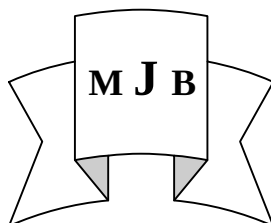


Value of Duke's Treadmill Score and Other Parameters to Predict Coronary Arterial Disease

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Abstract

Background: Exercise testing is useful in the assessment of presence of coronary arterial disease , the Duke's treadmill score is a composite index that was designed to provide survival estimates based on results from the exercise test, including ST-segment depression, chest pain, and exercise duration.

Objectives : the objectives of this study were to correlate the angiographic findings of the patients with Duke's score and adding other parameters like risks factors and type of ST deviation to increase it's accuracy.

Setting : Merjan teaching hospital and Shahid Almihrab cardiac centre.

Methods : Across sectional study done on hundred patients whom underwent exercise treadmill test with calculation of Duke's score followed by coronary angiograph that was correlated with Duke's score and other parameter added to it.

Results : By comparing the result of exercise treadmill test and Duke's score with the result of coronary angiography it showed that in the low risk Duke's group, the coronary angiographic results were mainly normal (40%) or single vessel disease (40%) and rarely showed two (10%) or three vessels disease (10%) and no left main stem disease was found. For the intermediate Duke's risk group the coronary angiographic results distributed on the normal (22.2%), single (30.2%), two (25.4%), and three vessels disease (19%) while it was rarely showed left main stem disease (3.2%). For high Duke's risk group the coronary angiographic results showed mainly three vessels disease (40.8%) and left main stem disease (37%), while it showed two vessels disease in 18.5% and rarely showed single vessel disease (3.7%) and no normal vessel were shown, The P value for this relation was <0.001. For intermediate Duke's risk group adding of patient's risk factors and the type of ST deviation were statistically significant in predict coronary lesion with P value 0.001, 0.028 respectively.

Conclusion : Duke's score can predict coronary lesion and adding of patient's risk factors and type of ST deviation can increase it's ability to predict coronary lesion.

قيمة مؤشر جهد ديوك و العوامل الأخرى لتوقع أمراض الشرايين التاجية

الخلاصة

خلفية الدراسة: أن فحص أجهاد القلب ذو فائدة في تقييم وجود أمراض الشرايين التاجية. أن مؤشر جهد ديوك هو مؤشر مركب صمم ليوفر تخمينات البقاء مركزة على نتائج أخذت من فحص أجهاد القلب وتتضمن انخفاض جزء S.T ، ألم الصدر، ومدة الفحص. **أهداف الدراسة:** أن الهدف من هذا البحث هو لربط نتائج قسطرة شرايين القلب للمرضى مع مؤشر ديوك مع إضافة عوامل أخرى مثل عوامل الخطورة و نوع جزء ST لزيادة دقته.

مكان الدراسة: مستشفى مرجان التعليمي ومركز شهيد المحراب لأمراض القلب.

طرق الدراسة: أن هذه الدراسة عبر قطاعية طبقت على مئة مريض الذين قاموا بفحص أجهاد القلب مع حساب مؤشر ديوك، تلى ذلك قسطرة الشرايين التاجية لتحديد علاقتها مع مؤشر ديوك و العوامل الأخرى التي أضيفت إليها.

نتائج الدراسة: بمقارنة نتائج فحص أجهاد القلب مع مؤشر ديوك ونتائج قسطرة شرايين القلب التاجية أظهرت أن نتائج قسطرة شرايين القلب في مجموعة ديوك الأقلية الخطورة كانت بالدرجة الأساسية طبيعياً بنسبة ٤٠٪، وأن هناك اعتلال وعاء دموي واحد بنسبة ٤٠٪، ونادراً ما يكون هناك اعتلال وعائيين ١٠٪ أو ثلاثة أوعية دموية ١٠٪، ولم تظهر أن هناك اعتلال في الشريان الأساسي الأيسر.

