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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

The value of the Duke treadmill score in predicting the presence and severity of coronary artery disease

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Abstract

Background and aim: We aimed to investigate the role of the Duke treadmill score (DTS) in predicting the presence and severity of coronary artery disease (CAD) by using the SYNTAX score (SS), and also to determine the cut-off value of DTS for both the presence and severity of CAD.

Methods: The study population consisted of 267 patients admitted to the outpatient clinic with chest pain, who underwent coronary angiography after a positive treadmill stress test. First the patients were divided into two groups: SS = 0 and SS > 0. Then the SS > 0 patients were classified into two subgroups with low (1–22) and high (> 22) SS.

Results: There was a strong negative correlation between DTS and SS (r = –072, p < 0.001). The area under the receiver-operating curve of DTS was 0.83 (0.77–0.88, p < 0.001) for predicting a significant presence of CAD. The optimal cut-off value of DTS to predict the significant presence of CAD was –3.7 (sensitivity of 74% and specificity of 73%). The area under the receiver-operating curve of DTS was 0.84 (0.78–0.90, p < 0.001) for predicting high SS. The optimal cut-off value of DTS to predict high SS was –11.2 (sensitivity of 81% and specificity of 80%). DTS was found to be an independent predictor of high SS in multivariate analysis.

Conclusions: DTS can predict the presence and severity of stable CAD before coronary angiography and may enable the estimation of the revascularisation method that will be required after the procedure.

Key words: Duke treadmill score, SYNTAX score, coronary artery disease, coronary angiography, exercise treadmill testing

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INTRODUCTİON

Coronary artery disease (CAD) is today's leading cause of mortality and morbidity. Approximately 50% of all deaths are caused by CAD. Hence, it is crucial to identify patients with CAD [1–3]. Prediction of cardiovascular disease in the adult population is very important in terms of both prevention and treatment.

Exercise stress testing is a widely used and inexpensive method for initial evaluation of patients with suspected CAD. The Duke treadmill score (DTS) is an index that provides diagnostic and prognostic information in the evaluation of the patients with suspected CAD and is calculated by using parameters such as ST-segment depression, chest pain, and exercise time [4–6].

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 [7–9].

The relationship between DTS and severity of CAD has not been well studied. Therefore, in this paper we investi-

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gated the role of DTS in prediction of presence, severity, and complexity (SYNTAX score) of CAD. Additionally, we aimed to determine the cut-off values of DTS in differentiation of patients with and without significant CAD and of patients with low and high SYNTAX scores.

METHODS

Study design and population

This study was designed as a cross-sectional observational study. The sample was derived from a population of 519 consecutive patients without a history of prior CAD, admitted to the outpatient clinic with chest pain (typical angina, atypical angina, non-anginal chest pain) between March and September 2014. Pretest probabilities (PTP) of all patients were calculated. Patients with low (< 15%, n = 92) and high (> 85%, n = 45) probability were excluded from the study. Only the patients with intermediate PTP (15–85%, n = 382) performed exercise stress testing, and DTS was calculated in each subject. Patients who were unable to perform exercise testing because of physical performance or other contraindications such as electrocardiogram (ECG) abnormalities (n = 26) and the existence of permanent pacemaker (n = 1) etc. were excluded. Patients with more than 1 mm horizontal or downsloping ST depression, more than 1.5–2 mm upsloping ST depression (80 ms after the J point), and typical chest pain due to effort were considered to have a positive stress test and underwent coronary angiography (CAG). These patients composed the study population. Since DTS cannot be calculated, patients with other positive stress test parameters such as more than 1 mm ST elevation (n = 3), dyspnoea (n = 5), wheezing (n = 1), rhonchus (n = 1), decrease in systolic blood pressure (n = 3), and arrhythmia (n = 8) due to effort were not included, but they also underwent CAG. Fifty-two patients were excluded due to severe valve disease (severe stenosis and/or regurgitation of all heart valves), existence of prosthetic valve diseases, heart failure (ejection fraction < 50), acute coronary syndrome (unstable angina pectoris), haematological disorders, previous myocardial infarction, or any revascularisation procedures (whether percutaneous transluminal coronary angioplasty or coronary artery bypass grafting [CABG]). Patients with a history of congenital heart disease, digoxin therapy, and chronic kidney disease and 15 patients who refused to undergo CAG were also excluded. Finally the SS of the remaining 267 patients were calculated. The association between DTS and SS was investigated.

