TIMI Myocardial Perfusion Grade and ST-segment resolution in the assessment of coronary reperfusion after primary angioplasty

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Abstract

Background: Angiographic coronary flow parameters and resolution of ST segment changes play an important role in the evaluation of reperfusion in patients with acute ST segment elevation myocardial infarction (STEMI). In previous studies on the relation between angiographic and electrocardiographic (ECG) parameters of coronary reperfusion, several alternative methods to assess ST segment resolution were used. Thus, the relation between the TIMI Myocardial Perfusion Grade (TMPG) and different methods to evaluate ST segment resolution seems to be of interest.

Aim: To evaluate the relationship between TMPG and absolute and relative ST segment resolution after successful primary percutaneous coronary intervention (pPCI).

Methods: We studied a population of STEMI patients successfully treated with pPCI. Reperfusion of the coronary microcirculation was determined using 4-grade TMPG scale in coronary angiography performed after successful pPCI. ST segment resolution was analysed in two manners: 1) by calculating the sum of ST segment elevation in infarct leads and depression in reciprocal leads after pPCI (absolute resolution, ΣSTD); 2) as a per cent reduction of summed ST segment deviation from the baseline value (relative resolution, ΣSTD%). Maximum ST segment elevation in a single lead on the postprocedural ECG was measured to categorise the risk of death. ST segment elevation > 1 mm for an inferior infarct or > 2 mm for an anterior infarct was considered the criterion of high risk (high risk ECG).

Results: The study population included 183 patients treated with pPCI. We found a significant but weak negative correlation between TMPG and ΣSTD (r = –0.27, p = 0.0002). Significant differences in median ΣSTD were observed between TMPG 0 vs. TMPG 2 and TMPG 3 groups (p = 0.0034 and 0.0121, respectively) and also between TMPG 1 and TMPG 2 (p = 0.02). A significant but very weak positive correlation was found between TMPG and ΣSTD% (r = 0.16, p = 0.0286). However, further analyses showed that differences in median ΣSTD% between patients with different TMPG values were statistically insignificant (p = 0.1756). In patients with TMPG 2/3, a high risk ECG was absent considerably more often (p = 0.0007). However, angiographic features of successfully vs. unsuccessfully reperfused microcirculation did not correspond to the presence of a high risk ECG in about 34% of cases.

Conclusions: TMPG is more closely related to absolute compared to relative ST segment resolution. A high risk ECG was absent in most patients with TMPG 2 or 3. However, in about one third of cases TMPG did not correspond to the presence of ECG high risk features. These data suggest that TMPG is complementary to ST segment resolution in the assessment of coronary reperfusion.

Key words: myocardial infarction, myocardial perfusion, coronary flow, ST segment resolution, coronary angioplasty

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INTRODUCTION

Among methods to evaluate the success of reperfusion after primary percutaneous coronary intervention (pPCI) in acute ST segment elevation myocardial infarction (STEMI), both electrocardiography (ECG) and coronary angiography are routinely used. Both angiographic evaluation of flow in the infarct-related artery (IRA) and resolution of initial ST segment changes provide important prognostic information [1, 2]. Reperfusion of the coronary microcirculation may be evaluated angiographically using 4-grade Myocardial Blush Grade (MBG) and TIMI Myocardial Perfusion Grade (TMPG) scales based on the assessment of contrast opacification within the microcirculation. While the MBG scale evaluates mostly the intensity of opacification, the TMPG scale is based on its dynamics. With TMPG 0 or 1, the infarction area is more extensive and mortality is significantly higher even if the IRA flow is normal (TIMI 3). TMPG 3 corresponds to complete reperfusion of the microcirculation [1, 3]. The most commonly used ECG method to evaluate reperfusion is an analysis of resolution of ischaemic ST segment changes in an ECG recorded after reperfusion therapy. A significant correlation was found between the degree of ST segment resolution and the reinfarction rate and early and late mortality in patients treated with pPCI [4–6]. ST segment changes may be evaluated either as a sum of ST segment deviations in all leads in a given infarction area or only in a single lead with the largest ST deviation [4, 5]. In addition, ST segment changes may be assessed in relation to changes seen before reperfusion and expressed as percentage (relative ST segment resolution), or residual ST segment deviation may be measured in the ECG after reperfusion (absolute ST segment resolution) [4, 5, 7]. The higher residual ST segment deviation, the worse are outcomes in MI [4–6]. After reperfusion therapy, simultaneous occurrence of TIMI 3 flow, complete angiographic reperfusion of microcirculation and complete resolution of ST segment changes may be seen in less than one fifth of all patients [8]. In some studies, discordance between ST segment resolution and angiographic degree of tissue reperfusion was seen in as many as 40% of cases [9]. Literature on the relation between evaluation of reperfusion using the TMPG scale and different approach to evaluate ST segment resolution is relatively scarce. Thus, it is of interest to analyse the relationship between observed improvement in the TMPG scale and absolute and relative ST segment resolution in patients who underwent a successful pPCI.