بالنسبة لمجموعة ديوك ألتوسطية الخطورة، فإن نتائج قسطرة الشرايين القلبية التاجية توزعت ما بين طبيعية ٢٢,٢٪، اعتلال وعاء دموي واحد ٣٠,٢٪، اعتلال وعائين دمويين ٢٥,٤٪، واعتلال ثلاث أوعية دموية بنسبة ١٩٪، بينما نادرا ما يكون هناك اعتلال في الشريان الأساسي الأيسر ٣,٢٪.

أما بالنسبة لمجموعة ديوك ذات الخطورة المرتفعة فإن نتائج قسطرة الشرايين التاجية كانت بالدرجة الأساسية اعتلال ثلاث أوعية دموية قلبية ٤٠,٨٪ واعتلال الشريان الأساسي الأيسر ٣٧٪، بينما كان هناك اعتلال بعائين دمويين بنسبة ١٨,٥٪، ونادرا ما يكون هناك اعتلال وعاء دموي واحد ٣,٧٪، ولم تظهر أن هناك نتائج طبيعية، وكانت قيمة (P) لهذه العلاقة > ٠,٠٠٠١. في مجموعة ديوك ألتوسطية الخطورة فإن إضافة عوامل الخطورة لدى المرضى ونوع انحراف جزء S.T كانت إحصائيا ذات قيمة في توقع ضرر الشرايين التاجية مع قيمة (P) ٠,٠٠٠١، ٠,٠٢٨ على التوالي.

الاستنتاج: أن مؤشر ديوك تستطيع أن تتنبأ بمدى ضرر الشرايين التاجية، و أن إضافة عوامل الخطورة لدى المرضى ونوع انحراف جزء S.T ممكن أن تزيد القابلية في توقع ضرر الشرايين التاجية.

Introduction

Ischemic heart disease is a condition in which there is an inadequate supply of blood and oxygen to a portion of the myocardium, typically occurs when there is an imbalance between myocardial oxygen supply and demand. The most common cause of myocardial ischemia is atherosclerotic disease of an epicardial coronary artery (or arteries) sufficient to cause a regional reduction in myocardial blood flow and inadequate perfusion of the myocardium supplied by the involved coronary artery.[1]

The exercise treadmill is used in the evaluation of symptomatic patients to predict the presence and extent of coronary artery disease and the short- and long-term prognosis.[2-8] Although a large number of noninvasive stress testing modalities are currently available, the exercise electrocardiogram is still used as a standard for comparison with other clinical and testing risk markers. It is also the least costly of all provocative noninvasive tests. As health-care costs continue to increase, emphasis will grow on using the exercise tests as the gatekeeper to expensive interventions [9]. The limited sensitivity and specificity of standard exercise electrocardiogram testing for detection of coronary artery disease have stimulated increased use and

development of noninvasive stress imaging technologies.[10] However, the added diagnostic accuracy of stress imaging tests is associated with substantially higher cost. An alternative to the use of more expensive tests is the more efficient use of available low-cost data. Statistical techniques that combine the patient's medical history, symptoms of chest pain, hemodynamic data, and exercise electrocardiogram response have been demonstrated to better predict coronary artery disease than a single electrocardiogram criterion like ST-segment depression.[3] Studies have shown that the diagnostic value of exercise testing can be improved by considering several factors in the test interpretation.[4-8]

Diagnostic and prognostic predictive accuracy increase when multiple pieces of information from the patient's clinical history and the treadmill test are integrated.[9,11]

There is an awareness of the need to apply scores for better decision making [12]. In 1987, Mark and coauthors described a prognostic exercise treadmill score (Duke's score) that was based on the duration of exercise, ST-segment deviation (depression or elevation), and the presence and severity of angina during exercise. This treadmill score has been shown to stratify prognosis accurately for both

inpatient and outpatient ischemic heart disease populations.[2,3]

This study was conducted to determine the importance of treadmill test in diagnosis of coronary arterial disease and to determine the importance of adding the patient's risk factors and the type of ST deviation to the result of Duke's score to further increase the accuracy of treadmill test diagnosis

Patients and Methods

The study was conducted as cross sectional study on one hundred patients evaluated consecutively at Merjan teaching hospital for patients in whom they had been evaluated for ischemic heart disease by exercise treadmill test and underwent coronary angiography within three months, the study had been started from January 2010 to October 2010.

