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PECULIARITIES OF HEART RHYTHM DISORDERS IN PATIENTS WITH MYOCARDIAL INFARCTION WITHOUT ELEVATION OF ST SEGMENT DEPENDING ON THE DEGREE OF CORONARY ARTERY LESIONS

Peculiarities of heart rhythm disorders in patients with myocardial infarction without elevation of ST segment depending on the degree of coronary artery lesions

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Summary. The prevalence of myocardial infarction and its leading role in the structure of overall and cardiovascular mortality encourages the search for predictors of complicated course of disease and the search for optimal means to prevent adverse events.

The aim of the study – to establish features of cardiac arrhythmias in patients with myocardial infarction without ST-segment elevation depending on the degree of coronary artery lesions.

Materials and Methods. The study involved 156 patients with NSTEMI aged 38 to 80 years. All patients were examined according to the current treatment protocol for patients with acute coronary syndrome without ST segment elevation and daily Holter ECG monitoring was performed for 3-5 days after hospitalization.

Results. It was found that the degree of coronary artery lesions is positively correlated with the likelihood of severe adverse ventricular arrhythmias and episodes of silent myocardial ischemia in the early period.

Conclusions. By determining the total score of coronary artery disease, it is possible to stratify the adverse course of NSTEMI, in particular, the occurrence of fatal ventricular arrhythmias in the early period.

Key words: myocardial infarction without ST segment elevation; ventricular arrhythmias; silent myocardial ischemia.

INTRODUCTION

Myocardial infarction (MI) is one of the leading causes of death and disability worldwide. In Ukraine, the frequency of registration of MI per capita is the highest in the European population, which puts this problem in the category of priority medical and social problems for our society [1].

In the last 20 years, there has been a trend of increasing incidence of myocardial infarction without

Особливості порушень серцевого ритму у пацієнтів з інфарктом міокарда без елевації сегмента ST залежно від ступеня ураження коронарних артерій

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Вступ. Розповсюдженість інфаркту міокарда та його провідна роль у структурі загальної та серцево-судинної смертності спонукає для пошуків предикторів несприятливого перебігу захворювання та пошуків оптимальних засобів для профілактики несприятливих подій.

Мета дослідження – встановити особливості порушень серцевого ритму в пацієнтів з інфарктом міокарда без елевації сегмента ST залежно від ступеня ураження коронарних артерій.

Матеріали і методи. В дослідженні взяли участь 156 пацієнтів із NSTEMI у віці від 38 до 80 років. Усіх хворих обстежено згідно з діючим протоколом лікування пацієнтів із гострим коронарним синдромом без елевації сегмента ST та проведено добуве моніторування ЕКГ за холтером на 3–5 добу після госпіталізації у стаціонар.

Результати. Встановлено, що ступінь ураження коронарних артерій позитивно корелює з імовірністю виникнення тяжких несприятливих шлуночкових аритмій та епізодів безбольової ішемії міокарда в ранньому періоді.

Висновки. Завдяки визначенню сумарного бала ураження коронарних артерій можливо стратифікувати несприятливий перебіг NSTEMI, зокрема виникнення фатальних шлуночкових аритмій у ранньому періоді.

Ключові слова: інфаркт міокарда без елевації сегмента ST; шлуночкові аритмії; безбольова ішемія міокарда.

ST-segment elevation (NSTEMI), which, according to some data, accounts for about half of all registered MI [2, 3]. The main problem with NSTEMI is that the long-term prognosis of these patients remains unsatisfactory, and mortality one year after the disaster equals or even exceeds that of STEMI [4].

Of great scientific interest are studies that develop the concept of predicting the nature of coronary artery disease using clinical and various non-invasive

instrumental parameters, which allows using simple and affordable research methods to stratify patients for invasive treatment [5]. In addition, the development of myocardial dysfunction on the background of acute ischemia leads to acute remodeling and potential electrical instability of the myocardium.

The aim of the study – to establish features of cardiac arrhythmias in patients with myocardial infarction without ST-segment elevation depending on the degree of coronary artery lesions.