METHODS
Study design

The study was a retrospective analysis of 183 consecutive STEMI patients who underwent a successful pPCI. A successful pPCI was defined as postprocedural TIMI 3 flow in the IRA, with a residual stenosis of not more than 20% and absence of clear dissection, thrombus, or perforation within the revascularised vessel. All patients included into the study fulfilled the ECG criteria of STEMI [10]. Exclusion criteria included shock before revascularisation of the IRA, fibrinolytic treatment within previous 2 weeks, previous coronary artery bypass grafting, previous angioplasty of the IRA, the left main coronary artery as the IRA, and patient death during pPCI. We also excluded patients with His bundle block or temporary or permanent ventricular pacing. Coronary angiography and pPCI were performed using the standard methods. Periprocedural drug therapy included heparin, acetylsalicylic acid, and clopidogrel. Use of glycoprotein IIb/IIIa inhibitors was left to the discretion of the treating physician.

Analysis of angiographic parameters

Evaluation of coronary flow after pPCI was preceded by intracoronary administration of a 200 μg nitroglycerin bolus. Images were recorded at 30 frames per second. TMPG was evaluated based on the dynamics of contrast opacification of coronary microcirculation manifesting as myocardial blush in the IRA territory, as described previously [1]. In some analyses, TMPG 0/1 patients (non-reperfused microcirculation) were compared to TMPG 2/3 patients (reperfused microcirculation), similarly to analyses reported by other authors [1, 3].

Evaluation of electrocardiographic parameters

We analyses 2 ECG tracing, the first one recorded before pPCI and the second one recorded after pPCI within 30 min after patient transfer to our coronary care unit. ST segment elevation was measured in groups of ECG leads corresponding to various locations of the infarction: I, aVL, and V_1–V_6 in anterior and anterolateral infarctions, or II, III, aVF, and V_5–V_6 in inferior and inferolateral infarctions. We also measured ST segment depression in reciprocal leads, i.e. II, III, and aVF for anterior infarctions and V_1–V_4 for inferior infarctions [4, 5]. Measurements were made relative to the TP segment (isoelectric line), 20 ms after QRS, with rounding to the nearest 0.01 mV. By adding absolute values of ST segment elevation in all infarct-related leads and ST segment depression in all reciprocal leads, a summed ST segment deviation was obtained [4, 6]. Absolute ST-segment resolution (ΣSTD) was defined as a residual summed ST deviation after pPCI and expressed in millimetres. Relative ST segment resolution (ΣSTD%) was defined as the per cent reduction of summed ST segment deviation from the baseline value [4, 6, 9]. In addition, we evaluated whether the ECG after pPCI fulfilled the criterion of high risk (high risk ECG). According to the literature data, this was defined as maximum ST segment elevation in any single infarction-related lead on the postprocedural ECG > 1 mm for an inferior infarct or > 2 mm for an anterior infarct [4].