Definitions and classifications

Chest pain was defined as typical angina if all of the following three criteria were met: 1. Substernal chest discomfort of characteristic quality and duration; 2. Provoked by exertion or emotional stress; 3. Relieved by rest and/or nitrates within minutes. Atypical angina was defined as presence of two of the above-mentioned criteria. If the patient had only one or none of the criteria, chest pain was considered to be non-anginal [10].

All of the patients were initially classified into SS = 0 and SS > 0 groups. Later, the patients with SS > 0 were classified into low-SYNTAX (1–22) and high-SYNTAX (> 22) groups. DTS and other parameters were evaluated between these groups. All participants gave informed consent, and the study protocol was approved by the Local Ethics Committee.

Exercise treadmill testing

Symptom-limited Bruce protocol was applied to all patients. Resting heart rate, blood pressure, and 12-lead ECG were recorded in the supine and upright positions before exercise. ECG was repeated every 3 min. Exercise testing was discontinued if exertional hypotension, malignant ventricular arrhythmias, marked ST depression (3 mm), or limiting chest pain were observed. An abnormal exercise ST response was defined as 1 mm or more horizontal or downsloping ST depression (J point ± 80 ms) or 1 mm or more ST-segment elevation in all leads excluding aVR without pathological Q waves. Patients with left bundle branch block, left ventricular hypertrophy, and Wolff-Parkinson-White syndrome were not included in the study [4, 6].

Duke treadmill score

The equation for calculating the DTS was as follows: DTS = exercise time – (5 × ST deviation) – (4 × exercise angina). Exercise angina was assessed as one of three levels: 0, none; 1, non-limiting; and 2, exercise-limiting. The DTS typically ranges from –25 to +15 [3].

Coronary angiography

Coronary angiographies were performed in our clinic using the standard Judkins method with iohexol (Omnipaque, NycomedIrelandltd, Cork, Ireland). During each injection, 6–10 mL of contrast agent was manually delivered. Coronary angiograms were assessed independently by two invasive cardiologists who were blinded to the clinical findings.

SYNTAX score

SYNTAX score is an angiographic tool that is used to grade the complexity of CAD. Each ≥ 50% coronary lesion in each vessel ≥ 1.5 mm in diameter is scored. The latest online updated version was used in the calculation of the SYNTAX scores (www.syntaxscore.com) [11]. After receiving basic training from the SYNTAX score website, the SYNTAX score was evaluated separately by two interventional cardiologists blinded to the study protocol and patient characteristics. Both numeric values and tertiles (≤ 22, > 22) of the score were used.

Statistical analysis

Continuous variables were expressed as mean ± standard deviations or median (inter-quartile range). Categorical variables were expressed as percentages. An analysis of normality of the continuous variables was performed with the Kolmogorov-Smirnov test. Comparison of parametric values between the two groups was performed by means of independent samples t test. Comparisons of nonparametric values between the two groups were performed by Mann-Whitney U test or Kruskal-Wallis test. The χ^2 test was used to compare the categorical variables. Multivariate logistic regression analysis was used to identify the independent predictors of high SS. Receiver-operating characteristic (ROC) analyses were used to detect the cut-off value of DTS in prediction of SS > 0 and high SS. Association between variables was tested using Spearman or Pearson correlation coefficient when appropriate. P values < 0.05 were considered as statistically significant. All statistical studies were carried out with the SPSS program version 20.0 for Windows.

RESULTS

The mean age was 61 ± 10 years, and 178 (69%) of 267 patients were males. Typical angina, atypical angina, and non-anginal chest pain were present in 60%, 25%, and 15% of the patients, respectively. The average values of DTS and SS in all of the patients were –6 ± 6 and 11 ± 11, respectively. 31% of all patients were detected to have SS of 0, 40% had low SS, and 29% had high SS. The clinical and demographic characteristics of all SS = 0 and SS > 0 patients are summarised in Table 1. The SS = 0 and SS > 0 groups had an average DTS value of 0 ± 4 and –8 ± 6, respectively. DTS differed significantly between the SS = 0 and SS > 0 groups (p < 0.001). Age, diabetes, family history, low density lipoprotein cholesterol, total cholesterol, estimated glomerular filtration rate (eGFR), previous aspirin, statin, angiotensin converting enzyme inhibitor/angiotensin receptor blocker (ACEI/ARB) use, and presence of typical angina were also significantly higher in the SS > 0 group when compared to the SS = 0 group.