MATERIALS AND METHODS

We conducted a comprehensive study of 156 patients with acute myocardial infarction without ST-segment elevation (NSTEMI) aged 38 to 80 (mean 62.0 ± 0.71 , median – 62 and interquartile range – 55 and 70) years, who are urgent demonstrations were hospitalized in the Municipal Non-Profit Enterprise "Vinnytsia Regional Clinical Medical and Diagnostic Center for Cardiovascular Pathology".

The criteria for including patients in the study were:

1. Verified NSTEMI, first diagnosed;
2. age up to 80 years;
3. the absence of contraindications to percutaneous coronary interventions and the use of the main groups of pharmacological agents included in the basic therapy of NSTEMI;
4. informed consent of the patient to participate in the study.

The criteria for exclusion from the study were:

1. STEMI, transferred in the past and recurrent acute myocardial infarction;
2. age of patients 80 years and older;
3. the presence of sinoatrial or atrioventricular block II-III degree, implanted or the need for implantation of an artificial pacemaker;
4. chronic heart failure NYHA-III, IV before the incident of acute myocardial infarction;
5. diseases of the respiratory system, kidneys and liver, which were accompanied by signs of pulmonary, renal and hepatic failure; anemic conditions with a hemoglobin level below 110 g / L ;
6. the presence of rheumatic and congenital heart defects, idiopathic and inflammatory myocardial lesions;
7. malignancies, severe neuropsychiatric disorders, alcohol abuse;
8. the presence of contraindications to percutaneous coronary interventions and the use of the main groups of pharmacological agents included in the basic therapy NSTEMI;
9. reluctance and refusal of the patient to participate in the study.

All patients were examined according to the NSTEMI protocol [6] and daily Holter ECG monitoring was performed for 3-5 days after hospitalization.

RESULTS AND DISCUSSION

To assess the severity of damage to individual main arteries, we calculated the conditional score of coronary artery lesion (CA), where 0 points - the absence of any atherosclerotic plaques in the CA (intact artery), 1 point - the presence of atherosclerotic stenosis up to 50 %, 2 points - from 50 % to 90 % of the lumen of CA and 3 points - CA occlusion (atherosclerotic stenosis > 90 %) [7]. In addition, the total conditional CA lesion score was additionally calculated as the sum of the right coronary artery (RCA), left anterior descending artery (LAD), and left circumflex artery (LCx) lesions. According to the obtained data, it was observed that the mean conditional score of RCA was 0.74 ± 0.08 , LAD - 2.03 ± 0.10 and LCx - 0.89 ± 0.09 , respectively. The total conditional CA lesion score was 3.66 ± 0.17 [7].

It was observed that in the group of patients with NSTEMI and existing hemodynamically significant stenosis (HSS) CA, compared with the group without HSS CA, significantly longer total episodes of supraventricular tachycardia / atrial fibrillation (SVT / AF) were recorded during the day, against $50=90$ (0.03), an increase in the total number of paired / group ventricular extrasystoles (VE) (24 vs. 16, $p=0.006$) and the total duration of ventricular tachycardia (VT) episodes per day (103 vs. 51 s, $p=0.02$). In addition, with a tendency to increase the number of cases with registered episodes of silent myocardial ischemia (SMI) (19.4 % vs. 4.5 %, $p=0.08$) in the presence of HSS CA, compared with their absence, determined a significant increase the number of SMI episodes per day (4 vs. 2, $p=0.04$) and their total duration (28 vs. 10 min, $p=0.01$) and the decrease in heart rate (HR) in SMI episodes (114 vs. 125, $p=0.03$) (Table 1).