Statistical analysis

Statistical analyses were performed using the SAS software, version 9.1, and the Statistica software, version 10.0. Normal distribution of the variables was verified using the Kolmo-

Table 1. Clinical characteristics of the study group

Age [years]	58.71 ± 15.76
	(29–81)
Gender — men	118 (64.5%)
Smoking	93 (50.8%)
Diabetes	37 (20.2%)
Hypertension	101 (55.2%)
Hyperlipidaemia	111 (67.7%)
Previous myocardial infarction	20 (10.9%)
Killip class > 1 on admission	34 (18.6%)
Duration of chest pain until intervention [h]	4.09 ± 2.99
Heart rate on admission [bpm]	75.84 ± 14.58
Systolic blood pressure on admission [mm Hg]	130.86 ± 24.63
Stent implantation	165 (90.16%)
Periprocedural GP IIb/IIIa antagonist use	94 (51.37%)

n — number of patients (% of the study group); mean values ± standard deviation

gorov-Smirnov or Shapiro-Wilk test. Correlations between variables were evaluated using the Spearman rank correlation test. Groups were compared using nonparametric analysis of variance (Kruskal-Wallis ANOVA). Proportions were compared using the χ^2 test with appropriate corrections. $P < 0.05$ was considered statistically significant.

RESULTS

Overall clinical and angiographic characteristics of the study population are shown in Tables 1 and 2. We analysed the relationship between TMPG and postprocedural ST segment deviation (ΣSTD), showing a statistically significant but weak negative correlation. A very weak but statistically significant positive correlation was found between TMPG and ΣSTD% (Table 3). For further evaluation of ST segment resolution in specific TMPG categories, we performed additional statistical analyses. We found significant differences in ΣSTD but not ΣSTD% between patients in different TMPG categories (Table 4). A post hoc analysis confirmed significant differences only between the following median values: TMPG 0 vs. TMPG 2 ($p = 0.0034$), TMPG 0 vs. TMPG 3 ($p = 0.012$), and TMPG 1 vs. TMPG 2 ($p = 0.0209$) (Fig. 1). We also compared rates of a high risk ECG pattern in patients with angiographically non-reperfused (TMPG 0/1) vs. reperfused (TMPG 2/3) coronary microcirculation. A high risk ECG pattern was absent significantly more frequently in patients with TMPG 2/3 ($p = 0.0007$). Of note, however, high risk ECG was not found in half of patients with TMPG 0/1 (n = 34, 51.5%) but it was present in about 24% of patients with TMPG 2/3 (Fig. 2). Thus, angiographic features of successfully vs. unsuccessfully reperfused microcirculation did not correspond to the presence of a high risk ECG in more than one third of the study population.

Table 2. Angiographic and electrocardiographic characteristics of the study group

Infarct-related artery (IRA):	
Right coronary artery	86 (46.99%)
Left anterior descending artery	74 (40.44%)
Left circumflex artery	23 (12.57%)
TIMI 3 flow in IRA before pPCI	29 (15.85%)
TIMI 3 flow in IRA after pPCI	183 (100)
TMPG within IRA territory after pPCI:	
TMPG 0	20 (10.93%)
TMPG 1	46 (25.14%)
TMPG 2	69 (37.7%)
TMPG 3	48 (26.23%)
TMPG 0/1	66 (36.06%)
TMPG 2/3	117 (63.93%)
Mean summed ST segment deviation before pPCI [mm]	17.43 ± 12.06
Mean summed ST segment deviation after pPCI [mm]	7.20 ± 6.35
Mean ΣSTD% [%]	50 ± 45
Presence of a high risk ECG pattern	60 (32.79%)

pPCI — primary percutaneous coronary intervention; ΣSTD% — relative summed ST segment resolution; n — number of patients (% of the study group); mean values ± standard deviation

Table 3. Correlations between TIMI Myocardial Perfusion Grade (TMPG) and ST segment resolution (Spearman rank correlation)

TMPG and ΣSTD	r = –0.27	p = 0.0002
TMPG and ΣSTD%	r = 0.16	p = 0.0286

ΣSTD — absolute summed ST segment resolution; ΣSTD% — relative summed ST segment resolution

DISCUSSION

In our study, we evaluated the relationship between angiographic and ECG approach to evaluate the success of coronary reperfusion. We found that higher TMPG in the IRA territory after pPCI was significantly associated with more complete absolute ST segment resolution. In contrast, the relation between TMPG and relative ST segment resolution was less clear. Although we found a significant but very weak correlation between TMPG and ΣSTD%, further statistical analysis showed no significant differences in ΣSTD% between different TMPG groups.

