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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Relation between ischaemic threshold measured during dobutamine stress echocardiography and coronary angiographic features

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Abstract

Background: Stress echocardiography has become an accepted method for the evaluation of coronary artery disease (CAD). One potential advantage of dobutamine over other stressors used with echocardiography is the possibility of assessing the ischaemic threshold.

Aim: This study explores the relation between the ischaemic threshold measured during dobutamine stress echocardiography (DSE) and coronary angiographic features.

Methods: Two hundred consecutive patients with positive high-dose (2.5–40 μg/kg/min) DSE test results were prospectively enrolled. Ischaemic threshold was recorded for all patients using the formula defined by the American Society of Echocardiography i.e. heart rate at which evidence of ischaemia first occurs divided by 220 minus the patient's age then multiplied by 100. All patients underwent coronary angiography, with recording of: (i) number of vessels (≥ 2.5 mm diameter) showing significant (≥ 70%) stenosis; (ii) maximum degree (percentage) of luminal stenosis; and (iii) worst atherosclerotic lesion type, among the affected coronary vessels.

Results: The mean age of the whole study cohort was 58.32 ± 10.5 years, 158 (79%) being male. 170 (85%) patients showed significant CAD, defined as ≥ 1 coronary vessel showing significant (≥ 70%) stenosis. Patients with single vessel disease showed a significantly higher ischaemic threshold (84.5 ± 0.3%) compared to two vessel (78 ± 2.2%) and multi-vessel disease (71.4 ± 2.8%) groups ($p < 0.001$). Patients with the worst lesions, i.e. type B, showed a significantly higher ischaemic threshold (81.6 ± 4.8%, $p < 0.05$), yet most of them (70%) showed single vessel disease. No statistically significant correlation was found between ischaemic threshold and degree of maximum luminal stenosis. Receiver operating characteristic curve analysis revealed that a recorded ischaemic threshold value of ≤ 75% predicted multi-vessel CAD with a sensitivity of 90%, a specificity of 97%, a positive predictive value of 87.5% and a negative predictive value of 97.8%.

Conclusions: Ischaemic threshold measured during high-dose DSE test significantly correlates with the number of significantly stenosed coronary arteries. However, it does not correlate with the degree of vessel stenosis. These findings provide further support regarding the utility of DSE in the clinical evaluation of patients with CAD.

Key words: ischaemic threshold, dobutamine stress echocardiography, coronary disease, coronary angiography

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INTRODUCION

Stress echocardiography has become an accepted and useful method for the evaluation of coronary artery disease (CAD) [1]. One potential advantage of the use of dobutamine over other forms of stress used in combination with echocardiography lies in the possibility of assessing the ischaemic threshold by determining the level of myocardial oxygen demand at which ischaemia develops during the infusion of incremental doses of dobutamine [2]. The belief that measurement of the ischaemic threshold may yield important and clinically relevant information in CAD patients has been encouraged by previous studies showing that the development of re-polarisation changes during the early stages of exercise testing is associated with a greater likelihood of cardiovascular events during

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subsequent follow-up [3, 4] and with a more frequent occurrence of transient myocardial ischaemia in everyday life [5]. The infusion of graded doses of dobutamine combined with a simultaneous real-time tomographic assessment of global and regional left ventricular function with echocardiography offers the unique possibility of determining the ischaemic threshold by direct analysis of the functional consequences of myocardial ischaemia [2]. Previous studies have mentioned that the functional significance of a coronary narrowing is better correlated to exercise-induced wall motion abnormality (WMA) on echocardiography than other usual markers of exercise-induced myocardial ischaemia [6, 7]. The current study sought to explore the relation between the ischaemic threshold assessed during high-dose dobutamine stress echocardiography (DSE) and coronary angiographic variables that have proven to be of utmost importance in the risk stratification of patients with CAD.