History and physical examination was taken from patients regarding age, sex, history of smoking, hypertension (patients were considered hypertensive if they had history of hypertension or blood pressure above 140/90 [13], diabetes (patient considered diabetic if had history of diabetes or fasting blood sugar above 126 mg/dl (7 mmol/l) or in a patient with classic symptoms of hyperglycemia and random blood sugar above 200mg/dl (11.1 mmol/l) [14], and previous history of ischemic heart disease. Investigations were done in form of random blood sugar, renal function test, resting electrocardiogram, and echocardiography. The treadmill test was done in treadmill test unit in Merjan teaching hospital or treadmill test unit in Shahid Almihrab cardiac centre and the Duke's score had been calculated to all patients and divided in to high, intermediate, and low risk groups. Coronary angiography was done in coronary angiographic unit in Shahid Almihrab cardiac centre. The exclusion criteria of the study include:

1. Acute myocardial infarction (within 2 days).
2. High-risk unstable angina.
3. Uncontrolled cardiac arrhythmias causing symptoms or hemodynamic compromise.
4. Moderate and severe stenotic valvular heart disease.
5. Uncontrolled symptomatic heart failure.
6. Acute pulmonary embolus or pulmonary infarction.
7. Acute myocarditis or pericarditis.
8. Acute aortic dissection.
9. Active infective endocarditis.
10. Electrolyte abnormalities.
11. Severe arterial hypertension (in the absence of definitive evidence, the committee suggests systolic blood pressure of >200 mm Hg or diastolic blood pressure of >110 mm Hg)[14]
12. Hypertrophic cardiomyopathy and other forms of outflow tract obstruction.
13. Mental or physical impairment leading to inability to exercise adequately.
14. High-degree atrioventricular block.
15. Patients with ST-T abnormalities at rest.
16. Abnormalities of ventricular activation, such as left bundle-branch block, Wolff-Parkinson-White, or left ventricular hypertrophy. These conditions enhance the probability of false positive results and interfere with test interpretation[15]
17. Patients were also excluded if 85% of the target heart rate was not achieved and the test remained negative, to eliminate false negative responses due to inadequate degrees of exercise stress.

The criteria for patients selection to enter the study includes the patients with high and

intermediate Duke's risk groups, and the low Duke's risk group in whom cardiologist decided to do coronary angiography depending on history of typical chest pain and patient's risk factors and possibility of false negative result of exercise treadmill test.

Exercise test:

The exercise test was carried out according to Bruce protocol using 12 leads continuous electrocardiogram monitoring during and after the stress tests, patients were exercised on a motor-driven treadmill, blood pressure was measured by arm-cuff sphygmomanometer during the last 30 seconds of each work stage, with ideal endpoint in an exercise treadmill testing was 100% of the age-predicted maximum heart rate (220–age for male and 200–age for female), Eighty-five percent of maximum heart rate was the minimum for an acceptable test, also the test was terminated if maximum ST depression of 3 mm or greater, a 10 mm Hg systolic drop in blood pressure from standing baseline, moderate to severe angina symptoms, feelings of syncope, skin color changes suggestive of hypoxia or hypotension, the patient's desire to stop, fatigue, shortness of breath, leg pain, increased arrhythmias (particularly premature ventricular ectopic that increase with the exercise level) and blood pressure ≥ 250 systolic or 115 diastolic.[16]

