Relationship Between Duke Treadmill Score and Severity of CAD in Suspected Patients

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Received: 21 Feb. 2022; Accepted: 18 Sep. 2022

Abstract- Nowadays, cardiovascular disease, including coronary artery disease, is the leading cause of death around the world. Duke Treadmill Score (DTS) is used as a prognostic score for patients suspected of coronary artery disease. Investigating the Relationship between DTS and syntax score (SxScore) as an indicator of complexity and severity of coronary artery disease in patients with intermediate and high Duke Score. This cross-sectional study was conducted at the exercise test unit of Heshmat Hospital in Rasht from September 2017 to December 2018. Among 1033 patients that passed exercise cardiac stress testing *(*EST*),* 118 patients who had positive exercise testing for CAD were enrolled. Coronary angiography was performed, and SxScore, a marker of CAD complexity, was determined. The relationship between DTS and SxScore was then evaluated. The data were analyzed by SPSS version 21. The risk of positive EST raised age more than 61 years (OR=1.072; 95%; CI=1.046-1.099), Hypertension (OR=3.235; 95%; CI=2.097-4.992), Hyperlipidemia (OR=2.109; 95%; CI=1.371-3.242) and Diabetes Mellitus (OR=2.15; CI=1.22-3.14). The presence of the following factors reduced positive EST: female (OR=0.377;95%; CI=0.133-1.068), retired (OR=0.128;95%; CI=0.045-0.361). The results of the present study showed that there was no significant difference between the degree of coronary artery involvement based on syntax with Duke scores (*P*=0.328). Although both DTS and Syntax scores are useful in evaluating coronary artery disease, there isn't a significant relationship between these scores, and they don't coincide. In other words, we cannot use DTS to predict the Syntax score.

Acta Med Iran 2022;60(11):714-719.

Keywords: Coronary artery disease; Exercise test; Ischemia; Duke treadmill score

Introduction

Coronary artery disease (CAD) is one of the leading causes of non-traumatic death around the world. CAD is also the leading cause of death in the United States, which is estimated to account for one-third of all deaths in people over the age of 35 years (1-3). Preventive and therapeutic measures taken in this regard have dramatically reduced mortality rates in recent years in North America and Western Europe, although there was an increase in mortality rates in Asia and Eastern Europe (1,4). The rate of this disease is rapidly increasing in developing countries, so the rate of death caused by coronary artery diseases will increase from 16.7 in 2002 to 23.3 million in 2030 (5). Coronary artery disease develops due to genetics or its interaction with other environmental factors. These environmental factors include smoking, diabetes mellitus, and hypertension (6,7). In many cases, CAD develops and progresses in interaction with several genetic and environmental factors (8-13).

Exercise tolerance test has been used to assess patients who present with chest pain and intermediate pre-test probability of ischemic heart disease (14). The limited sensitivity and specificity of standard exercise ECG testing for the detection of coronary artery disease have stimulated increased use and development of noninvasive stress imaging technologies (15). However, the added diagnostic accuracy of stress imaging tests is associated with substantially higher costs. An alternative

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to the use of more expensive tests is the more efficient use of available low-cost data. Diagnostic and prognostic predictive accuracy increases when multiple pieces of information from the patient's clinical history and the treadmill test are integrated (15).

Duke Treadmill Score (DTS) is a composite index that is based on the results from the exercise test, including ST-segment depression, chest pain, and exercise duration, and provides more accurate prognostic information for the evaluation of patients with clinically-suspected ischemic heart disease. Syntax score (SS) is an angiographic scoring system that is widely used to evaluate the severity and complexity of CAD. It is used in the estimation of long-term outcomes of CAD and in the selection of the treatment modality. Its efficacy has been demonstrated in various studies (16,17). Some studies (15,18) have suggested that the DTS score helps in assessing the severity of the disease.

Hence, given the few studies conducted in this regard and the high incidence of coronary artery disease due to inappropriate lifestyle of people and high medical costs imposed on the patient and society, and the lack of similar research in Guilan province of Iran, it was decided to conduct (19) this research to investigate the relationship between Duke Treadmill Score (DTS) and the complexity and severity of coronary artery disease involvement SxScore in groups of patients who are suspected of having CAD because of chest pain or exertional dyspnea and also have high and intermediate Duke scores in EST.

Materials and Methods

Participants

This cross-sectional study was conducted at the exercise test unit of Heshmat Hospital in Rasht from September 2017 to December 2018. Patients were recruited through non-probability purposive sampling. Patients of both genders above the age of 30 years who presented first time with angina, and patients without a history of prior CAD, admitted to the outpatient clinic with chest pain (typical angina, atypical angina, non-angina chest pain) were included in the study. Patients excluded from the study were those who had previously undergone cardiac bypass surgery, coronary angiography, or myocardial infarction were excluded from this study.