METHODS

Study design and data collection

The original enrollment included 510 patients who were referred to our stress echocardiography labs for a high-dose DSE test between September 2011 and April 2013. 320 patients showed positive results suggestive of coronary ischaemia. According to the pre-defined inclusion and exclusion criteria, only 200 patients with positive high-dose DSE were eligible for inclusion in the current study. Included patients showed symptoms suggestive of myocardial ischaemia and normal resting left ventricular ejection fraction (LVEF%). Exclusion criteria included patients with a prior history of unstable angina or myocardial infarction (MI), those with prior percutaneous coronary intervention or coronary artery bypass graft surgery, those with significant valvular diseases, congenital heart disease or any myocardial disease apart from ischaemia. Patients with contraindications to dobutamine infusion (e.g. with a history of complex ventricular arrhythmias or uncontrolled hypertension with blood pressure [BP] > 180/110 mm Hg), with contraindications to atropine intake (e.g. with a history of narrow-angle glaucoma or obstructive uropathy) and patients with limited life expectancy due to coexistent disease (e.g. malignancy), were also excluded. All included patients stopped taking anti-anginal therapies 48 h before DSE test. Before inclusion, informed written consent was obtained from each patient and the study protocol was reviewed and approved by our local institutional human research committee; it conforms to the ethical guidelines of the 1975 Declaration of Helsinki, as revised in 2008.

Definition of risk factors of CAD

The presence of hypertension was defined as systolic BP ≥ 140 mm Hg and/or diastolic BP ≥ 90 mm Hg, previously recorded by repeated non-invasive office measurements, which led to life-style modification and/or intake of antihypertensive drug therapy [8]. The presence of diabetes mellitus was defined as fasting plasma glucose ≥ 126 mg/dL and/or 2 h post-glucose load ≥ 200 mg/dL, or specific anti-diabetic drug therapy intake [9]. Dyslipidaemia was defined as low density lipoprotein cholesterol > 100 mg/dL, and/or serum triglycerides > 150 mg/dL, and/or high density lipoprotein cholesterol < 40 mg/dL (< 50 mg/dL in women) [10].

Baseline echocardiographic assessment

Assessment of regional and global left ventricular (LV) systolic functions was performed in all patients by transthoracic echocardiography using a General Electric Vivid 7 cardiac ultrasound machine (General Electric, Horten, Norway), equipped with harmonic imaging capabilities. A 2.5 MHz phased array probe was used to obtain standard two-dimensional, M-mode and Doppler images. Patients were examined in the left lateral recumbent position using standard parasternal and apical views. Images were digitised in a cine-loop format, and saved for subsequent playback and analysis. Views were analysed by a single echocardiographer employing the software program of the echocardiography machine. Regional wall motion was assessed according to the standard 17-segment model as recommended by the American Society of Echocardiography [11]. Regional wall motion was visually assessed for each segment individually, considering both endocardial excursion and systolic thickening. Each segment was graded according to the semi-quantitative scoring system described by Knudsen et al. [12]. Segments with poorly-defined endocardial borders for 50% or more of their length were considered non-visualised and assigned a score of 0 [13]. Wall thickening was assessed at a distance of at least 1 cm from the adjacent segment, to minimise the effect of tethering [14].

DSE protocol

Dobutamine (Dobutamine MYLAN®, MYLAN S.A.S, France) was administered by intravenous infusion starting at a dose of 5 μg/kg/min and raised incrementally every 3 min up to a maximum of 40 μg/kg/min or until a study end-point was reached. In patients not achieving 85% of their age-predicted maximal heart rate (HR) at the end of the final stage, atropine was administered intravenously (IV) in 0.25–0.5 mg increments at 1-min intervals up to a maximum dose of 2.0 mg, while dobutamine infusion was continued. LVEF% by modified Simpson's method and LV internal dimensions using M-mode were recorded for all patients at rest and at peak dose of dobutamine infusion. Ischaemic threshold (as recommended by the American Society of Echocardiography) was calculated for every patient as follows: the HR at which evidence of ischaemia first occurs divided by 220 minus the patient's age then multiplied by 100. HR at which evidence of ischaemia first occurs was recorded through continuous monitoring of LV contractility. Low ischaemic threshold suggests early evidence of myocardial ischaemia during test protocol.