The results of the following analysis, which assessed changes in the parameters of ECG monitoring by Holter depending on the value of the total score of the CA lesion (\leq and $>$ 3 points) showed that in the group with milder (total score of CA ≤ 3 points), compared with more severe anatomical lesions CA (total score of CA $>$ 3 points), there was a significant decrease in heart rate at night (58 vs. 64, $p=0.02$) with a higher circadian index (CI) (1.52 vs. 1.41, $p=0.04$), significantly higher daily number of registered supraventricular extrasystoles (SE) (840 vs. 646, $p=0.04$) and, accordingly, their number per 1 hour of study (27 vs. 35, $p=0.04$) (Table 2).

It was noteworthy that in the group with more severe anatomical lesions of the CA, compared with milder, recorded a significantly higher frequency of cases with a daily VE level $>$ 30 episodes (67.8 % vs. 49.5 %, $p=0.03$), significantly higher total number of VE per day (2752 vs. 1802, $p=0.007$) and, accordingly, their number for 1 hour of study (115 vs.

Table 1. Features of cardiac arrhythmias in NSTEMI patients depending on the presence of hemodynamically significant CA stenoses

Holter ECG indicators (n=156)	HSS CA is absent (n=22)	Available HSS CA (n=134)	P
Total duration of SVT / AF episodes per day, s	50 (18; 140)	90 (42; 400)	0,03
Total number of paired / group VE per day	16 (8; 32)	24 (18; 48)	0,006
The total duration of episodes of VT per day, s	51 (26; 79)	103 (83; 122)	0,02
The average number of SMI episodes per day	2 (1; 3)	4 (2; 4)	0,04
Total duration of SMI episodes per day, min	10 (6; 14)	28 (10; 32)	0,01
Average heart rate in SMI episodes, per min	125 (110; 136)	114 (102; 128)	0,03

Notes. Comparison of percentages between groups was performed according to the criterion χ^2 , absolute values - according to Mann-Whitney U test.

Table 2. Peculiarities of daily heart rate regulation, structure of heart rhythm disorders and ventricular repolarization status in NSTEMI patients depending on the severity of anatomical lesions of the CA

Holter ECG indicators (n=156)	Total score CA \leq 3 (n=97)	Total score CA $>$ 3 (n=59)	P
Heart rate night, per min	58 (52; 65)	64 (55; 69)	0,02
CI	1,52 (1,34; 1,65)	1,41 (1,30; 1,55)	0,04
Total amount of SE per day	840 (292; 3199)	646 (268; 1810)	0,04
Average amount of SE per 1 hour	35 (12; 133)	27 (11; 75)	0,04
VE $>$ 30 per day, number of patients (%)	48 (49,5 %)	40 (67,8 %)	0,03
Total number of VE per day	1802 (34; 3598)	2752 (97; 5442)	0,007
The average number of VE for 1 hour	75 (2; 151)	115 (4; 226)	0,007
The average number of VE for 1 hour $>$ 10, number of patients (%)	32 (33,0 %)	29 (49,2 %)	0,04
Average number of VE for 1 hour $>$ 100, number of patients (%)	23 (23,7 %)	24 (40,7 %)	0,03
Pair / group VE, number of patients (%)	23 (23,7 %)	30 (50,8 %)	0,0005
Polytopic VE, number of patients (%)	11 (11,3 %)	19 (32,2 %)	0,001
Early VE (R on T), number of patients (%)	17 (17,5 %)	21 (35,6 %)	0,01
Episodes of VT per day, number of patients (%)	7 (7,2 %)	12 (20,3 %)	0,02
The total duration of episodes of VT per day, s	62 (58; 83)	102 (82; 126)	0,04
SMI episodes per day, number of patients (%)	12 (12,4 %)	15 (25,4 %)	0,04
Total duration of SMI episodes per day, min	9 (8; 16)	18 (12; 24)	0,03

Notes. Comparison of percentages between groups was performed according to the criterion χ^2 , absolute values - according to Mann-Whitney U test.