All necessary information, including general information (age, gender, job, and living place) and history of different diseases, were collected based on the patient's reports. The exercise test was performed with treadmill and MORTARA equipment, and for all positive EST cases, Duke Score was calculated according to the following formula: DTS=exercise time-(5 x ST deviation)-(4 x exercise angina) (20).

Accordingly, patients can be classified into three groups: 1-patient with a Duke score higher than or equal to 5, was placed in the low-risk group, 2-patients with a Duke score between 5 and -11 were placed in the intermediate-risk group, and 3- patients with a Duke score of less than or equal to -11 were placed in the high-risk group and is one of the valid and recommended criteria for estimating coronary artery stenosis (20,21).

According to Duke Score, for all the subjects classified in the high and intermediate risk groups (77 patients), coronary angiography was done within 6 months in Heshmat hospital.

Ethics approval

This study was approved by the Ethics Committee of Guilan University of Medical Science (IR.GUMS.REC.1396.507); all necessary permissions were obtained from the relevant authorities prior to beginning the study.

Coronary angiography

Coronary angiography was performed by the Judkins technique, using the standard Seldinger technique through a percutaneous femoral or radial artery puncture. Each angiogram was analyzed independently by an experienced interventional cardiologist who was blinded to the patient clinical data. Those patients whose angiogram was normal were excluded from the study. The coronary lesion considered between variables was considered significant. In this study, syntax score was used as a reference method to determine coronary artery involvement. The information obtained from coronary angiography was entered into the syntax1 calculator at syntaxscore.com. Based on the syntax score, patients were divided into three groups low (0-22), intermediate (23-32), and HIGH (33 and more) syntax score (20).

Statistical analysis

After collecting the data, they were analyzed in SPSS, version 21, software. The Kappa coefficient was used to determine the agreement between Duke Score and the syntax score. Sensitivity, specificity, PPV, accuracy, and 99% confidence interval for these indicators were used to predict syntax levels in coronary artery involvement. Z test was used to compare these indicators in terms of individual variables and disease-

dependent variables. The significance level of tests was considered at $P<0.05$ level.

Results

There were 1033 patients included in the study. The mean age of the patients was 47.85±10.26years with a minimum age of 30 years and maximum age of 70 years. About 535 (51.8%) patients were males, and 498 were females (48. 2%). The main risk factors for CAD among study participants were diabetes mellitus 150 (14.5%), then 239 hypertension (23.1%), hyperlipidemia 304 (29.4%), and smoking 162 (15.7 %). Among 1033 patients who were investigated with EST, 118 patients had positive exercise test results, and Duke Score was calculated for them (Figure 1).

According to the results of this study, among 118 patients with positive EST, 34.7% (n=41) had a low-risk Duke Score, 60.2% (n=71) had an intermediate-risk Duke Score, and 5.1% (n=6) had a high-risk Duke Score.

According to patients' angiography findings, among 71 patients with intermediate Duke Score, 59 cases (76.6%) had low syntax scores, 11 cases (14.3%) had intermediate syntax scores, and 1 case (1.3%) had high syntax scores. Among 6 patients with high Duke Score, the Syntax score was calculated as low in 4 cases (5.2%) and intermediate in 2 cases (2.6%).

The results of the present study showed that there was no significant difference between the degree of coronary artery involvement based on syntax with Duke scores (P=0.328).

Association between Duke Treadmill Score and the SYNTAX score is presented below (Inserted into table 1).

The regression coefficients and odds ratio as predictors related to positive exercise tests are also presented in Table 2 (Inserted into table 2).

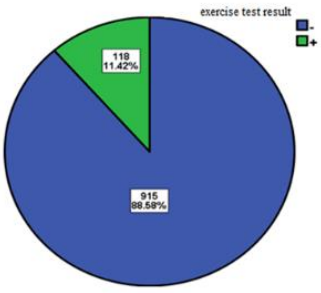

Figure 1. Exercise test results

Table 1. Association between Duke Treadmill Score and SYNTAX score

Coronary artery involvement based on Duke	Stenosis of the arteries based on syntax score			*P**
	Low N (%)	Intermediate N (%)	High N (%)	
Intermediate	59(76.6)	11(14.3)	1(1.3)	0.328
High	4(5.2)	2(2.6)	0(0)	

*For categorical variables, Fisher's Exact test

Table 2. Regression coefficients and odds ratio of predictors related to positive EST based on Duke Treadmill

Variable	Condition	N (%)	*P*	Univariate OR(CI)
Gender	Male	74(13.8)	0.012	1.0 (ref.)
	Female	44(8.8)		0.377(0.133-1.068)
Age	<30	1(2.1)	0.001	1.072(1.046-1.099)
	31-40	3(1.3)		
	41-50	31(9.1)		
	51-60	48(16.2)		
	>61	35(29.2)		
Job	housewife	39(9.7)	0.001	0.527(0.162-1.712)
	Self-employed	42(12.1)		0.294(0.137-0.635)
	retired	8(13.8)		0.128(0.045-0.361)
	employed	12(6.7)		0.256(0.101-0.648)
	Farmer	12(38.6)		1.0 (ref.)
	Student	0(0)		0(0)
HTN	Yes	62(25.9)	0.001	3.235(2.097-4.992)
	No	56(7.1)		1.0 (ref.)
HLP	Yes	60(19.7)	0.001	2.109(1.371-3.242)
	No	58(8)		1.0 (ref.)
DM	Yes	31(20.7)	0.001	2.15(1.22-3.14)
	No	87(9.9)		1.0 (ref.)