End-points for terminating the test included: attainment of the maximum dose of dobutamine and/or atropine; achievement of target HR (> 85% of age-predicted maximal HR); echocardiographic detection of WMA not present at baseline or worsening of previously existing WMA; symptoms judged to be unacceptable by the attending cardiologist; serious arrhythmia detected by electrocardiography (ECG) monitoring; ST segment elevation > 0.1 mV at 80 ms from the J point; and systolic BP > 200 mm Hg or diastolic BP > 110 mm Hg or a decrease in systolic BP > 30 mm Hg from the baseline [15]. Standard views were recorded at baseline, at the end of each stage of dobutamine infusion, as well as during recovery. Visual assessment of wall motion and systolic thickening was performed as before. The test was considered positive upon detecting WMA not present at baseline, or worsening of previously existing WMA in ≥ two contiguous LV segments belonging to the same blood supply territory.

Patient monitoring

All patients had continuous HR, ECG and pulse oximetry monitoring. HR and BP readings were recorded at baseline, at the end of each stage of dobutamine infusion, and during recovery. A 12-lead ECG was recorded at baseline and during recovery. Patients were questioned at the end of the test regarding any symptoms or adverse drug reactions.

Coronary angiography

All patients underwent coronary angiography within one week after stress testing. Subsequently, coronary revascularisation modalities were individually tailored. Coronary angiographic findings were interpreted by an independent interventionalist blinded to the results of DSE test. Interpretation was done with the aid of caliper measurements, with special emphasis on the number of vessels (epicardial vessels of at least 2.5 mm diameter) showing significant luminal stenosis (≥ 70% diameter reduction), maximum degree of luminal stenosis (percentage of diameter reduction) and worst atherosclerotic lesion type (type A, B or C) defined according to the ACC/AHA angiographic classification of coronary lesions [16]. Patients with ≥ 50% stenosis of the left main stem were classified as having two-vessel, or three-vessel (if the right coronary artery had ≥ 70% stenosis), disease.

Statistical analysis

All statistical calculations were done using Statistical Package for Social Sciences (SPSS for Windows) software (version 15.0, SPSS Inc., Chicago, IL, USA). Descriptive statistics were done to all included parameters. All continuous variables were statistically described in terms of mean ± standard deviation. Categorical variables were described with absolute and relative (percentage) frequencies. ANOVA test was used to estimate the relationship between ischaemic threshold and the number of affected coronaries and the worst atherosclerotic lesion type. Pearson correlation coefficient was used to demonstrate a correlation between ischaemic threshold and maximum degree of luminal stenosis. The number of affected coronaries was studied in relation to worst atherosclerotic lesion type, using Pearson χ^2 test. P values were used to describe significance. Receiver operating characteristic (ROC) curve analysis was used to estimate ischaemic threshold cut-off values in order to non-invasively predict the number of affected coronaries in ischaemic patients undergoing high-dose DSE test.

Table 1. Baseline characteristics of the study population

Item	Value
Age [years]	58.32 ± 10.5
Male	158 (79%)
Diabetes mellitus	71 (35.5%)
Hypertension	73 (36.5%)
Dyslipidaemia	70 (35%)
Smoking	76 (38%)
Family history of CAD	38 (19%)

CAD — coronary artery disease

RESULTS

Baseline clinical characteristics

A total of 200 patients with a positive high-dose DSE test suggestive of coronary ischaemia were enrolled in the current study. The mean age of the whole study cohort was 58.32 ± 10.5 years, 158 (79%) being male. Table 1 shows the baseline clinical characteristics of the included patients. All patients underwent a baseline echocardiographic assessment including recording of LVEF%, LV internal dimensions and wall motion assessment.

High-dose DSE test

The included patients showed positive results suggestive of coronary ischaemia according to the aforementioned test protocol. There were no recorded serious adverse events during and/or shortly after the test. The mean ischaemic threshold recorded for the whole study population was 80.4 ± 5.15%. This was calculated individually, relying on the HR, recorded upon detection of WMA not present at baseline, or worsening of previously existing WMA in ≥ two contiguous LV segments belonging to the same blood supply territory. Analysis of intra-observer variability revealed a close correlation between repeated measurements of regional wall motion by the single operator, with a correlation coefficient r = 0.91.