75, $p=0.007$), increasing the frequency of cases with VE level $>10 > 49.2\%$ vs. 33.0% , $p=0.04$) and VE $>$ 100 for 1 h of the study (40.7% vs. 23.7% , $p=0.03$), higher frequency of registration of cases of paired / group VE (50.8% against 23.7% , $p=0.0005$), polytopic VE (32.2% vs. 11.3% , $p=0.001$), early (R on T) VE (35.6% vs. 17.5% , $p=0.01$), unstable episodes of VT (20.3% vs. 7.2% , $p=0.02$) and their total daily duration (102 vs. 62 s, $p=0.04$).

In addition, in patients with more severe anatomical lesions of the CA observed a significant increase in the frequency of registration of episodes of SMI during the day (25.4% vs. 12.4% , $p=0.04$) and their total duration (18 vs. 9 min, $p=0.03$).

Thus, the results of the study showed that in patients with NSTEMI there is some association between the severity of anatomical lesions of the CA,

as determined by CVG, and the increased incidence of various severe and prognostic ventricular arrhythmias detected by Holter ECG. Also, in the group with HSS CA, compared to its absence, there was a significant increase in the duration of asymptomatic episodes of SVT / AF per day ($p=0.03$).

We have established a connection between the degree of CA stenosis and the occurrence of ventricular tachyarrhythmias. Previous studies have been performed in various categories of patients to assess the prognostic impact of MI with or without ST-segment elevation in patients with ventricular tachyarrhythmias and sudden cardiac arrest on admission. In high-risk patients with ventricular tachyarrhythmias, non-MI had a higher mortality rate than MI, respectively, NSTEMI than STEMI, along with MI associated with VT ≥ 48 hours [8].

We found an association between an increase in the frequency and duration of episodes of SMI with an increase in the degree of CA damage. SMI is increasingly recognized as part of the spectrum of coronary heart disease. The spectrum of SMI varies from asymptomatic coronary heart disease to critical disease requiring intensive care. SMI is an important public health problem and its early detection can prevent many episodes of sudden cardiac death each year. Episodes of asymptomatic ischemia occur in approximately 25-50 % of patients with coronary heart disease (CHD) and may exceed symptomatic episodes by more than 20:1 [9].

LITERATURE

1. Хвороби системи кровообігу як медико-соціальна та соціально-політична проблема / за ред. В. М. Коваленко, В. М. Корницького. – К., 2014. – 279 с.
2. Impact of routine invasive strategy on outcomes in patients with non-ST-segment elevation myocardial infarction during 2005–2014: A report from the Polish Registry of Acute Coronary Syndromes (PL-ACS) / Ł. Piątek, K. Wilczek J. Kurzawski [et al.] // *Cardiol. J.* – 2020. – Vol. 27 (5). – P. 583–589. DOI: 10.5603/CJ.a2018.0136.
3. Pattern and Outcome of Acute Non-ST-Segment Elevation Myocardial Infarction Seen in Adult Emergency Department of Al-Shaab Teaching Hospital: A prospective Observational Study in a Tertiary Cardiology Center / M. Abdelhameed, O. Hakim, A. Mohamed, E. Gadour // *Cureus.* – 2021. – Vol. 13 (9). – e17981. DOI: 10.7759/cureus.17981.
4. Epidemiology of coronary heart disease and acute coronary syndrome / F. Sanchis-Gomar, C. Perez-Quilis, R. Leischik, A. Lucia // *Ann. Transl. Med.* – 2016. – Vol. 4 (13). – P. 256. DOI: 10.21037/atm.2016.06.33.
5. Future directions for cardiovascular disease comparative effectiveness research / M. A. Hlatky, P. S. Douglas, N. L. Cook [et al.] // *J. Am. Coll. Cardiol.* – 2012. – Vol. 60 (7). – P. 569–580. DOI: 10.1016/j.jacc.2011.12.057.

