evaluation by noninvasive studies.

This pain score has been evaluated in similar studies. Nevertheless, in order to be able to utilize the pain score clinically at the first visit of the patient, we need to perform further studies. The sensitivity of the test was considerably higher, especially in the patients with a score of 3. These patients can be referred for angiography without completing the supplementary tests. On the other hand, in the patients with a score of 0, the test sensitivity was considerably valuable for rejecting the probability of coronary artery disease and there was no need for more specialized examinations for such patients as 91% of the patients with a pain score of 0 had completely normal vessels on angiography. Moreover, about 70% of the individuals with a pain score of 1 to 2 had coronary artery disease on angiography and, as such, these individuals can be directly referred to angiography without any further investigation.

Among the patients with a pain score of 0 when the scan shows normal results, the possibility of coronary artery disease is very weak and these patients can be excluded from further heart examinations and can be dismissed. Thus, the use of the pain score at the first visit as a consultative examination may reduce the number of referrals to higher levels and the need for unnecessary angiography (anatomically normal vessels). The results of the pain score sensitivity stood low in our study in comparison with that in similar studies, while its specificity was high (40%) in our study in comparison with that in other studies (28%).[17]

Limitations

In the current study, we performed visual examination of the percentage of the vessel stenosis to calculate the intensity of coronary artery stenosis and we did not make use of an appropriate quantitative method such as FFR to accurately evaluate the functional intensity stenosis, which may have weakened the study results. However, in contrast to similar studies, we did not determine stenoses <50% as the borderline between the anatomically normal and abnormal coronary artery disease.

In the present study, all the studied individuals did not have perfusion scan, which renders a portion of our information

inaccurate. Also, we evaluated the pain score of the patients with chronic cardiac pain with a duration >1 month. The evaluation of this score is not possible in patients with acute chest pain, which necessitates more serious and faster examinations.

The pain score was based on the patients' self-report, which could have had an influence on their responses because they had been candidated to undergo angiography. This may have led to an overestimation of pain intensity and other factors.

CONCLUSIONS

In the present study, there were no relationships between pain characteristics such as location, radiation, quality, and duration and the involved vessel location (LAD, LCX, and RCA). Nonetheless, we found a relationship between a lower ejection fraction, higher pain score, smoking history, and high-risk thallium scan and abnormal angiographic results.

Contrary to the previous studies in this field, heart disease risk factors such as diabetes and hypertension did not have a significant relationship with angiographic results, but pain radiation and pain quality had a significant difference between the 2 groups of normal anatomy and abnormal anatomy. Also, the factors accelerating pain, including pain intensification accompanied by activity and food consumption and psychological stress and crying, or the consumption of anti-acid or milk and the improvement in pain with TNG and massage had a significant difference between the 2 groups, which is indicative of the fact that besides pain characteristics, it is necessary to pay more attention to the decreasing and intensifying factors in the examination sessions.

The studied pain score proved greatly useful in the patients with a higher risk of coronary vessel involvement. Be that as it may, in patients with an intermediate pain score, it is important to perform other examinations such as scan or treadmill tests for correct decision-making. In addition, this score can be useful in making decisions to refer the patient to higher therapeutic levels or angiography.

For further investigation, it would be desirable to perform similar studies with larger sample volumes. According to our study, the pain score had sensitivity of about 80% and specificity of about 45% for the possibility of coronary artery involvement, which is equal to the sensitivity of the scan, but the specificity of the pain score was lower than that reported in similar studies. Furthermore, it had low specificity in comparison with the treadmill test and MP scan.

REFERENCES

1. Bexendale M. Pathophysiology of coronary artery disease. Nurs Clin North Am. 2000; 20(20): 143-52.
2. Alinezhad Z. Heart disease nursing. 1sr ed. Tehran: Shahrab Pub; 1996. p: 42-6.
3. Jahanbin A. Epidemiology and prevention of heart disease. 9th Iran congress of heart association. 1sr ed. Tehran: Teimoorzadeh Pub; 1997. p: 32-43
4. Dessotte CA, Dantas RA, Schmidt A, Rossi LA. Health-related quality of life in patients admitted after a first episode of acute coronary syndrome. Revista Latino-Americana de Enfermagem 2011;19:1106-13
5. Vahidian Azimi A, Alhani F, Ahmadi F, Kazemnezhad A. Assesing risk factors of coronary heart disease. 3th Iran- Arab (Middle East) Cardiovascular Congress, 2009
6. Beyranvand MR, Lorvand A, Alipour Parsa S, Motamedi MR, Kolahi AA. The quality of life after first acute myocardial infarction 2011;15:264-72
7. www.heart.org/HEARTORG/Conditions/HeartAttack/SymptomsDiagnosisofHeartAttack/AnginaPectoris_UCM_437515_Article.jsp, 2012
8. Hotopf M, Mayou R, Wadsworth M, Wessely S. Psychosocialand developmental antecedents of chest pain in young adults. Psychosom Med 1999; 61:861–7.

9. Savage DD, Devereux RB, Garrison RJ, Castelli WP,Anderson SJ. Mitral valve prolapse in the general population .۲.Clinical features: the Framingham Study. Am Heart J 1983; 106:577–81.

10. Chambers J, Bass C. Chest pain with normal coronary anatomy: a review of natural history and possible etiologic factors. ProgCardiovasc Dis 1990; 33:161–84.

11. Kroenke K, Mangelsdorff AD. Common symptoms in ambulatory care: incidence, evaluation, therapy, and outcome. Am J Med 1989; 86:262–6.

12. Jain D, Fluck D, Sayer JW, Ray S, Paul EA, Timmis AD. One-stop chest pain clinic can identify high cardiac risk. J Roy Coll Physicians 1997; 31:401–4.

13. Proudfit WL, Shirey EK, Sones FM. Selective cine coronary arteriography: correlation with clinical findings in 1000 patients. Circulation 1966; 33:901–10.

14. Kemp HG, Kronmal RA, Vliestra RE, Frye RL. Seven year survival of patients with normal or near normal coronary arteriograms: a CASS registry study. J Am CollCardiol 1986; 7:479–83.

15. Dans PE, Keruly JC, Brinker JA, Tabatznik B, Pristoop AS, Buchanan SG. Analysis of physician and hospital differencesin 'negative' coronary angiogram rates. Arch Int Med 1988;148:2633–7.

16. Bulpitt CJ, Shipley MJ, Demirovic J, Ebi-Kryston KL, Markowe HL, Rose G. Predicting death from coronary heart disease using a questionnaire. Int J Epidemiol 1990;19:899–904.

17. Wu EB, Hodson F, Chambers JB A simple score for predicting coronary artery disease in patients with chest pain.QJM. 2005 Nov;98(11):803-11

18. Braunwald's heart disease: 10th edition. Philadelphia, Elsevier Saunders: 2015, pp.1188, table; Risk stratification based on noninvasive testing.