The clinical and demographic characteristics of the low (1–22) and high SS groups (> 22) are shown in Table 2. In the SS > 0 group, DTS was detected to be –4 ± 3 and –13 ± 5 in the low and high SS groups, respectively (Fig. 1). The high SS group had significantly higher values of DTS when compared to the low SS group (p < 0.001). Additionally, diabetes, high density lipoprotein cholesterol, total cholesterol, eGFR, and previous ACEI/ARB were higher in the high SS group when compared to the low SS group. The presence of typical angina, atypical angina, and non-anginal chest pain were similar between the high and low SS groups (p > 0.05).

Correlation analysis was performed to investigate the relationship between DTS and SS. As shown in Figure 2, strong negative correlation was found between DTS and SS (r = –0.72, p < 0.001).

ROC curve analysis was performed to establish the cut-off values of the DTS for predicting SS > 0 and high SS. In ROC analysis, the cut-off value of DTS between the SS = 0 and SS > 0 groups was –3.7 (AUC = 0.83; 0.77–0.88; p < 0.001), sensitivity 74%, and specificity 73% (Fig. 3), while it was –11.2 (AUC = 0.84; 0.78–0.90; p < 0.001), sensitivity 81%, and specificity 80% (Fig. 4) between the low and high SS groups.

In multivariate regression analysis age, family history, statin use, typical angina, eGFR and DTS were found to be the independent predictors of high SS (b: 0.127, p < 0.043, b: 0.178, p = 0.002, b: 0.114, p = 0.041, b: 0.290, p ≤ 0.001, b: 0.123, p = 0.015 and b: 0.424, p ≤ 0.001, respectively) (Table 3).

Table 1. Clinical and demographic characteristics of all SS = 0 and SS > 0 patients (n = 267)

	SS = 0 (n = 81)	SS > 0 (n = 186)	P
Age [years]	59 ± 8	63 ± 8	**0.004**
Gender, male	54 (66%)	126 (67%)	0.212
Diabetes	20 (24%)	60 (32%)	**0.001**
Hypertension	33 (41%)	81 (43%)	0.302
Smoking	18 (22%)	40 (21%)	0.901
Family history	19 (23%)	53 (28%)	**0.001**
Body mass index [kg/m²]	24 ± 3	27 ± 3	0.073
LDL-C [mg/dL]	130 ± 31	145 ± 32	**0.002**
HDL-C [mg/dL]	47 (28–77)	44 (25–76)	0.053
Triglycerides [mg/dL]	157 (138–214)	164 (135–215)	0.856
TC [mg/dL]	188 (169–304)	209 (171–332)	**0.028**
eGFR	100 ± 36	89 ± 32	**0.021**
Duke treadmill score		–8 ± 6	
SYNTAX score	0 ± 4	15 ± 12	**< 0.001**
Previous medication:			
Acetylsalicylic acid	7 (9%)	35 (19%)	**0.044**
Statin	8 (10%)	42 (23%)	**0.036**
ACEI/ARB	12 (15%)	61 (33%)	**0.021**
CCB	5 (7%)	14 (8%)	0.764
Beta-blocker	5 (6%)	13 (7%)	0.788
Types of chest pain:			
Typical angina	10 (12%)	148 (80%)	**< 0.001**
Atypical angina	35 (40%)	31 (17%)	**< 0.001**
Non-anginal chest pain	41 (48%)	7 (3%)	**< 0.001**

ACEI/ARB — angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; CCB — calcium channel blocker; eGFR — estimated glomerular filtration rate (mL/min/1.73 m²); HDL-C — high-density lipoprotein cholesterol; LDL-C — low-density lipoprotein cholesterol; SS — SYNTAX score; TC — total cholesterol

DISCUSSION

In the present study, we demonstrated that DTS decreased with increasing angiographic CAD severity. Furthermore, DTS was an independent predictor of high SS. Additionally, there