Coronary angiography

All patients underwent coronary angiography. Only 170 (85%) patients showed angiographically significant CAD (≥ 70% diameter reduction in at least one epicardial artery measuring ≥ 2.5 mm diameter). Angiographic data including the number of vessels affected, maximum degree of luminal stenosis

Table 2. Mean ischaemic threshold values in relation to number of vessels affected and type of coronary lesions

Sub-population		Number of patients (%)	Ischaemic threshold (%)	F (ANOVA test)	P (ANOVA test)
Number of vessels affected	1	91 (53.5%)	84.5 ± 0.3	734.8	< 0.001
	2	48 (28.2%)	78 ± 2.2		
	> 2	31 (18.2%)	71.4 ± 2.8		
Type of lesion	A	84 (49.4%)	79.6 ± 5.1	3.9	< 0.05
	B	67 (39.4%)	81.6 ± 4.8		
	C	19 (11.2%)	78.4 ± 6.7		

Table 3. Mean ischaemic threshold values in relation to maximum coronary luminal stenosis

Sub-population		Number of patients	Ischaemic threshold (%)
Percentage of luminal stenosis	70 – < 80%	38 (22.2%)	78.5 ± 5
	80 – < 90%	57 (33.4%)	79.5 ± 6
	90 – < 100%	56 (32.8%)	83.5 ± 3
	100%	19 (11%)	78 ± 7

(percentage of diameter reduction), and worst atherosclerotic lesion type were recorded.

Ischaemic threshold and number of stenosed coronary arteries

Patients were sub-classified according to the number of coronary vessels (one vessel, two vessels or > two vessels) showing significant stenosis. Mean ischaemic threshold was calculated for each sub-population. Using the ANOVA test, it was found that there was a highly significant difference between the three sub-populations regarding mean ischaemic threshold ($p < 0.001$). A low mean ischaemic threshold value was significantly associated with more coronary arteries being affected. This data is shown in Table 2.

Ischaemic threshold and worst coronary lesion type

Patients were re-classified according to the frequency of presence of worst type of coronary lesions (i.e. lesion type A, B or C). Mean ischaemic threshold was calculated for each sub-population. Using the ANOVA test, it was found that there was a significant difference between the three sub-populations regarding mean ischaemic threshold ($p < 0.05$). Post-hoc analysis showed that this significant difference was related to significantly higher mean ischaemic threshold among the type B lesion sub-population compared to either the type A lesion or the type C lesion sub-populations. No statistically significant difference was encountered upon comparing the type A and type C sub-populations. This is shown in Table 2. Further data analysis revealed a statistically significant finding: most of the patients i.e. 47 (70.1%) patients belonging to the lesion type B sub-population suffered from single vessel disease.

Ischaemic threshold and maximum degree of luminal stenosis

Patients were further re-classified according to the maximum degree of luminal stenosis (70 – < 80%, 80 – < 90%, 90 – < 100%, or 100%). Mean ischaemic threshold was calculated for each sub-population. There was no statistically significant correlation between the recorded ischaemic threshold and the degree of maximum luminal stenosis determined angiographically (Pearson correlation coefficient: 0.154, $p > 0.05$). This is shown in Table 3.

Prediction of multi-vessel significant coronary effect

ROC curve analysis (Figs. 1, 2) of mean ischaemic threshold values among patient sub-populations exhibiting one vessel, two vessel or > two vessels disease revealed that a cut-off value of ≤ 75% during high-dose DSE predicted the presence of two vessel disease with a sensitivity of 100%, a specificity of 34%, a positive predictive value (PPV) of 25.4%, a negative predictive value (NPV) of 100%, and a predictive accuracy of 75.5%. The same cut-off value predicted the presence of more than two vessel disease with a sensitivity of 90.3%, a specificity of 97.1%, a PPV of 87.5%, an NPV of 97.8%, and a predictive accuracy of 98.8%.