Exercise was continued until ST-segment changes appeared, and for 1-3 minutes thereafter (to insure the evoked abnormalities were persistent and not artifactual). The ischemic ST-segment response is generally defined as flat or downsloping depression of the ST segment >0.1 mV below baseline (i.e., the PR segment) and lasting longer than 0.08 s [1], or upsloping ST segment depressed 0.15 mV (1.5 mm) or more at 80 milliseconds after the J point which

may be the only electrocardiographic finding in patients with well-defined obstructive coronary artery disease, so in patient subsets with a high coronary artery disease prevalence, a slow upsloping ST segment depressed 0.15 mV or more at 80 milliseconds after the J point should be considered abnormal.[17-19]

Duke's score was calculated for every patient as described by Mark and coauthors as following:

Duke's score = exercise time-(5 X ST deviation)-(4 X anginal index), the tread mill anginal index was taken as 0 for no angina, 1 for non limiting angina, and 2 for exercise-limiting angina. [20]

The score typically ranges from -25 to +15. These values correspond to low-risk (with a score of $\geq +5$), (e.g. patient exercised for 8 minutes without ST segment deviation and no chest pain; the calculation of Duke's score as following: $8 + (5 \times 0) + (4 \times 0) = 8 + 0 + 0 = +8$), moderate-risk (with scores ranging from -10 to +4), and high-risk (with a score of ≤ -11) categories.^(20,21)

All medication that may interfere with exercise test results was discontinued at least five-lives before the exercise testing.

Coronary Angiography:

The coronary angiography was done by percutaneous Judkin's technique via femoral route with machine Philips Allura 9 model 2007, within 3 months of exercise test.

Significant narrowing was considered if there was more than 70% of narrowing in the vessel lumen except left main stem artery where more than 50% narrowing considered significant. According to the result of coronary angiography the patients were divided in five groups: normal(no significant narrowing), single vessel disease (significant narrowing in one vessel), two vessels disease (significant narrowing in two vessels), three

vessels disease (significant narrowing in three vessels), and left main stem vessels disease (significant narrowing in left main stem vessel regardless the narrowing in other vessels).

Statistical Analysis:

The Statistical significance for observed differences was assessed by student T test, test of proportions and analysis of variance used to compare differences between variables.[22,23]

P value < 0.05 was considered statistically significant

P value < 0.001 was considered statistically extremely significant

P value > 0.05 was considered statistically not significant.

Results

A total of (100) patients were included in this study, 76 males (76%) and 24 females (24%), mean age was 56.8 ± 8.3 years ranged from (32-75) years were divided into 3 age groups (young from 32 to 40 years old, middle age group from 40 to 60 years old, and elderly age group from 60 to 75 years old), there were 46 diabetics (46%) and 56 hypertensive (56%) and 47 smokers (47%).

Regarding treadmill test the mean of ST deviation was 1.68 ± 0.87 , the mean number of affected leads was 4.7 ± 2.5 , the Duke's score ranged from -20 to 11, with mean -5.9 ± 6.9 , the chest pain developed in 69 (69%) patients.

Regarding coronary angiography there were 18 (18%) patients with normal results, while 82 (82%) patients had abnormal result distributed as 24 (24%) patients had single vessel disease, 22 (22%) patients had two vessels disease, 24 (24%) patients had three vessels disease, and 12 (12%) patients had left main stem disease.

Table 1

Shows the result of Duke's score in relation to coronary angiographic

finding in which 10 (10%) patients with low risk, 63 (63%) patients with intermediate risk and 27 (27%) patients with high risk.

The left main stem and three vessels disease occurred more in high risk group (37%, 40.8%) and it was significantly more than intermediate and low risk group, while normal and single vessel occurred more in low risk group (40%, 40%) and it was significantly more than intermediate and high risk group. For the intermediate Duke's risk group the coronary angiographic results distributed as normal (22.2%), single (30.2%), two (25.4%), and three vessels disease (19%), while it was rarely associated with left main stem disease (3.2%).

Table 2

Shows coronary angiographic findings in the patients distributed against the age, sex, diabetes, hypertension, and smoking.

