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Original Research Article

The Implication of Duke Treadmill Score (DTS) on the Extent of Coronary Artery Lesions by Angiography

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Abstract

Exercise testing is used to evaluate patients with coronary artery disease. The Duke treadmill score (DTS) is a composite index for diagnostic and prognostic estimates based on results of the exercise test.
A cross sectional study used to assess patients referred to The Iraqi Centre for Heart Diseases with chest pain by exercise test and coronary angiography during the period from May 2013 to April 2014.
A significant coronary artery lesion: ≥50% left main stem stenosis or, ≥70% stenosis in other epicardial vessels. Significant lesion in the left main stem or three vessels defines an extensive coronary artery disease (CAD). Non extensive disease means significant lesion in one or two vessels.
80 patients included in the study (40 patients with high risk DTS, and 40 patients with non-high risk DTS). 61 patients were males (76%), 19 patients were females (24%). 38 patients of the high risk group (95%) had a significant coronary artery disease, 13 patients of them (32%) had extensive coronary artery disease. More than half of the non-high risk group (58%) had no coronary lesion, 17 patients (42%) with significant coronary disease, with one patient with extensive coronary disease (P<0.001).
The Duke treadmill test provides diagnostic and prognostic information for the evaluation of symptomatic patients for clinically suspected ischemic heart disease.

Key words: CAD, Duke treadmill score

تضمين مؤشر ديوك لفحص إجهاد القلب على سعة انتشار إصابة الشرايين التاجية من خلال الفحص القسطاري

الخلاصة

يستعمل فحص أجهاد القلب لتقييم المرضى الذين يعانون من أمراض الشرايين التاجية. ويعد مؤشر ديوك لفحص إجهاد القلب من المؤشرات التي تعطي فكرة جيدة عن الحسابات التشخيصية والمستقبلية اعتمادا على نتائج فحص اجهاد القلب.

هذه دراسة مقطع عرضي لعينة من المرضى المحالين إلى المركز العراقي لأمراض القلب في مجمع مدينة بغداد الطبية /بغداد –العراق للفترة من شهر مايس 2013 إلى نهاية شهر نيسان 2014 واللذين يعانون من آلام الصدر وثم إجراء فحص إجهاد القلب وفحص قسطرة الشرايين التاجية التشخيصية. تم اعتبار نسبة تضيق≤50% في الجذع الأيسر الرئيسي ونسبة التضييق ≤70% في الشرايين التاجية ذات أهمية. في حين تم اعتبار الإصابة ذات الأهمية في الجذع الأيسر الرئيسي أو ثلاثة من الشرايين الأخرى الرئيسية إصابة واسعة. أما الأصابة غير الواسعة تعني ضرر ذو أهمية في شريان تاجي واحد أو أثنين.

شملت الدراسة 80 مريض (40 مريض لديهم مؤشر ديوك عالي الخطورة، 40 مريض لديهم مؤشر ديوك غير عالي الخطورة). 61 مريض كانوا من الذكور (76%)، 19 مريض كانوا من الأناث (24%). 38 مريض ينتمون الى مجموعة عالي الخطورة (95%) كان لديهم مرض الشرايين التاجية وذو أهمية، 13 مريض منهم (32%) كان لديهم مرض الشرايين التاجية الواسع. أكثر من نصف المرضى في مجموعة غير عالي الخطورة (58%)

كانو غير مصابين بمرض الشرايين التاجية، 17 مريض (42%) كان لديهم مرض الشرايين التاجية ذو أهمية مع مريض واحد كان لديه مرض الشرايين التاجية الواسع ($P<0.001$).

أن مؤشر ديوك لفحص أجهاد القلب أثبت معلومات تشخيصية ومستقبلية للمرضى اللذين يعانون من ألم الصدر ويشتبه أصابتهم بأمراض الذبحة الصدرية.

الكلمات المفتاحية: مرض الشرايين التاجية، مؤشر ديوك لفحص أجهاد القلب.

Introduction

CADhas been remaining the first killer and the major cause of public health problems in the world, which is one of the most common causes of morbidity and mortality in different communities, moreover, CAD is the main cause of death in the United States of America among human adults representing approximately one-third of all dead people, who are over the age of 35 years[1].The CAD mortality in North America and Western Europe in the recent decades has been successfully reduced by the treatment, while in contrast, it has increased in Asia and Eastern Europe [2].Coronary artery disease development and progression is stimulated by genetic and/or genetic or other factors; among these factors are tobacco use, diabetes mellitus (DM), and hypertension [3]. In most cases, CAD has a multifactorial genetic basis, involving a number of genes and environmental factors, which are interacting to determine whether or not the disease will develop as well as its severity[4].

Materials and Methods

This was a cross sectional study conducted at the Iraqi Centre for Heart Diseases; the main cardiac center in the Medical City Teaching Hospital in Baghdad.

