

VALUES OF HEART RATE TURBULENCE PARAMETERS AND THE OTHER PROGNOSTIC INDICATORS OBTAINED FROM 24 HOUR ECG HOLTER MONITORING IN MYOCARDIAL INFARCTION SURVIVORS TREATED WITH PRIMARY CORONARY ANGIOPLASTY

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Abstract: Assessment of heart rate turbulence (HRT) is a newly improved tool for stratification of prognosis after myocardial infarction. Pathological values of two parameters describing HRT (turbulence onset – TO, turbulence slope – TS) in these patients correlate with other predictors of sudden cardiac death e.g. low left ventricular ejection fraction.

The aim of this study was to evaluate whether pathological values of HTR correlate with ECG Holter monitoring based data reflecting heart rate variability (HRV) abnormalities, presence and number of arrhythmias or ST segment deviations.

Material: 89 patients (pts) with acute myocardial infarction, after successful primary coronary angioplasty, with sinus rhythm during hospitalization in coronary care unit were enrolled into the study. 72% of pts were males, mean age 57±10,5.

Method: Analysis of 24-hour ECG monitoring including: HRT and HRV analysis, number and quality of supraventricular and ventricular arrhythmias, as well as analysis of ST segment deviations was performed during the second day of hospitalization. Chi² test was used for statistical analysis.

Results: 5 pts had TO>0% (5,6%) and 8 pts had TS<2,5ms/RR (9%). Patient with “abnormal” values of TO had higher mean heart rate and lower number of supraventricular extrasystoles/24 hours (p<0,05). Patient with “abnormal” values of TS had also higher mean heart rate, but also higher maximal and minimal heart rate, as well as shorter SDNN, and lower triangle index (p<0,05).

The differences in remaining parameters between patients having values of TO and TS defined as “normal” or “abnormal”, such as number of ventricular extrasystoles, couplets, salvos, ventricular tachycardias, elevations or depressions of ST segment did not reach statistical significance.

Conclusion: In the group of patients with myocardial infarction successfully treated with primary coronary angioplasty the results of HRT assessment are strongly associated with results of HRV analysis. This observation confirms the usefulness of HRT for assessment of activity of autonomic nerve system in regulation of heart rate in myocardial infarction survivors.

INTRODUCTION:

The assessment of risk of sudden cardiac death in myocardial infarction survivors is a problem of great clinical importance, since primary prophylactic therapy has been possible. Heart rate turbulence (HRT), an electrocardiographic method for risk stratification, is described by two parameters: turbulence onset (TO) and turbulence slope (TS). TO indicates a decrease of RR interval (RRI) duration directly after ventricular extrasystolic beat, is expressed in percent, and value of >0% is associated with the worse prognosis. TS informs how fast the RRI changes after the pause, is expressed in ms/RRI, and poor prognostic value is <2,5ms/RRI. Despite the mechanisms of HRT are

not well understood, this method provides the additional data, which patients should be classified as the high-risk group. In some previous studies, HRT combined with low left ventricular ejection fraction ($\leq 30,0\%$), age over 65 years and diabetes mellitus gave a satisfactory predictive accuracy of death in postinfarction patients [1]. There were also some attempts to stratify a risk of death in patients with chronic heart failure with this method [2]. The values of HRT in myocardial survivors are correlated with heart rate even when premature ventricular beat is artificially programmed by electrical stimulation [3].

In this study we assessed whether pathological values of HTR correlate with ECG Holter monitoring based data reflecting heart rate variability (HRV) abnormalities, presence and number of arrhythmias or ST segment deviations as an indicator of ischaemic events

MATERIAL AND METHODS:

Eighty-nine patients, with acute myocardial infarction, with sinus rhythm were included into the study in the period of 12 – 24 hour after successful primary angioplasty. There were 64 males (72%) and 25 females (28%) in this group, mean age – $57 \pm 10,5$ years. Clinical characteristics of the group of myocardial infarction survivors are presented in Table 1.

Table 1. Clinical characteristics of study group

Parameter	Value
Left ventricle ejection fraction – range	18 – 62%
Main left coronary artery as infarction related artery	2%
Left anterior descending artery as infarction related artery	37%
Circumflexing artery as infarction related artery	14%
Right coronary artery as infarction related artery	56%
Arterial hypertension	54%
Diabetes mellitus	10%
Dyslipidaemia	78%
Nicotinism	42%
Peak activity of creatine kinase – range	396 – 20565 u/l

All patients underwent 24-hour Holter ECG monitoring with Reynolds recorder. TO and TS were calculated by the method described by Schmidt [4]. The measurements were performed for every single ventricular extrasystole and averaged. Apart of HRT parameters, standard deviation of RRI (SDNN), minimal, maximal and mean heart rate, number and forms of supraventricular and ventricular arrhythmias as well as ST segment deviations were analyzed. The patients were divided according to the value of TO ($>0\%$ or $\leq 0\%$) and value of TS ($<2,5\text{ms/RRI}$ or $\geq 2,5\text{ms/RRI}$). The average values of mentioned above parameters from Holter ECG records were compared between groups with normal and abnormal value of TO and TS, statistical significance of differences was calculated using χ^2 test.