Previous studies mostly evaluated the relationship between TMPG and relative ST segment resolution. A relatively weak (r = 0.24) but significant correlation between TMPG and summed relative ST segment resolution was seen after thrombolytic treatment [11]. A better correlation (r = 0.58)

Table 4. Differences in median ST segment resolution between various TMPG categories

	TMPG 0	TMPG 1	TMPG 2	TMPG 3	P
ΣSTD [mm]	11.25 (7–15)	8 (4–13)	4 (3–7)	5 (3–7)	0.0004
ΣSTD% [%]	43.5 (9.5–73.5)	50 (31–71)	63 (33–82)	68.5 (43–85.5)	0.1756

Median values (interquartile range), Kruskal-Wallis ANOVA; TMPG — TIMI myocardial perfusion grade; ΣSTD — absolute summed ST segment resolution; ΣSTD% — relative summed ST segment resolution
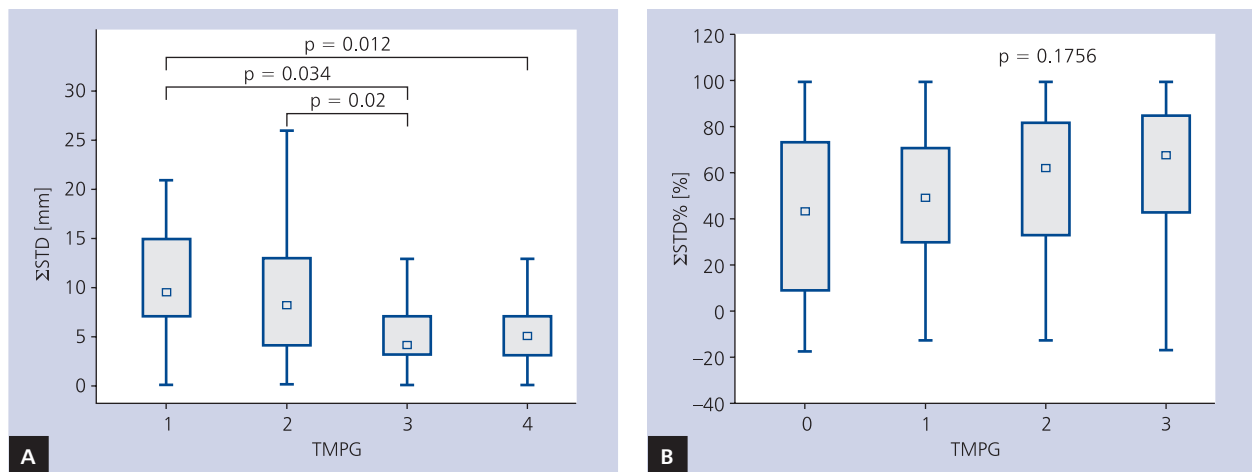
Figure 1. Absolute and relative summed ST segment resolution in relation to TIMI Myocardial Perfusion Grade (TMPG). A. Significant differences in median ΣSTD between the following groups: TMPG 0 vs. TMPG 2, TMPG 0 vs. TMPG 3, and TMPG 1 vs. TMPG 2; B. No significant differences in median ΣSTD% between different TMPG groups; Kruskal-Wallis ANOVA
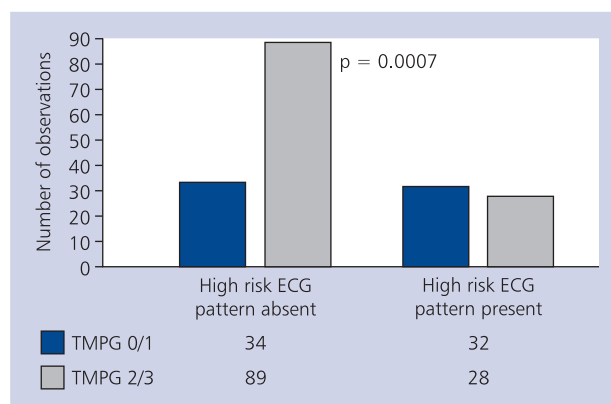
Figure 2. Presence of a high risk ECG pattern in groups TMPG 0/1 and TMPG 2/3 (χ^2 test); TMPG — TIMI Myocardial Perfusion Grade