Patients

The sample which was collected over the period from May 2013 to April 2014 consisted of 102 patients. 22 patients were excluded, 15 patients with previous revascularization and 7 patients with LBBB on baseline ECG. Other exclusive criteria including: severe uncontrolled hypertension, acute coronary syndrome, aortic stenosis, decompensated heart failure, uncooperative patients, and patients with leg disability. The remaining 80 patients underwent exercise ECG testing for clinical suspicion of CAD based on intermediate &high pretest probability for CAD by age, gender, and symptoms followed by coronary angiography study as a part of risk stratification according to the ACC/AHA guidelines.

80 patients were included in this study, 19 patients were female (10 patients with high risk and 9 patients with non-high risk) and 61 patients were male (30 patients with high risk and 31 patients with non-high risk).

All patients underwent symptom-limited treadmill exercise testing according to the standard Bruce protocol by using Tepa Pro_2200/2011 machine.Exercise testing was discontinued if exertional hypotension, malignant ventricular arrhythmias, marked ST depression (≥3 mm), or limiting chest pain was reported. An abnormal exercise ST response was defined as ≥1 mm of horizontal or downsloping ST depression at (J-point+60 ms). The Duke treadmill score(DTS) was calculated as the following: DTS= exercise time (minute)−5 ×(maximum ST deviation) − 4× (treadmill angina index). Angina index =0 ifnoanginal pain during exercise, 1for non-limiting anginal pain, 2if angina was why the test terminated. A (DTS) of ≤ −11 was defined as high risk , a DTS of > −11 to + 5 was defined as intermediate risk , while a score of > +5 was defined as low risk [5].

A significant coronary artery lesion by angiography was defined as follows: ≥ 50% left main stem stenosis or, ≥70% stenosis in other epicardial vessels. The presence of a significant lesion in the left main stem or

three epicardial vessels was labeled as extensive coronary artery disease, while non-extensive coronary artery disease indicates a significant lesion in one or two epicardial vessels[6].

Statistical analysis

Was performed by using the SPSS version 20, IBM, US, 2010. Descriptive statistics were presented as mean and SD for the age, and frequencies and proportions for other variables. Student's t test was used to compare DTS risk groups, coronary artery lesions subtypes, and mean ST changes. Chi square test (X^2) was used to assess the significance of associations between variables. Level of significance (P.value) ≤ 0.05 was considered significant. Finally all findings and results were presented in tables.

Ethical Considerations

1. The study protocol was approved by the Faculty of Medicine and the Committee of postgraduate studies of University of Baghdad.
2. Verbal consent of patients was obtained prior to participations.
3. Data including the names and identifications information of the patients were kept in a secured database and weren't disclosed to unauthorized individuals.

Results

There were 80 patients included in the study (40 patients were with high risk DTS, the other 40 were with non-high risk DTS). The mean age 55.6 ±9.6 years. 61 patients were males (76.0%) and 19 were females (24.0%). There was no significant difference in age groups and means between males and females (p>0.05), as shown in table1.

Table 1: Age and sex distribution of studied group

Age (years)	Male		Female		Total		P-value
	No.	%	No.	%	No.	%	
< 50	22	36.0	6	32.0	28	35.0	0.51
50 – 59	17	28.0	5	26.0	22	28.0	
60 – 69	17	28.0	4	21.0	21	26.0	
≥ 70	5	8.0	4	21.0	9	11.0	
Total	61	100.0	19	100.0	80	100.0	
Mean ±SD*	54.7 ± 9.1		57.8 ±11.4		55.6 ±9.6		0.34
Range (years)	42 – 71		45 – 78		42 -78		

*Standard deviation

The main risk factors for CAD among study participants were HT (65%), DM (34.0%) and smoking (43.0%). Participants who had one risk factor represented 40%, those who had two risk factors represented 26.0%, those who had no risk factors represented 18.0% and those who had three risk factors represented 16.0%, as shown in table 2.

Table 2: Distribution of risk factors (N=80)

Risk factor		No.	%
HT	Yes	52	65.0
	No	28	35.0
DM	Yes	27	34.0
	No	53	66.0
Smoking	Yes	34	43.0
	No	46	57.0
Risks Combination	None	14	18.0
	One risk factor	32	40.0
	Two risk factors	21	26.0
	Three risk factors	13	16.0

According to the results of DTS, the patients fell into two groups:

1. 40 patients with high risk DTS group(50%).
2. 40 patients with non-high risk DTS group(50%).

For both groups there were:

A. Twenty five patients (31.0%) had no vessel disease.

B. Nineteen patients (24.0%) had one vessel disease.

C. Twenty two (27.0%) patients had two vessel disease

D. Fourteen patients (18.0%) had three vessel disease.

E. No patients had LMS disease (0.0%)

As shown in table 3.