Regarding the age, normal coronary angiography occurred in 66.7% of young age group while only 5.6% of elderly age group had normal coronary angiography, the p value was 0.043 (statistically significant).

Regarding the sex, normal coronary angiography occurred in 14.5% of male patients while it was normal in 29.2% of female patients, the p value was 0.024 (statistically significant).

Regarding diabetes, 93.5% of patients with diabetes had abnormal coronary angiography while 70.4% of patients without diabetes had abnormal coronary angiography, the p value was 0.038 (statistically significant).

Regarding hypertension, 91.1% of patients with hypertension had abnormal coronary angiography while 70.4% of patients without hypertension had abnormal coronary angiography, the p value was 0.044 (statistically significant).

Regarding smoking, abnormal coronary angiography occurred in 93.6% of smoker patients and in 71.7% of non smoker patients, the p value was 0.037 (statistically significant).

Table 3

Shows the treadmill test risk groups and number of risk factors in relation to coronary angiographic findings in which the adding of risk factors to Duke's score were not statistically significant in low and high risk group (p value 0.26, 0.63), while in intermediate risk group there was 63 patients, in whom 14 patients had normal coronary angiography, 13 patients of them didn't have diabetes or more than one risk factor, and only one patient had risk factors, and there were 49 patients with abnormal coronary angiography, in whom 32 patients of them had risk factors, while 17 patients didn't have risk factors, and the adding of risk factors to intermediate risk group was statistically significant (p value 0.001).

Table 4

Shows coronary angiographic findings in the patients distributed against treadmill parameters (type of ST deviation, stage of starting electrocardio-graphic changes, chest pain, and arrhythmia).

For type of ST deviation all patients with ST elevation and downsloping got abnormal coronary angiography, while only 33.3% with upsloping ST deviation got abnormal coronary angiography, and it was statistically significant (P value <0.001).

For stage of starting changes 89.9% of those with changing started in stage I or II had abnormal coronary angiography, while 66.7% of those with changing started in stage III or

more had abnormal coronary angiography, and it was statistically significant (P value 0.018).

For chest pain all patients with limiting chest pain had abnormal coronary angiography while it was abnormal in 85.3% of patients with non limiting chest pain and in 58.1% of patients without chest pain, and it was statistically significant (P value <0.001).

For arrhythmia (including unifocal ventricular ectopic beats, multifocal ventricular ectopic beats, pairs of ventricular ectopic beats, runs of ventricular tachycardia, ventricular fibrillation), the coronary angiography was abnormal in 83.3% of patients with arrhythmia and in 81.7% of patients without arrhythmia, and it was statistically not significant (P value 0.992).

Table 5

Shows The treadmill risk groups and the type of ST deviation (normal, upsloping, horizontal, downsloping, and elevation) in relation to coronary angiographic finding in which the adding of type of ST deviation to Duke's score was not statistically significant in low and high risk group (p value 0.834, 0.749) respectively, while in intermediate risk group the patients with upsloping ST depression usually had normal coronary angiography (63.6%), and for patients with horizontal ST depression most of them had abnormal coronary angiography (83.3%), and for those with downsloping ST depression and ST elevation all patients had abnormal coronary angiography, and adding the type of ST deviation to intermediate risk group was statistically significant (p value 0.028).

Table 1 The result of Duke's score in relation to coronary angiographic finding:

Duke's Risk Groups	Coronary Angiography						Total
	Normal	Single Vs.	Two Vs.	Three Vs.	LMS.	Abnormal total	
Low risk	4 40.0%*	4 40.0%*	1 10.0%	1 10.0%	0 0.0%	6 60.0%	10 100.0%
Intermediate risk	14 22.2%	19 30.2%	16 25.4%	12 19%	2 3.2%	49 77.8%	63 100.0%
High risk	0 0.0%	1 3.7%	5 18.5%	11 40.8%*	10 37.0%*	27 100.0%	27 100.0%
Total	18 18.0%	24 24.0%	22 22.0%	24 24.0%	12 12.0%	82 82.0%	100 100.0%