was reported between TMPG and relative ST segment resolution in a single lead in patients treated invasively [12]. Other authors showed significantly more frequent occurrence of more than 50% ST segment resolution after pPCI in patients with TMPG 2 or 3 [13]. Similarly, Appelbaum et al. [14] noted that complete (> 70%) ST segment resolution was most frequent in patients with TMPG 3. In this study, baseline ST segment elevation in groups with TMPG 3 and TMPG < 3 did

not differ, and thus relative resolution was equal to residual ST segment elevation. Relative ST segment resolution, which is a ratio of ST segment deviations observed before and after reperfusion therapy, depends on the severity of initial ST segment changes, In case of an extensive infarction, large residual myocardial damage may be observed after reperfusion therapy, which results in persisting ST segment elevation in infarction-related leads. In contrast, when the infarction area is small, residual damage after reperfusion therapy is also small. In these 2 situations, similar relative ST segment resolution may correspond to various degrees of residual ST segment deviation [7]. De Luca et al. [6] found that summed residual ST segment deviation after pPCI was an independent prognostic factor that had larger predictive value than relative ST segment resolution. Desmet et al. [15] compared various methods to evaluate ST segment resolution after reperfusion therapy in STEMI and found significant associations between the extent of myocardial damage and hypoperfusion by positron emission tomography (PET) and residual ST segment deviation. No correlation was observed, however, between the degree of myocardial damage as assessed by PET and relative ST segment resolution. Other authors showed that absolute ST segment resolution is an independent predictor of microvascular obstruction as evaluated by cardiac magnetic resonance imaging (MRI), in contrast to relative ST segment

resolution [16]. Our findings seem to confirm that residual ST segment deviation after reperfusion therapy is a better measure of coronary microcirculation damage in STEMI than relative ST segment resolution.

In our study population, summed ST segment deviation after pPCI was smallest in patients with TMPG 2 and largest in patients with TMPG 0. This is an unexpected finding as ΣSTD may be expected to be lowest in TMPG 3 group, as this corresponds to complete reperfusion of the microcirculation. In addition, based on the report by Marra et al. [17] who showed that microcirculation damage and necrosis are relatively smaller with complete lack of contrast opacification of the microcirculation (TMPG 0) than with persisting contrast opacification (TMPG 1), we expected lower ΣSTD in TMPG 0 group compared to TMPG 1. Similarly, discordance between the angiographic evaluation of coronary reperfusion and the presence of a high risk ECG pattern was observed in many cases. Of course, it cannot be excluded that contrast opacification actually corresponding to TMPG 3 was miscategorised as TMPG 2. With semiquantitative evaluation such as the TMPG scale, reproducibility is limited regarding both intra- and interobserver agreement [18]. A quantitative method to evaluate the kinetics of contrast opacification of the microcirculation, TIMI Myocardial Perfusion Frame Count (TMPFC), indicates that it is difficult to clearly distinguish subpopulations with TMPG 2 and TMPG 3. On the contrary, the distribution of TMPFC results is unimodal, with significant overlap between TMPG 2 and TMPG 3 [19]. Thus, it is possible that in some cases, normal reperfusion of the microcirculation was erroneously categorised as TMPG 2. This does not explain, however, the discrepancies regarding residual ST segment deviation in TMPG 1 and TMPG 0 groups, and commonly observed lack of the high risk ECG pattern in patients with angiographically occluded microcirculation. Although a relation between the degree of ST segment elevation and evidence of microcirculation damage in cardiac MRI was shown, function of the microcirculation could be evaluated not less than 48 h after pPCI [16]. It is possible that no such clear relation between early microcirculation damage and the degree of ST segment deviation can be seen immediately after pPCI compared to that observed several hours after reperfusion. Due to a multitude of factors affecting ST segment changes, the degree of its deviation does not have to be strictly and quantitatively related to the severity of perfusion defects and myocardial damage [20–22]. It seems that a relatively larger extent of microcirculation damage in patients with TMPG 1 compared to those with TMPG 0 might lead to impaired membrane ion pump function and cell uncoupling in a larger number of adjacent cardiomyocytes. This might result in reduced potential gradient between various areas of the myocardium, increasing its electrical homogeneity and attenuating the injury current. This would manifest with paradoxically larger resolution of ST segment deviation in patients with more extensive myocardial damage. It has also been speculated that in some locations of ischaemic damage, ST segment deviation vectors point in opposite direction and as a result, the apparent net degree of ST segment deviation may not correspond to the actual extent of myocardial damage (ischaemic ST-segment counterpoise) [23].