Table 3: Distribution of DTS and angiographic findings

Variables (Total no. =80)		No.	%	P-value (<0.05)
DTS	High risk	40	50.0	
	Non-High risk	40	50.0	
Vessels involved	None	25	31.0	
	One vessel	19	24.0	
	Two vessels	22	27.0	
	Three vessels	14	18.0	
	LMS disease	0	0	

No significant difference had been found in between both genders regarding DTS risk groups (p=0.79).It had been found that patients in high risk groups were older in age than those in non-high risk DTS group;(the mean age was 59.2 ± 8.3 years vs. 52.02 ± 6.7 years, respectively), (p=0.001), furthermore, the age group distribution revealed that frequent high risk with advancing age group as compared to non-high risk, where 15% of the high risk group and 55% of the non-high risk group aged < 50 years, while 15% of high risk group vs. 7.5% of non-high risk group aged > 70 years as shown in table 4.

Table 4: Association of DTS with age and sex

		DTS				P-value
		High risk		Non-High risk		
		No.	%	No.	%	
Sex	Male	30	75.0	31	78.0	0.79
	Female	10	25.0	9	22.0	
Age groups	< 50	6	15.0	22	55.0	0.001
	50 – 59	16	40.0	6	15.0	
	60 – 69	12	30.0	9	22.0	
	≥ 70	6	15.0	3	8.0	
	Mean ± SD	59.2 ± 8.3		52.02 ± 6.7		0.001

There was a significant association between high risk DTS and extensive and non-extensive CAD among study participants (p<0.001), as shown in table 5.

Table 5: Association of DTS with CAD

CAD	DTS				P-value
	High risk		Non-High risk		
	No.	%	No.	%	
No lesion	2	5.0%	23	58.0%	< 0.001
Non extensive CAD	25	63.0%	16	40.0%	
Extensive CAD	13	32.0%	1	2.0%	

A significant association was observed between the patients with no lesions of the vessel by angiography and non-high risk DTS (p<0.001). This indicated high specificity of DTS in addition to high sensitivity, as shown in table 6.

Table 6: Distribution of DTS according to the number of vessels involved

Angiographic findings	DTS			
	High risk		Non-High risk	
	No.	%	No.	%
No lesion	2	5.0%	23	58.0%
One vessel	7	18.0%	12	30.0%
Two vessels	18	45.0%	4	10.0%
Three vessels	13	32.0%	1	2.0%
Total	40	100.0%	40	100.0%
P-value < 0.001				

Discussion

The prognostic evaluation is a crucial component of clinical evaluation of patients with CAD. Although patients with stable angina have low mortality rate, the risk of myocardial infarction, the need for interventions and the symptoms all affect the clinical evolution of the disease[7-10]. Demographic presentation of the present study revealed that males were more than females and the mean age of females was higher than that of males although, no significant difference was observed in age groups and mean age between males and females ($p>0.05$). This finding is consistent with results of Saeed et al study in Iraq, [11] and Assiri[12].The present study revealed that half of study participants had high risk DTS and other half had non-high risk DTS, this finding is close to that reported by Liao L et al in USA [13], and Shaikh et al[14]. In the present study about one-third of the patients had no vessels involved, other two thirds had from one to three vessels, on the other hand, the extent of CAD was: extensive for 18.0%, non-extensive for 51.0% of the patients, and no lesion for 31.0%,the left main stem involvement was non 0.0% . This picture is close to the results of other two studies in USA; Kwok et al study [15], and Lauer MS study [5], in regard to three vessel involvement while it was inconsistent in regard to left main stem involvement, this inconsistency might be attributed to the small sample size in our study, and interobserver and intraobserver variation in the quantification of LMS lesion. The sex in the present study did not significantly affect the outcome of DTS ($p=0.79$). This finding is inconsistent with that found in other study was carried out by Jang JY et al study in South Korea [16], and an earlier study was conducted by Shaw LJ et al in USA [17] that found significant association between sex and DTS, the inconsistency with these studies might be attributed to the small number of females compared to males in our study.

This study revealed a significant association of DTS with old age ($p=0.001$). This finding is in line with the results of Shaw et al [17] and Marwick et al[18].The present study revealed a significant association between high risk DTS and the extent CAD ($p<0.001$). This finding is consistent with results of Acar et al [19] that concluded a strong correlation between high risk DTS and coronary lesion complexity. Shaw et al study in USA [17]found also a significant association between high risk DTS with extensive and significant CAD.A significant association was observed by this study between non-high risk patients and no lesion detected by angiography ($p<0.001$). This finding is consistent with results of Tamargo et al[20] that resulted high

sensitivity and specificity of DTS indiagnosis and prognosis of CAD lesions.

Limitations of The Study

1. Small sample size.
2. Inter and intraobserver variability in the exercise ECG interpretation and angiographic lesion quantification.
3. Referral bias.

Conclusions

DTS is a significant diagnostic and prognostic tool for CAD.A significant association between DTS and elderly age.High risk DTS had a significant association with extensive, and significant CAD, and S-T segment depression on ECG.Non high risk group patients had more association with no lesions by angiography and almost no extensive CAD.

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