OR(CI), odds ratio (confidence interval 95%); ref, reference; Hypertension (HTN), Hyperlipidemia (HLP), Diabetes Mellitus (DM)

In multiple linear regression analysis of females (OR=0.377;95%; CI=0.133-1.068), age group of 61 years old and more (OR=1.072;95%; CI=1.046-1.099), retired (OR=0.128;95%; CI=0.045-0.361), HTN (OR=3.235;95%; CI=2.097-4.992), HLP (OR=2.109;95%; CI=1.371-3.242) and DM (OR=2.15; CI=1.22-3.14) were considered as predictive factors for positive EST.

Discussion

In this study, we investigate the relationship between the DUKE Treadmill score and syntax score (SxScore) as an indicator of the complexity and severity of coronary artery disease in patients with intermediate and high Duke scores. The results of the present study showed that there was no significant difference between the degrees of coronary artery involvement based on syntax with Duke Scores.

Different studies have indicated that Exercise testing is the most widely performed test for prognostic assessment of ischemic heart disease in patients who are able to stand exercise and who have no substantial abnormalities in the resting electrocardiogram. It is assumed that the patients with suspicion of ischemic heart disease and a low-risk exercise test result have a favorable prognosis (22,23). The SYNTAX score, which is used in the evaluation of angiographic severity of coronary lesions, has already been shown to predict mortality in addition to its role in the decision-making process of intervention procedure (percutaneous coronary intervention [PCI] or CABG) (14).

On the other hand, Asad *et al*., in 2018 demonstrated that the no of vessels involved was more in the intermediate group and high-risk DTS score group patients as compared to the low group. Also, Kania *et al.*, in 2019, investigated High-resolution body surface potential mapping in exercise assessment of ischemic heart disease. They indicated ischemic changes outside the standard precordial lead position that was not visible when using the standard 12-lead exercise test (22). The results of our study were in line with the results of these two studies.

According to another finding of this research, females reduced the risk of positive EST, but Adrián I. Löffler *et al*., in 2018, showed that patients with intermediate to high probability for obstructive CAD because the majority were men with a high incidence of co-morbidities and given that they were referred for coronary angiography (24). This difference in outcome can be related to the different types of study and sample sizes, and research design.

In addition, we show a statistically significant association between the age group of 61 years old and more with positive EST in the final model, which was similar to the review study by sharif and Alway in 2016. They indicated in a high-risk population, such as those aged over 50 with typical angina symptoms, a negative result cannot rule out CAD, although the results may be of some prognostic value (25). In our study, retired people reduced the risk of positive EST. From the researcher's viewpoint, it may be possible to justify the reason for higher awareness and performance scores in retired people due to their less business, less involvement in life issues, and having more time to study and perform actions in that direction. Moreover, the risk of positive EST was increased in that history of HTN by 3.2 times rather than the history of hypertension. Like the present research, studies have also shown that arterial hypertension is one of the strong predictors of a positive exercise stress test (24,26). Furthermore, hyperlipidemia raised the risk of positive EST by 2.1 times rather than without a history of hyperlipidemia. Additionally, DM raised the risk of positive EST by 2.15 times rather than without a history of DM. on the other hand, MITU *et al.*, in 2014 investigated the Predictive value of positive exercise stress testing and correlations with cardiovascular risk factors. In their study achieved, type 2 diabetes mellitus and dyslipidemia did not significantly influence the results of the EST (26). This difference in results is due to the sample size and kind of study.

Given what was stated above, it seems that Duke Score is only a criterion for the evaluation of coronary artery disease risk and has no definite relationship with the involved coronary artery anatomy or preferred method of revascularization. In contrast, SYNTAX directly specifies the coronary anatomy and preferred method of revascularization. Therefore, each of the above two scores has a unique value, and the result of Duke cannot be generalized to SYNTAX. Given the results of previous studies and their limitations and the results of the current study, it is recommended that future studies be conducted with a larger sample size and by considering race and gender variables in multiple centers.

Acknowledgments

The present research project was approved by the

Vice Chancellor of Research of Guilan University of Medical Sciences, which undertook the financial support of the center. The authors hereby express their gratitude to the staff of Heshmat hospital, especially those people participating in the research, for their sincere cooperation.

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