Table 2. Baseline characteristics according to low and high SYNTAX score groups

	Low-SS group (1–22); n = 108	High-SS group (> 22); n = 78	P
Age [years]	61 ± 10	62,4 ± 9,3	0.543
Gender, male	72 (67%)	54 (69%)	0.433
Diabetes	38 (35%)	22 (28%)	**0.033**
Hypertension	46 (43%)	35 (45%)	0.369
Smoking	24 (22%)	16 (21%)	0.528
Family history	30 (28%)	23 (30%)	**0.001**
Body mass index [kg/m^2]	26 ± 3	27 ± 2	0.450
LDL-C [mg/dL]	143 ± 39	148 ± 33	0.235
HDL-C [mg/dL]	45 (34–77)	41 (28–73)	**0.044**
Triglycerides [mg/dL]	167 (135–215)	176 (138–210)	0.756
TC [mg/dL]	201 (169–302)	211 (198–332)	**0.049**
eGFR	91 ± 29	79 ± 24	**0.001**
Duke treadmill score	–4 ± 3	–13 ± 5	**< 0.001**
SYNTAX score	7 ± 5	27 ± 5	**< 0.001**
Previous medication:			
Acetylsalicylic acid	19 (18%)	15 (20%)	0.345
Statin	23 (22%)	20 (25%)	0.240
ACEI/ARB	32 (30%)	28 (36%)	**0.041**
CCB	9 (8%)	7 (9%)	0.670
Beta-blocker	6 (6%)	7 (9%)	0.233
Types of chest pain:			
Typical angina	77 (72%)	59 (76%)	0.104
Atypical angina	21 (19%)	14 (18%)	0.780
Non-anginal chest pain	10 (9%)	5 (6%)	0.219

Abbreviations as in Table 1

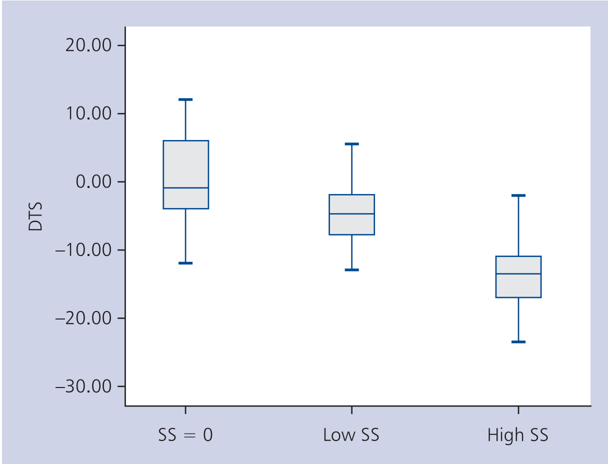

Figure 1. Duke treadmill score (DTS) levels in SYNTAX score (SS) groups; low SS: 1–22, high SS: > 22

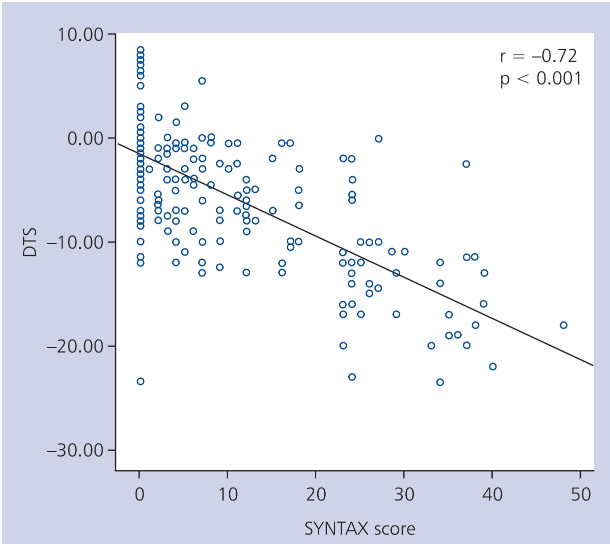

Figure 2. Correlation between Duke treadmill score (DTS) and SYNTAX score

was a significant negative correlation between DTS and SS. To the best of our knowledge, this is the first study evaluating the prediction strength of DTS in the presence and severity of CAD by determining a cut-off value.