An important limitation of our study was the lack of a clearly defined timing of ECG recording after IRA recanalisation. ECG was performed within 30 min of patient transfer to our coronary care unit but this might have translated to major differences in time from the restoration of IRA flow. Other study limitations include retrospective nature of the study, a relatively small sample evaluated in the study, and subjective evaluation of contrast opacification of the microcirculation which might have led to a systematic error in determining TMPG, and the fact that location of the infarct was not accounted for when evaluating ST segment resolution.

Our analyses indicate that residual ST segment deviation is significantly related to TMPG but concordance between these parameters is not complete. ST segment resolution and the angiographic degree of contrast opacification of the myocardial area supplied by the IRA likely reflect partially different phenomena that occur after coronary reperfusion. Some previous studies already suggested that angiographic and ECG approaches to evaluate coronary reperfusion for the purpose of predicting outcomes in STEMI patients should be considered complementary [8, 9, 24, 25]. Our findings also indicate that these methods should indeed be considered complementary and not alternative.

CONCLUSIONS

In patients who underwent successful pPCI, TMPG is more closely related to absolute compared to relative ST segment resolution. Maximum residual ST segment elevation does not fulfil the criterion of a high risk ECG in most patients with reperfused coronary microcirculation (TMPG 2 or 3). However, in about one third of cases TMPG did not correspond to the presence of ECG high risk features. These data suggest that both approaches are complementary in the assessment of the success of coronary reperfusion.

Conflict of interest: none declared

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Angiograficzna skala TMPG a rezolucja odcinka ST w ocenie reperfuzji po pierwotnej angioplastyce wieńcowej

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Streszczenie

Wstęp: W określaniu wyniku leczenia reperfuzyjnego i wczesnej stratyfikacji ryzyka chorych z ostrym zawałem serca z uniesieniem odcinka ST (STEMI) ważne miejsce zajmują angiograficzne parametry przepływu wieńcowego, a także ustępowanie zmian odcinka ST po pierwotnej przezskórnej interwencji wieńcowej (pPCI). Angiograficzna ocena reperfuzji na poziomie tkankowym w terytorium tętnicy odpowiedzialnej za zawał (IRA) może być dokonywana na podstawie stopnia kontrastowania mikrokrążenia wieńcowego w skali TMPG (*TIMI Myocardial Perfusion Grade*). Ustępowanie zmian odcinka ST może być

wyrażane przez wielkość odchylenia odcinka ST obecnego w EKG po leczeniu reperfuzyjnym (rezolucja bezwzględna) lub też przez jego redukcję w stosunku do wartości wyjściowych (rezolucja względna). W dotychczasowych badaniach relacji między angiograficznymi i elektrokardiograficznymi parametrami reperfuzji wieńcowej na ogół stosowano alternatywnie tylko jedną z dwóch wspominanych metod określenia rezolucji odcinka ST. Interesującym zagadnieniem wydaje się więc zbadanie wzajemnych zależności występujących między stopniem reperfuzji wieńcowej w skali TMPG a rezolucją odcinka ST określaną jednocześnie różnymi metodami.

Cel: Celem niniejszej pracy była ocena zależności występujących między stopniem reperfuzji mikrokrążenia wieńcowego w skali TMPG a bezwzględną i względną rezolucją odcinka ST u chorych po skutecznym zabiegu pPCI.