RESULTS.

TO ranged in entire investigated group from (-19,62) to 7,6%, and TS from 0,29 to 44,5ms/RRI. Five patients (5,6%) had $\text{TO} > 0\%$. TO in these patients ranged from 1,08 to 7,6% - mean $2,7 \pm 1,94\%$. None patient with $\text{TO} > 0\%$ had $\text{TS} < 2,5\text{ms/RRI}$. Eight patients (9%) had $\text{TS} < 2,5\text{ms/RRI}$. TS in these patients ranged from 0,29 to 2,31ms/RRI – mean $1,45 \pm 0,59\text{ms/RRI}$. The results of statistical analysis are presented in Table 2 and Table 3.

Table 2. Comparison of Holter monitoring based results between patients with abnormal and normal value of turbulence onset (TO) - * p<0,05

Parameter	Averaged value ± SD in the group with TO>0%	Averaged value ± SD in the group with TO≤0%	Significance p
Supraventricular extrasystole/24 hours*	199±707	976±2001	0,041
Ventricular extrasystole/24 hours	428±1063	32±59	0,41
Maximal heart rate	99,0±17,5	90,0±10,8	0,2
Minimal heart rate	63,0±11,2	54,0±4,5	0,0863
Mean heart rate*	75,0±10,3	65,0±6,2	0,0365
Triangle index	20,0±8,8	25,0±6,3	0,2843
Depth of ST depression	0,24±0,78	0,0±0,0	0,4888
Number of ST depressions	0,1±0,3	0,0±0,0	0,4458
Couplets	33,5±156	3,6±5,8	0,67
Salvos	11,0±58	1,0±2,2	0,6851
rMSSD	30,2±35,5	26,0±7,8	0,8385
SDNN	74,0±31,0	71,0±8,1	0,8796
Supraventricular tachycardia	0,3±1,7	0,4±0,89	0,8455
Ventricular tachycardia	0,77±2,8	0,2±0,44	0,6563
ST elevations	0,19±0,39	0,0±0,0	0,2831

Table 3. Comparison of Holter monitoring based results between patient with abnormal and normal values of turbulence slope (TS) - * p<0,05

Parameter	Averaged value ± SD in the group with TS<2,5ms/RR1	Averaged value ± SD in the group with TS≥2,5ms/RR1	Significance p
Supraventricular extrasystole/24 hours	70±138	260±866	0,538
Ventricular extrasystole/24 hours	343±555	412±1074	0,859
Maximal heart rate	102,3±14,1	98,2±17,2	0,5537
Minimal heart rate*	71,2±12,3	62,1±10,7	0,019
Mean heart rate*	84±14,8	74±9,4	0,0042
Triangle index*	14±7,9	21±8,6	0,034
Depth of ST depression	0,5±0,9	0,2±0,7	0,3045
Number of ST depressions	0,25±0,46	0,08±0,28	0,1465
Couplets	17,5±31,0	33,1±159,2	0,7848
Salvos	7,3±13,1	11,2±59,3	0,847
rMSSD	19,2±8,2	31,2±36,1	0,395
SDNN*	51,2±26,1	76,2±30,1	0,0409

Supraventricular tachycardia	0,25±0,46	0,32±1,8	0,9122
Ventricular tachycardia	1,5±3,5	0,66±2,7	0,42
ST elevations	0,12±0,35	0,18±0,39	0,6665

CONCLUSION. In the group of patients with myocardial infarction successfully treated with primary coronary angioplasty the results of HRT assessment are strongly associated with results of HRV analysis. This observation confirms the usefulness of HRT for assessment of activity of autonomic nerve system in regulation of heart rate in myocardial infarction survivors.

References:

1. Barthel P, Schneider R, Bauer A et al., Risk Stratification After Acute Myocardial Infarction by Heart Rate Turbulence, *Circulation* 2003; 108: 1221-1226.
2. Koyama J, Watanabe J, Yamada A et al., Evaluation of Heart-Rate Turbulence as a New Prognostic Marker in Patients With Chronic Heart Failure. *Circ J* 2002; 66; 902-907.
3. Watanabe M, Marine J, Sheldon R et al., Effects of Ventricular Premature Stimulus Coupling Interval on Blood Pressure and Heart Rate Turbulence. *Circulation* 2002; 106; 325-330.
4. Schmidt G, Malik M, Barthel P et al., Heart-rate turbulence after ventricular premature beats as a predictor of mortality after acute myocardial infarction. *Lancet* 1999; 353; 1390-1396.