* statistically significant, P value < 0.001

Table 2 Statistical analysis of demographic characteristic of patient's group:

*statistically significant

Risk Factors		Coronary Angiography		Total	P. value
		Normal	Abnormal		
Age groups	young	2(66.7%)*	1(33.3%)	3	0.043
	middle	14(23%)	47(77%)*	61	
	elderly	2(5.6%)	34(94.4%)*	36	
Sex	Male	11(14.5%)	65(85.5%)*	76	0.024
	Female	7(29.2%)*	17(70.8%)	24	
Diabetes	Yes	3(6.5%)	43(93.5%)*	46	0.038
	No	15(27.8%)*	39(72.2%)	54	
Hypertension	Yes	5(8.9%)	51(91.1%)*	56	0.044
	No	13(29.6%)*	31(70.4%)	44	
Smoking	Yes	3(6.4%)	44(93.6%)*	47	0.037
	No	15(28.3%)*	38(71.7%)	53	

Table 3 The treadmill risk groups and no. of risk factors in relation to coronary angiographic finding:

TMT RISK GROUPS	>1 RISK FACTORS* OR DM.	CORONARY ANGIOGRAPHY		Total	P value
		NORMAL	ABNORMAL		
Low Risk	yes	1	4	5	0.261
	no	3	2	5	
	Total	4	6	10	
Intermediate Risk	yes	1	32	33	0.001
	no	13	17	30	
	Total	14	49	63	
High Risk	yes	0	20	20	0.633
	no	0	7	7	
	Total	0	27	27	

*Risk factors in this study include hypertension, smoking, elderly age group, and male gender.

Table 4 The result of treadmill parameters in relation to coronary angiographic finding:

TMT PARAMETERS		CORONARY ANGIOGRAPHY		Total	P. value
		NORMAL	ABNORMAL		
Type of ST deviation	Normal	4(40%)	6(60%)	10	<0.001
	Upslopping	8(66.7%)	4(33.3%)	12	
	Horizontal	6(12.0%)	44(88.0%)	50	
	Downslopping	0(0.0%)	23(100%)	23	
	Elevation	0(0.0%)	5(100.0%)	5	
Stage of starting changes	I,II	7(10.1%)	62(89.9%)	69	0.018
	≥III	7(33.3%)	14(66.7%)	21	
	Normal	4(40.0%)	6(60.0%)	10	
Chest pain	No	13(41.9%)	18(58.1%)	31	<0.001
	Nonlimiting	5(14.7%)	29(85.3%)	34	
	Limiting	0(0.0%)	35(100.0%)	35	
Arrhythmia	Yes	3(16.7%)	15(83.3%)	18	0.992
	No	15(18.3%)	67(81.7%)	82	

Table 5 The treadmill risk groups and the type of ST deviation in relation to coronary angiographic finding:

TMT GROUPS	RISK	TYPE OF ST DEVIATION	CORONARY ANGIOGRAPHY		Total	P. value
			NORMAL	ABNORMAL		
LOW RISK		NORMAL	3(42.9%)	4(57.1%)	7	0.834
		UP SLOPPING	1(100.0%)	0(0.0%)	1	
		HORIZONTAL	0(0.0%)	1(100.0%)	1	
		ELEVATION	0(0.0%)	1(100.0%)	1	
		Total	4(40.0%)	6(60.0%)	10	
INTERMEDIATE RISK		NORMAL	1(33.3%)	2(66.7%)	3	0.028
		UP SLOPPING	7(63.6%)	4(36.4%)	11	
		HORIZONTAL	6(16.2%)	31(83.8%)	37	
		DOWN SLOPPING	0(0.0%)	10(100.0%)	10	
		ELEVATION	0(0.0%)	2(100.0%)	2	
		Total	14(22.2%)	49(77.8%)	63	
HIGH RISK		HORIZONTAL	0(0.0%)	12(100.0%)	12	0.749
		DOWN SLOPPING	0(0.0%)	13(100.0%)	13	
		ELEVATION	0(0.0%)	2(100.0%)	2	
		Total	0(0.0%)	27(100%)	27	