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) [12–14]. DTS is a risk stratification index that was developed by Mark et al. [4] and Shaw et al. [6]. DTS is widely used in the prediction of CAD [4, 6, 15]. DTS includes non-invasive clinical information, while SS exhibits information about the severity and complexity of coronary lesions. The SYNTAX score presents information about prognosis. Moreover, DTS is also known to provide information about prognosis [10, 12, 16]. While DTS is expected to be low and SS to be high in patients with severe CAD, the number of studies demonstrating a comprehensive evaluation of both these two risk stratification methods is limited.

Acar et al. [17] identified strong negative correlation between DTS and SS (r = –0.93). In our study the r-value was detected to be 0.75. Both studies found a strong negative correlation between DTS and SS. The difference between correlation coefficients can be attributed to the difference in the average DTS values. Acar et al. [17] found the average DTS value to be –2.5 ± 7, while it was –6 ± 6 in our study. Our study population had lower DTS values. The difference in the number of patients may also be the rea-

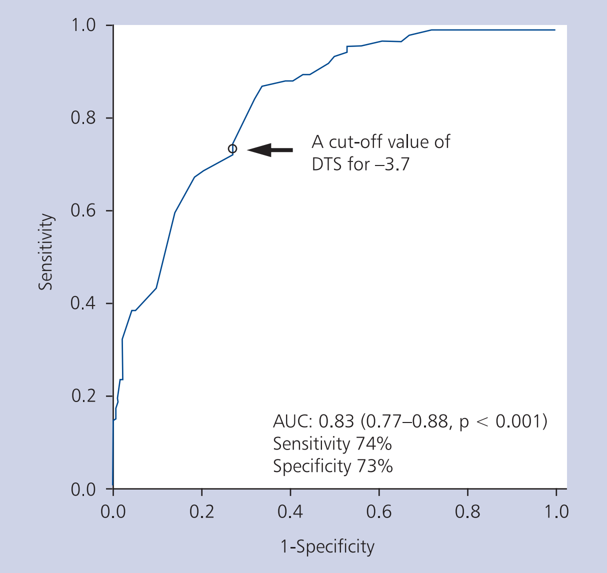

Figure 3. Receiver-operating characteristic curves for Duke treadmill score (DTS) in prediction of SYNTAX score > 0

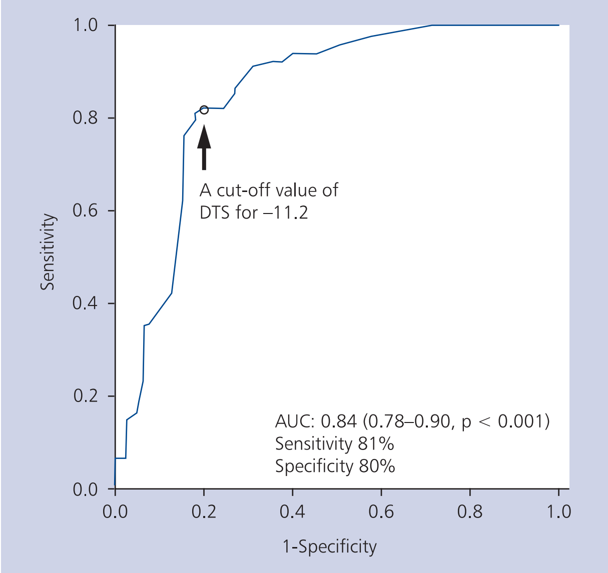

Figure 4. Receiver-operating characteristic curves for Duke treadmill score (DTS) in prediction of high SYNTAX score > 22

Table 3. Determinants of high SYNTAX score in multivariate analysis

Independent variables	Unstandardised coefficients		Standardised coefficients		P
	B	SE	B	t	
Age	0.370	0.048	0.127	1.467	**0.043**
Gender	0.042	0.029	0.067	1.039	0.123
Diabetes	0.102	0.046	0.104	1.281	0.086
Hypertension	0.103	0.051	0.101	1.097	0.099
Family history	0.219	0.038	0.178	3.109	**0.002**
Smoking	0.038	0.040	0.053	0.878	0.508
eGFR	0.129	0.041	0.123	2.130	**0.015**
DTS	0.504	0.051	0.424	8.756	**< 0.001**
HDL-C	0.033	0.029	0.064	1.011	0.568
TC	0.019	0.049	0.021	0.867	0.841
ACEI/ARB use	0.087	0.034	0.020	0.915	0.571
ASA use	0.118	0.035	0.103	1.353	0.066
Statin use	0.101	0.053	0.114	1.401	**0.041**
Typical angina	0.389	0.049	0.290	5.569	**< 0.001**
Atypical angina	0.095	0.042	0.098	0.986	0.178