DISCUSSION

Currently, DSE is widely approved for the detection of CAD [17–19], for risk stratification after MI [20] and for the prediction of peri-operative and late cardiac events in patients scheduled for major surgery [21]. The current study included 200 patients with positive high-dose DSE test results suggestive

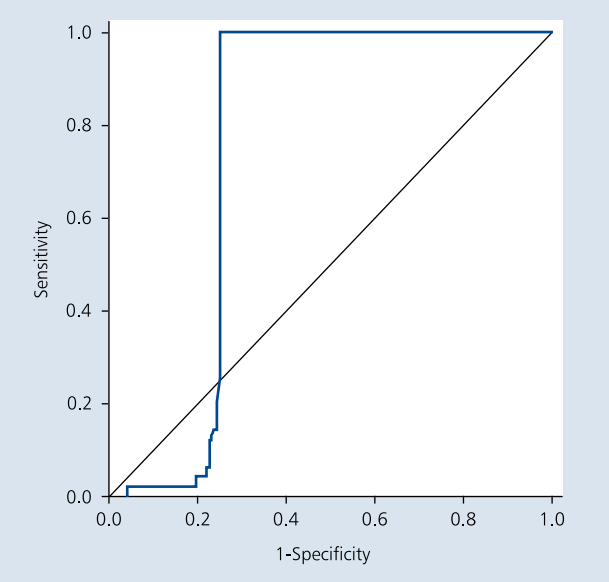

Figure 1. Receiver operating characteristic curve plotted to obtain the optimal cut-off value of ischaemic threshold in order to predict the presence of significant two-vessel disease

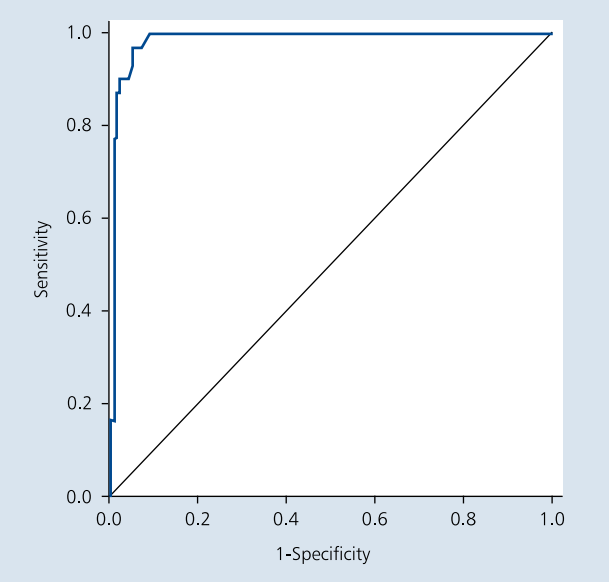

Figure 2. Receiver operating characteristic curve plotted to obtain the optimal cut-off value of ischaemic threshold in order to predict the presence of significant multi-vessel (> two vessel) disease

of underlying coronary ischaemia. Ischaemic threshold was recorded individually using the formula recommended by the American Society of Echocardiography. This was in addition to the recording of routine echocardiographic data during the test protocol. Low ischaemic threshold indicated early development of myocardial ischaemia at relatively low HR, while a high ischaemic threshold indicated the opposite. The current study aimed at illustrating the relationship between ischaemic threshold recorded during DSE and various angiographic features important for risk stratification of patients with CAD. All patients underwent coronary angiography. 170 patients showed significant coronary stenosis. Data analysis showed that a low ischaemic threshold was significantly associated with a larger number of coronary vessels showing significant stenosis. When patients were sub-classified according to the worst atherosclerotic lesion type, it was found that patients belonging to the type B lesion sub-group showed a higher mean ischaemic threshold compared to type A and type C lesion sub-groups. Interestingly, further statistical analysis showed that 70% of the patients belonging to the type B lesion sub-group suffered from single vessel disease, which is a statistically significant finding that explained higher mean ischaemic threshold in that sub-group of patients and supports the previously mentioned conclusion that a low ischaemic threshold is associated with more coronary vessels being affected. Testing the correlation between ischaemic threshold during DSE and maximum diameter stenosis encountered at coronary angiography thereafter revealed negative results i.e. no statistically significant correlation between both parameters. Hence, the number of significantly stenosed coronaries is the chief angiographic determinant of low ischaemic threshold during stress testing. So, patients with a high ischaemic threshold probably will have single vessel disease, yet this vessel might show a critical stenosis. Moreover, statistical analysis of the previously mentioned results led to extraction of ischaemic threshold best cut-off value in order to predict ≥ two coronary vessels being affected. Ischaemic threshold value of ≤ 75% during high-dose DSE predicted a two coronary vessel effect with an accuracy of 75.5% and a > two coronary vessels effect with an accuracy of 98.8%.