Discussion

This study showed that Duke's score is valid in detecting coronary artery disease specially high risk group (all patients had coronary arterial disease specially three vessels and left main stem disease (77.8%) which carry poor prognosis).

normal, single, two, three, and left main stem disease in coronary angiographic result in high Duke's risk group was 0%, 3.7%, 18.5%, 40.8%, and 37% respectively in this study, and it was 0.4%, 5.9%, 15.7%, 39.5%, and 38.5% respectively in Leslee et al study[24], and it was 0%, 12.7%, 20%, 36.3%, and 31% respectively in Peters RM et al study[25].

On other hand Duke's score can predict the severity of coronary arterial disease in that high risk group (according to Duke's score) can predict the left main stem disease or three vessels disease, while in the low risk group there was a decrease the incidence of the left main stem and three vessels disease with increase in the chance of coronary angiography to be normal or single vessel disease, and the p value of correlation between Duke's score and coronary angiographic result was <0.001 and this was in agreement with Leslee et al study[24](p value <0.001) and Peters RM et al study[25](p value <0.001).

The study showed that 22.2% of patients with intermediate risk Duke's score had normal coronary angiography and this may be attributed to small vessels disease or false positive results of treadmill test or under estimation of severity of the coronary lesion. The false positive result of exercise test may be attributed to false result of test (positive result in normal coronary vessels) or false result of coronary angiography (as in patient with distal vessels disease) [26].

normal, single, two, three, and left main stem disease in coronary

angiographic result in intermediate Duke's risk group was 22.2%, 30.2%, 25.4%, 19%, and 2.3% respectively in this study, and it was 22.3%, 24.5%, 20%, 20%, and 10.5% respectively in Leslee et al study[24], and it was 11%, 34%, 26%, 25%, and 4% respectively in Peters RM et al study[25].

Patients with low risk score didn't necessary had normal vessels, 60% of patients with low risk group whom cardiologist decided to arrange for coronary angiography (in spite of the result of treadmill test) had abnormal coronaries.

Obstructive disease limited to the circumflex coronary artery may result in a false-negative stress test since the lateral portion of the heart which this vessel supplies is not well represented on the surface 12-lead electrocardiogram.[1]

Since the overall sensitivity of exercise stress electrocardiography is only ~75%, a negative result does not exclude coronary artery disease, although it makes the likelihood of three-vessel or left main coronary artery disease extremely unlikely.[1]

normal, single, two, three, and left main stem disease in coronary angiographic result in low Duke's risk group was 40%, 40%, 10%, 10%, and 0% respectively in this study, and it was 55%, 25%, 10%, 10%, and 5% respectively in Leslee et al study[24], and it was 40%, 40%, 20%, 0%, and 0% respectively in Peters RM et al study[25].

The results of table 2 showed that the results of exercise tolerance test needs to be interpreted with caution in patients with young age group for 66.7% of them had normal angiography while only 5.6% of elderly age group had normal coronary angiography, so that the results of exercise tolerance test needs to take age in consideration before deciding to arrange for coronary angiography, and

the p value of the comparing the age groups (young, middle, elderly) with coronary angiography was 0.043 and this in agreement with finding of Keith Cohn et al study [7] (p value <0.001).

This study showed that normal coronary angiography were more in female, and p value for sex groups (male, female) was 0.024 and this in agreement with finding of Keith Cohn et al study [7] (p value <0.001). The sex of the subject being tested achieved predictive significance, probably because coronary disease is much less prevalent among females.[27]

This study showed that patients with risk factors like diabetes, hypertension, and smoking were more likely to have abnormal results of coronary angiography, while Duke's score does not take risk factors in consideration.