ASA — acetylsalicylic acid; DTS — Duke treadmill score; rest abbreviations as in Table 1

son for this inequality in correlation coefficients. Acar et al. [17] divided the patients into three tertiles considering DTS (≤ –11, –10 to 4, ≥ 5) and calculated the average SS of each group. The patients with an average DTS value of –11 or less, who were defined as group 3, had an average SS of 23 ± 6. The numbers of main coronary artery and bifurcation lesions, chronic total occlusion, and ostial lesions were found to be significantly higher in this patient population (p < 0.001). In our study, the average DTS value of the patients with high SS (> 22) was found to be –13 ± 5. In this context, the outcomes of these two studies support each other. Unlike in the study of Acar et al. [17] we also divided the patients into SS = 0 and SS > 0 groups firstly. Then the patients with SS > 0 were divided into two groups: low and high SS. Cut-off values of DTS in discriminating SS = 0 and SS > 0 patients, and also the patients with low and high SS, were calculated. DTS was found to have a strong predictive value in patients with high SS.

Shaw et al. [6] demonstrated that DTS was effective in predicting severe CAD [10]. They regarded CAD severity as the number of diseased arteries rather than the morphological and structural properties of coronary arteries. However, SS includes different parameters such as lesion location, bifurcation, angulation, diameters, and calcification. Recently, Gabaldo et al. [18] identified angiographically significant CAD (> 70 stenosis) in all patients with low DTS (< –11) but they did not use a scoring system. It was investigated whether there was a significant stenosis (> 70%) in at least one vessel [18]. We better standardised the severity of coronary lesions using a well-established method, the SYNTAX score. Alvarez Tomargo et al. [19] also demonstrated that DTS predicts the presence of left main coronary disease, and three-vessel disease and two-vessel disease involving proximal left anterior descending artery, with a high specificity (90.5%). In our study, DTS predicted CAD with a considerably high specificity (up to 80%), especially in patients with high SS. These two studies also support each other, and it can be speculated that DTS has quite a high negative predictive value.

Lin et al. [20] examined the plaque burden in the coronary arteries via computed tomographic angiography (CTA) in patients with low, moderate, and high DTS and found that plaque characteristics can be predicted with 38% sensitivity and 100% specificity in moderate and high DTS. In the same study, a significant correlation was found between DTS and mixed plaque score as well as CTA-identified obstructive CAD (OR 4.20, 95% CI 1.15–15.34, $p < 0.001$). Unlike the above study, an invasive procedure (CAG) was used to evaluate the presence and severity of CAD in our study. When the outcomes of our study and the study by Lin et al. [20] were evaluated together, it can be suggested that patients with high DTS will probably have less plaque burden. Since patients undergoing CTA are exposed to a high radiation dose, application of a well calculated DTS would be more logical.

Banerjee et al. [21] compared DTS with single-photon emission computed tomography myocardial perfusion imaging (SPECT-MPI) in patients with stable angina. The results of the exercise treadmill test using DTS score were satisfactorily correlated with SPECT-MPI scanning in low DTS subsets of patients. Therefore, they suggested that the patients with low DTS do not need an MPI study and should undergo CAG for further evaluation [21]. In another similar study, it was hypothesised that patients with low DTS can be referred to CAG without SPECT-MPI and patients with high DTS can be followed on medical management [22]. Similarly, our study revealed that patients with DTS < –11.2 may have a high SS and should undergo CAG.