REFERENCES

1. Circulation system diseases as medical-social and social-politic problem. In: Kovalenko VM, Kornatskiy VM, eds. Kyiv; 2014. 279 p. Ukrainian.
2. Piątek Ł, Wilczek K, Kurzawski J, Gierlotka M, Gąsior M, Półoński L, Sadowski M. Impact of routine invasive strategy on outcomes in patients with non-ST-segment elevation myocardial infarction during 2005–2014: A report from the Polish Registry of Acute Coronary Syndromes (PL-ACS). *Cardiol J.* 2020;27(5):583-589. DOI: 10.5603/CJ.a2018.0136.
3. Abdelhameed M, Hakim O, Mohamed A, Gadour E. Pattern and Outcome of Acute Non-ST-Segment Elevation Myocardial Infarction Seen in Adult Emergency Department of Al-Shaab Teaching Hospital: A prospective Observational Study in a Tertiary Cardiology Center. *Cureus.* 2021;13(9):e17981. DOI: 10.7759/cureus.17981.

CONCLUSIONS

1. The increase in the total score of coronary artery lesion is positively correlated with the likelihood of manifestations of electrical instability of the myocardium, in particular with high-grade ventricular arrhythmias (Lown IV-V) and paroxysmal ventricular tachycardia.
2. With severe damage to the coronary arteries increases the likelihood of painless myocardial ischemia according to Holter ECG.
3. By determining the total score of coronary artery disease, it is possible to stratify the adverse course of NSTEMI, in particular, the occurrence of fatal ventricular arrhythmias in the early period.

6. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC) / M. Roffi, C. Patrono, J. P. Collet [et al.] // *Eur. Heart. J.* – 2016. – Vol. 37 (3). – P. 267–315. DOI: 10.1093/eurheartj/ehv320.
7. Ivanov VP. Characteristics of anatomic injury of coronary arteries in patients with acute myocardial infarction without ST elevation depending on plasma level of gene 2 growth stimulating factor and risk of adverse events / V. P. Ivanov, I. A. Mezhiyevska, V. Yu. Maslovskiy // *Acta Medica Leopoliensia.* – 2020. – Vol. 26 (1). – P. 20–25. DOI: 10.25040/aml2020.01.020.
8. Prognostic impact of acute myocardial infarction in patients presenting with ventricular tachyarrhythmias and aborted cardiac arrest / M. Behnes, K. Mashayekhi, C. Weiß [et al.] // *J. Am. Heart Assoc.* – 2018. – Vol. 7 (19). – e010004. DOI: 10.1161/JAHA.118.010004.
9. Gul Z. G. Silent myocardial ischemia / Z. G. Gul, A. N. Makaryus. – Treasure Island (FL): StatPearls Publishing, 2021.

4. Sanchis-Gomar F, Perez-Quilis C, Leischik R, Lucia A. Epidemiology of coronary heart disease and acute coronary syndrome. *Ann Transl Med.* 2016;4(13):256. DOI: 10.21037/atm.2016.06.33.
5. Hlatky MA, Douglas PS, Cook NL, Wells B, Benjamin EJ, Dickersin K, et al. Future directions for cardiovascular disease comparative effectiveness research. *J Am Coll Cardiol.* 2012;60(7):569-580. DOI: 10.1016/j.jacc.2011.12.057.
6. Roffi M, Patrono C, Collet JP, Mueller C, Valgimigli M, Andreotti F, et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC). *Eur Heart J.* 2016;37(3):267-315. DOI: 10.1093/eurheartj/ehv320.

7. Ivanov VP, Mezchievska IA, Maslovskiy VYu. Characteristics of anatomic injury of coronary arteries in patients with acute myocardial infarction without ST elevation depending on plasma level of gene 2 growth stimulating factor and risk of adverse events. *Acta Medica Leopoliensia*. 2020;26(1):20-25. DOI: 10.25040/aml2020.01.020.

8. Behnes M, Mashayekhi K, Weiß C, Nienaber C, Lang S, Reiser L, et al. Prognostic impact of acute

myocardial infarction in patients presenting with ventricular tachyarrhythmias and aborted cardiac arrest. *J Am Heart Assoc*. 2018;7(19):e010004. DOI: 10.1161/JAHA.118.010004.

9. Gul ZG, Makaryus AN. *Silent myocardial ischemia*. Treasure Island (FL): StatPearls Publishing; 2021.

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