There were another studies that showed relationship between coronary angiography and patient's risk factors and derive a scoring system involving the age, diabetes, and hyperlipidemia as in Vinod Raxwal et al in which Consecutive patients referred for evaluation of chest pain who underwent standard treadmill testing followed by coronary angiography were studied. then the variables and coefficients were used to derive a simplified score. The simplified score was calculated as follows: (6 x maximal heart rate code) + (5 x ST-segment depression code) + (4 x age code) + angina pectoris code + hypercholesterolemia code + diabetes code + treadmill angina index code. The simplified score had a range from 6 to 95, with < 40 designated as low probability, between 40 and 60 was intermediate probability, and > 60 was high probability for CAD.[28]

We tried to add risk factors to increase sensitivity of Duke's score to predict coronary artery disease. The results

showed that analysis of risk factors was valuable in patients with intermediate risk group, and so we suggest to take risk factors in consideration before referring patients to coronary angiography in patients with intermediate risk group (only one patient out of 33 patients with intermediate risk group whom had risk factors appeared to have normal coronary angiography, while 13 patients out of 30 patients with intermediate risk and no risk factors appeared to have normal coronary angiography). Adding of risk factors to high risk group was of no value because all of them had abnormal results, and adding of risk factors to low risk also didn't improve to results probably because of low number.

This study showed that type of ST segment deviation was of value in predicting the results of exercise tolerance test. All patients with down slopping ST segment depression had abnormal results of coronary angiography, while only 33.3% of patients with up slopping S.T segment depression had abnormal results of coronary angiography, and adding of this parameter to Duke's score can improve the results in patients with intermediate risk and so we suggest to take it in consideration in patients with intermediate risk Duke's score before referring to coronary angiography, while adding type of ST deviation to high risk group was of no value because all of them had abnormal results, and adding type of ST deviation to low risk also didn't improve to results probably because of low number. the p value of comparing the type of ST deviation with coronary angiography was <0.001 and this in agreement with finding of Keith Cohn et al study[7] (p value <0.001).

The stage of starting changes of exercise test is of value in evaluating the results of exercise tolerance test,

and this has been taken in consideration in Duke's score that depends on duration of exercise tolerance test, the p value of comparing the stage of starting changes of exercise test with coronary angiography was 0.018 and this is in agreement with finding of Keith Cohn et al study[7] (p value <0.001), and this study showed also that symptom of chest pain was of value in predicting coronary disease, and again this parameter had been taken in consideration in Dukes score, the p value of comparing the chest pain in exercise test with coronary angiography was <0.001 and this is in agreement with finding of Keith Cohn et al study[7] (p value <0.001).

This study showed that arrhythmia didn't add much value for predicting coronary disease, the p value for exercise induce arrhythmia was 0.992 (statistically not significant) and it was 0.249 (statistically not significant) in Keith Cohn et al study[7], while it was significant when comparing with severe coronary angiography (triple-vessel, left main stem disease), the p value was 0.003[7].

Limitation

1. Not all patients underwent treadmill test did coronary angiography so we can't calculate the sensitivity and specificity of the test.
2. Lipid profile wasn't done to the patients.

Conclusion and Recommendation

- 1- Duke's score is valid in predicting coronary arterial disease.
- 2- High risk Duke's score patients need to be referred directly to coronary angiography for they usually have significant coronary disease.
- 3- Low risk Duke's score doesn't mean that they have no significant coronary disease.

4- Normal coronary angiography is found more in female and young age group.

5- Adding of risk factors to Duke's score increases it's ability to predict coronary arterial disease in intermediate risk group, and needs to be taken in consideration before referring for coronary angiography.

6- Adding of type of ST deviation (downsloping ST depression, ST elevation) increases the ability of Duke's score to predict coronary arterial disease in intermediate risk group, and needs to be taken in consideration before referring for coronary angiography.

7- Development of arrhythmia doesn't increase ability of Duke's score in predicting coronary arterial disease.

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