Duke treadmill score includes almost all of the parameters (ST depression, exercise capacity, chest pain) that make us regard the exercise test as positive and refer the patient to CAG. Therefore, this scoring system plays an important role in the prediction of significant CAD (high SS). On the other hand, the correlation between DTS and SS, which was proven to be reliable and leads to the decision of interventional procedure, has not been well identified. Our study revealed that DTS can differentiate patients with SS > 0 from SS = 0 efficiently. The cut-off value of DTS for predicting significant CAD (SS > 0) was found to be –3.7. On the other hand, the cut-off value of DTS was detected to be –11.2 for differentiating patients with low and high SS. DTS was determined to be a predictor of SS. This asserts that the patients who were determined to have low DTS (< –11.2) may be candidates for surgical treatment, and both patients and physicians should be provident about this eventuality. At the present time, physicians usually ignore DTS results while making a decision about CAG. DTS can provide information about the potential outcomes of CAG such as requirement of CABG and PCI and therefore we believe that it should be used more often in clinical practice. Our results also support the evidence that DTS can be used more often in clinical cardiology practice instead of CTA to avoid radiation exposure, especially in patients with high DTS.

Limitations of the study

The number of patients is relatively small, the representation of female gender is insufficient, and our study design is cross-sectional. Our study was a single-centre registry performed in a tertiary care cardiology centre. The presence of atherosclerotic plaque does not always indicate that the patients are at risk for adverse events. Therefore we cannot confirm whether patients with higher DTS have increased major adverse cardiac events. Evaluation of the vulnerability of these atherosclerotic plaques would be more illuminative in terms of predicting future outcomes. Therefore, the lack of intravascular ultrasound application was another limitation of our study. Our study was designed and performed in a Turkish population. Ethnicity may be confounder and may affect the correlation between DTS and atherosclerotic burden. Further studies with larger patient populations are needed.

CONCLUSIONS

DTS is an index of non-invasive treadmill exercise test, which can be calculated easily and it can predict the presence and severity of CAD. DTS can provide pre-processing guidance about revascularisation for physicians before the procedure.

Conflict of interest: *none declared*

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W dniu 26 stycznia 2016 roku nominację profesorską otrzymali:

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Pani Profesor i Panu Profesorowi
serdeczne gratulacje i okolicznościowe życzenia składają:
Redaktor Naczelny oraz Rada Redakcyjna i Naukowa „Kardiologii Polskiej”

Znaczenie punktacji w skali Duke w teście wysiłkowym na bieżni w prognozowaniu obecności i stopnia ciężkości choroby wieńcowej

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Streszczenie

Wstęp i cel: Celem pracy było zbadanie znaczenia punktacji w skali Duke w teście wysiłkowym na bieżni (DTS) w prognozowaniu obecności i stopnia ciężkości choroby wieńcowej (CAD) z zastosowaniem skali SYNTAX (SS) oraz określenie wartości odcięcia DTS dla obecności i stopnia ciężkości CAD.

Metody: Badana populacja obejmowała 267 chorych, którzy zgłosili się do poradni z bólem w klatce piersiowej i zostali poddani koronarografii po uzyskaniu dodatniego wyniku testu wysiłkowego na bieżni. Pacjentów podzielono na dwie grupy: SS = 0 i SS > 0. Następnie chorych, u których SS wynosiło > 0, podzielono dodatkowo na dwie podgrupy z niską (1–22) i wysoką (> 22) wartością SS.

Wyniki: Stwierdzono silną ujemną korelację między DTS a SS (r= –0,72; p < 0,001). Pole pod krzywą ROC dla prognozowania istotnej obecności CAD wynosiło 0,83 (0,77–0,88; p < 0,001). Optymalna wartość progowa DTS w prognozowaniu istotnej obecności CAD wynosiła –3,7 (czułość 74%, swoistość 73%). Pole pod krzywą ROC dla prognozowania wysokiej wartości SS wynosiło 0,84 (0,78–0,90; p < 0,001). Optymalna wartość progowa DTS w prognozowaniu wysokiej wartości SS wynosiła –11.2 (czułość 81%, swoistość 80%). Punktacja DTS była niezależnym czynnikiem predykcyjnym wysokiej wartości SS w analizie wieloczynnikowej.

Wnioski: DTS pozwala prognozować obecność i stopień ciężkości stabilnej CAD przed koronarografią i umożliwia określenie metody rewaskularyzacji, która będzie konieczna po wykonaniu tej procedury.

Słowa kluczowe: skala Duke w teście wysiłkowym na bieżni, skala SYNTAX, choroba wieńcowa, koronarografia, test wysiłkowy na bieżni

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