Comparison with other studies

Of the numerous previous studies related to the use of high-dose DSE for the assessment of patients with CAD, only a few have included an analysis of the ischaemic threshold, and these have shown a wide spectrum of results. In agreement with the current study results, Panza et al. [2] showed that a low ischaemic threshold recorded during a high-dose DSE test was associated with more coronary vessels showing significant stenoses. However, they named the dobutamine dose at which WMA were first detected as the ischaemic threshold. Moreover, their study utilised transoesophageal echocardiography and a considerable proportion of included patients had a history of previous coronary revascularisation and/or MI. Cohen et al. [22] also reported a lower dobutamine ischaemic threshold (both in terms of HR and dobutamine dose) in patients with multi-vessel disease compared to single-vessel disease. Similarly, Segar et al. [17] reported that the likelihood of multi-vessel disease among their study patients was higher when the dobutamine stress test became positive

at a HR ≤ 125 bpm. However, in a more recent study from Cohen et al. [23], no difference was found upon using the HR as an ischaemic threshold during high-dose DSE among patients with one, two- or three-vessel disease. This might be related to the fact that analysis of the ischaemic threshold was performed in only 23 patients and that the HR (used as ischaemic threshold) in patients with one vessel disease was uncharacteristically low (91 ± 7 bpm).

In the current study, the ischaemic threshold measured during high-dose DSE test showed poor correlation with maximum coronary diameter stenosis. A prior study reported that HR–BP product at ischaemic threshold (newly developing WMA) correlated positively with quantitative coronary stenosis [24]. However, this study was carried out using exercise echocardiography and only patients with single vessel disease were included.

To the best of my knowledge, the current study is the first to use the special equation for calculating ischaemic threshold during DSE test (HR at evidence of ischaemia / 220 – patient's age × 100), to evaluate its relationship to quantitative coronary angiography. It has been proved that HR is the most important physiological determinant of ischaemia induced by dobutamine [2]. Moreover, I sought uniquely to test the relationship between ischaemic threshold during DSE and each of coronary diameter stenosis and atherosclerotic lesion type.

Clinical implications

The findings of the present investigation may have important implications for the assessment of patients with CAD. Patients with a high ischaemic threshold (> 75%) at DSE test most probably will have a significant single vessel disease, but there is no guarantee as to how significant (degree of diameter stenosis) the disease will be. I hypothesise that the ability to estimate the ischaemic threshold with dobutamine may constitute an important advantage of this over other forms of stress (such as dipyridamole or adenosine) used in combination with echocardiography. Moreover, this provides support for the use of DSE in investigational studies that include measurements of ischaemic threshold. The present study findings indicate that analysis of the results of DSE test can be used not only for the detection of CAD, but also for the risk stratification of these patients. Finally, the induction of ischaemia at low doses of dobutamine, observed in a proportion of patients with multi-vessel disease included in the current study, may help explain why myocardial segments with depressed systolic function and preserved thallium uptake may not show a positive inotropic response to dobutamine [25].

Limitations of the study

The data presented in our study only applies to patients defined by inclusion and exclusion criteria. Moreover, this is a single-centre study. The present study did not include follow-up information to document a direct relation between a low dobutamine ischaemic threshold and the occurrence of adverse cardiovascular events. This limitation, however, is common to all studies that include an unselected population of patients with CAD, because those variables indicative of poor prognosis are the same ones that are used to decide the best therapy for each individual patient. The current study did not compare standard methods of ischaemia severity assessment (i.e. wall motion score index and dobutamine infusion dose at which ischaemia develops) vs. the ischaemic threshold formula. This issue was outside the scope of the current study. Visual assessment only was used to quantify angiographic stenosis. It is worth mentioning that invasive assessment of coronary blood flow (using fractional flow reserve assessment) in borderline coronary lesions was not adopted. Another limitation is the lack of quantitative methods of measuring systolic LV wall thickening. Instead, the echocardiographer adopted visual assessment only.