Metody: Badanie przeprowadzono w populacji chorych z ostrym STEMI poddanych skutecznej pPCI. Stopień reperfuzji mikrokrążenia wieńcowego w terytorium IRA określano w 4-stopniowej skali TMPG, w koronarografii wykonanej bezpośrednio po zakończeniu pPCI. Zmiany odcinka ST oceniano na podstawie EKG uzyskanych przed podjęciem leczenia (zapis wyjściowy) i wykonanym natychmiast po przeniesieniu chorego na oddział intensywnej terapii. Rezolucję odcinka ST analizowano na dwa zasadnicze sposoby: 1) jako sumaryczne rezydualne odchylenie odcinka ST (ΣSTD) w EKG wykonanym po zabiegu pPCI, sumując wartości uniesienia ST w odprowadzeniach zawałowych i obniżenia ST w odprowadzeniach przeciwstawnych (rezolucja bezwzględna); 2) jako redukcję sumarycznego odchylenia ST w stosunku do zmian w EKG wyjściowym, będące wartością procentową (rezolucja względna, ΣSTD%). Ponadto EKG wykonywane po pPCI analizowano pod kątem obecności zmian odcinka ST odpowiadających kategorii wysokiego ryzyka wystąpienia zgonu po zawale. Jako elektrokardiograficzne kryterium wysokiego ryzyka (Wyznacznik EKG Wysokiego Ryzyka) przyjęto obecność uniesienia ST > 1 mm w zawale ściany dolnej lub > 2 mm w zawale ściany przedniej po zabiegu PCI.

Wyniki: Badana populacja obejmowała 183 chorych (64,5% mężczyzn) w wieku 58,71 $\pm$ 15,76 roku. W czasie pPCI w 90% przypadków wszczepiono stent. U połowy chorych zastosowano antagonistę receptora IIb/IIIa. Angiograficzne cechy znacznie upośledzonej reperfuzji mikrokrążenia (TMPG 0 lub 1) były obecne u 66 (36,06%) osób, zaś otwarte mikrokrążenie (TMPG 2 lub 3) w 117 (63,93%) przypadkach. Średnia wartość ΣSTD wynosiła 7,20 $\pm$ 6,35 mm, a średnia wartość ΣSTD% — 50 $\pm$ 45%. Wyznacznik EKG Wysokiego Ryzyka był obecny po pPCI u 60 chorych (32,79% całej populacji). Stwierdzono istotną, ale słabą, ujemną korelację między TMPG i ΣSTD (r = –0,27; p = 0,0002). Wartości ΣSTD różniły się istotnie między grupami TMPG 0 *vs.* TMPG 2 i TMPG 3 (odpowiednio: p = 0,0034 i 0,0121), a także między TMPG 1 *vs.* TMPG 2 (p = 0,02). Zależności między stopniem TMPG i ΣSTD% okazały się słabsze. Wprawdzie stwierdzono istotną, choć bardzo słabą, dodatnią korelację TMPG z ΣSTD% (r = 0,16; p = 0,0286), jednak dalsze analizy wykazały statystyczną nieistotność różnic wartości ΣSTD% w poszczególnych stopniach TMPG (p = 0,1756). Reperfuzji wieńcowej odpowiadającej TMPG 2/3 znamiennie częściej towarzyszyła nieobecność Wyznacznika EKG Wysokiego Ryzyka (p = 0,0007). Jednak u ok. 34% wszystkich chorych angiograficzne cechy otwartego lub zamkniętego mikrokrążenia nie korelowały z występowaniem EKG Wysokiego Ryzyka.

Wnioski: U chorych skutecznie leczonych pPCI stopień reperfuzji wieńcowej w skali TMPG pozostaje w wyraźniejszym związku z bezwzględną niż ze względną sumaryczną rezolucją odchylenia odcinka ST. U większości chorych z otwartym mikrokrążeniem (TMPG 2/3) maksymalna wartość ΣSTD najczęściej nie spełnia kryterium wysokiego ryzyka zgonu. Jednak w ok. 1/3 przypadków angiograficzna ocena reperfuzji wieńcowej w skali TMPG nie koreluje z występowaniem elektrokardiograficznych cech wysokiego ryzyka. Stanowi to argument za komplementarnością obu metod w ocenie skuteczności reperfuzji wieńcowej.

Słowa kluczowe: zawał serca, reperfuzja wieńcowa, przepływ wieńcowy, rezolucja odcinka ST, angioplastyka wieńcowa

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