CONCLUSIONS

The results of the present study demonstrate that in patients with CAD the ischaemic threshold measured during a high-dose DSE test significantly correlates with the number of significantly stenosed coronary vessels. However, it does not correlate with the degree of vessel stenosis. An ischaemic threshold value of ≤ 75% predicts multi-vessel disease. Because the studied variables have important prognostic implications, these findings provide further support regarding the utility of DSE in the clinical evaluation of patients with CAD.

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Zależność między progiem niedokrwienia zmierzonym w czasie próby dobutaminowej a parametrami koronarografii

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Streszczenie

Wstęp: Echokardiografia obciążeniowa jest obecnie uznaną metodą oceny choroby wieńcowej (CAD). Jedną z zalet dobutaminy w stosunku do innych czynników obciążających stosowanych w badaniu echokardiograficznym jest możliwość określenia progu niedokrwienia.

Cel: Celem pracy była ocena zależności między progiem niedokrwienia mierzonym w czasie echokardiograficznej próby dobutaminowej (DSE) i parametrami koronarografii.

Metody: Do badania włączono prospektywnie 200 kolejnych pacjentów z dodatnim wynikiem wysokodawkowej (2,5–40 μg/kg/min) DSE. U wszystkich chorych zapisano wartość progu niedokrwienia, stosując wzór określony przez *American Society of Echocardiography* (częstotliwość rytmu serca, przy której pojawiają się objawy niedokrwienia, podzielona przez 220 minus wiek pacjenta, a wynik tego działania pomnożony przez 100). U wszystkich chorych wykonano koronarografię i odnotowano następujące parametry: (i) liczba tętnic (o średnicy ≥ 2,5 mm) z istotnym (≥ 70%) zwężeniem; (ii) maksymalny stopień (odsetek) zwężenia światła naczynia; (iii) najgorszy typ zmiany miażdżycowej w zajętych naczyniach wieńcowych.

Wyniki: Średnia wieku w całej badanej grupie wynosiła 58,32 ± 10,5 roku; w tej grupie było 158 (79%) mężczyzn. U 170 (85%) chorych stwierdzono istotną CAD, definiowaną jako istotne (≥ 70%) zwężenie ≥ 1 tętnicy wieńcowej. U pacjentów z chorobą jednonaczyniową próg niedokrwienia był istotnie wyższy (84,5 ± 0,3%) niż w grupach z chorobą dwunaczyniową (78 ± 2,2%) i wielonaczyniową (71,4 ± 2,8%) ($p < 0,001$). U osób z bardziej nasilonymi zmianami, określonymi jako typ B, stwierdzono istotnie wyższy próg niedokrwienia (81,6 ± 4,8%, $p < 0,05$), jednak u większości (70%) z nich występowała choroba jednonaczyniowa. Nie stwierdzono statystycznie istotnych korelacji między progiem niedokrwienia a stopniem największego zwężenia światła naczynia. Analiza krzywych ROC wykazała, że zapisana wartość progu niedokrwienia wynosząca ≤ 75% stanowiła czynnik prognostyczny wielonaczyniowej CAD, charakteryzujący się 90-procentową czułością, 97-procentową swoistością, wartością predykcyjną dodatnią wynoszącą 87,5% i wartością predykcyjną ujemną równą 97,8%.

Wnioski: Próg niedokrwienia zmierzony w czasie wysokodawkowej DSE znamiennie koreluje z liczbą istotnie zwężonych tętnic wieńcowych. Nie wykazano jednak korelacji ze stopniem zwężenia naczyń. Uzyskane wyniki stanowią kolejne potwierdzenie użyteczności DSE w klinicznej ocenie chorych z CAD.

Słowa kluczowe: próg niedokrwienia, dobutaminowa echokardiograficzna próba obciążeniowa, choroba wieńcowa, koronarografia

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