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**RELATIONSHIP RHYTHM DISTURBANCES AND FEATURES OF HEART REMODELING IN PATIENTS WITH PERIPARTUM CARDIOMYOPATHY**

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*Abstract: This article discusses the occurrence, frequency of rhythm and conduction disturbances in patients with peripartum cardiomyopathy. The relationship between arrhythmia and cardiac conduction disturbances and remodeling in patients with peripartum cardiomyopathy was analyzed.*

*Keywords: Peripartum cardiomyopathy, Rhythm and conduction disturbances, Left ventricular ejection fraction.*

The relevance of the study. Peripartum cardiomyopathy is a rare but potentially life-threatening form of non-coronary myocardial disease that develops in the last trimester of pregnancy or within a few months after childbirth [1]. The disease proceeds with clinically significant heart failure, not necessarily with dilatation of the heart cavities, but with an ejection fraction (EF) below 45% [2,3]. In rare cases, sudden death may develop, associated with a violation of the rhythm and conduction of the heart [2]. The results of multicentre studies indicate that in most cases ventricular tachycardia is the cause of ventricular fibrillation and sudden arrhythmic death [4].

It is known that the pathological substrate for the development of ventricular tachycardia in cardiomyopathies is the negative remodeling of the dilated myocardium, which reflects the altered structure and function of myocytes, tissue architectonics, dysfunction of ion channels, intercellular connections, and changes in the activity of the autonomic nervous system [5,6].

At the same time, the violations of the characteristics of the electrical activity of the heart (rhythm and conduction) in patients with peripartum cardiomyopathy, as well as their relationship with the features of cardiac remodeling, have not been sufficiently studied so far.

The purpose of the study is to analyse the evaluation of the frequency and characteristics of arrhythmias and conduction disorders in patients with peripartum cardiomyopathy, and the relationship of these problems to the features of cardiac remodeling.

**Materials and research methods.** The study included 104 patients with a verified diagnosis of peripartum cardiomyopathy, which was made in accordance with the current WHO classification of 1995 year and the recommendations of the working group on peripartum cardiomyopathy, the ESC Heart Failure Association 2010.

In addition to assessing the clinical condition of patients according to clinical evaluation scale for chronic heart failure, the 6-minute walking test was performed along the hospital corridor, standard and daily ECG recording (Cardiolab Ukraine), transthoracic echocardiography (Sanoline Verso pro, Siemens) at complete rest according to the generally accepted method with determination of volumetric and linear parameters of the heart, with the calculation of initial left ventricular myocardial contractility.

Patients were randomized into 2 groups; Group 1 - patients with initial left ventricular ejection fraction less than 35% and group 2 - patients with left ventricular ejection fraction more than 36 but less than 45%, "mildly reduced".

For statistical processing, MS Excel, Biostatics for Windows 4.03 software packages were used. Descriptive statistics was carried out with the calculation of the arithmetic mean (M), standard deviation (SD), with a percentage. Significance of differences was determined according to Student's t-test. Data are presented as M $\pm$ SD. Differences were considered statistically significant at  $p < 0.05$ .

Results of the study: The average age of the women included in the study was 28.2 $\pm$ 0.8 years. The disease manifested with symptoms and signs of heart failure in the majority of patients after childbirth 79 (76%), while in 51 cases after 3 or more months, and in the remaining cases, clinical manifestations of heart failure developed in the last trimester of pregnancy.

The widespread use of long-term ECG registration significantly increased the likelihood of detecting arrhythmia and conduction of the heart. According to the results of Holter monitoring in patients with peripartum cardiomyopathy, both supraventricular and ventricular arrhythmias were recorded. Of the supraventricular arrhythmias, despite the tendency to dilatation of the left atrium (LA >4.0 cm), atrial fibrillation occurred only in 6 (12%) cases; of them in 4 paroxysmal and in 2 cases permanent form. In one case, episodes of nodal supraventricular tachycardia and accelerated lower ventricular rhythm were recorded (Table No. 1).

Ventricular arrhythmias occurred much more often and were recorded in 81 (78%) cases, and in 60 (58%) cases it corresponded to the II gradation according to Lown. High gradations of ventricular arrhythmias occurred in 44 patients, so in 38 (36.5%) III class, 44 (42%) paired and 19 (18%) group. Unsustainable form of ventricular tachycardia 10 (10%) cases. At one patient developed sustained ventricular tachycardia on the second day of hospitalization, which was stopped by defibrillation.

Analysis of heart rate variability indicators showed an increase in SDNN by 12% and RMSSD by 18%, an increase in the total spectrum power by 32%. These changes were accompanied by an increase in the power of the high-frequency component of the HF spectrum by 28% and a decrease in the LF/HF ratio by 26% compared to the standard values.

Violations of the conduction of an electrical impulse along the conduction system of

the ventricles are characterized by blockade of the right and / or left bundle branch block According to the results of our study, it was noted that the most common conduction disorder in patients with peripartum cardiomyopathy was left bundle branch block (LBBB) 26%, which was several times more often recorded than right bundle branch block (RBBB) 9% ( $p > 0.003$ ). Of the cardiac conduction disorders, AV blockade of the 1st degree was recorded in 17 (16%) cases, transient atrioventricular blockade of the 2nd degree was rare, only 5 (4%) cases (Table No. 1).

**Table No. 1. The frequency and nature of cardiac arrhythmias and conduction in patients with peripartum cardiomyopathy.**

Cardiac arrhythmia and conduction disorders	Number of patients (n =104)	%
<b>Supraventricular arrhythmia:</b>		
atrial fibrillation, permanent form	2	1,92
atrial fibrillation, paroxysmal form	4	3,84
supraventricular paroxysmal tachycardia	1	0,96
accelerated lower atrial rhythm	1	0,96
<b>Ventricular arrhythmia:</b>	<b>81</b>	<b>78</b>
I class by Lown	21	20
II class by Lown	60	58
III class by Lown	38	36,5
IVA class by Lown	44	42
IV B class by Lown	19	18
unstable form of ventricular tachycardia	10	10
stable form of ventricular tachycardia	1	0,96
<b>Blockades:</b>		
AV block I degree	17	16
AV block II degree transient	5	4
-complete LBBB	27	26
-complete RBBB	9	9

*Note: LBBB - blockade of the left bundle branch block; RBBB - blockade of the right bundle branch block.*

As noted, the aim of the next stage of the study was to study the relationship between rhythm disturbances and features of cardiac remodeling in patients with peripartum cardiomyopathy. The analysis was carried out in 2 groups of patients; the first with left ventricular ejection fraction not exceeding 35%, and the second more than 36% but less than 45%. According to the results of the 6-minute walk test, the distance travelled in group 1 was  $82.24 \pm 20.45$  m, and in group 2  $170.22 \pm 23, 15$  m ( $p < 0.005$ ). The number of points scored on the clinical evaluation scale for chronic heart failure was  $10.50 \pm 1.0$  and  $7.05 \pm 0.67$  in groups I and II, respectively ( $p < 0.005$ ). Analysis of indicators reflecting the features of the course of chronic heart failure showed significant differences characterizing significantly worse manifestations in patients of group 1.

A comparative analysis of the parameters of central hemodynamic showed that the absolute values of heart rate (HR) ( $106.55 \pm 5.34$ ) in group 1 indicated severe tachycardia, while in the comparison group tachycardia was moderate ( $93.8 \pm 3.29$  bpm) ( $p < 0.04$ ). The level of systolic blood pressure in group I was slightly lower relative to group II, with no significant differences: systolic blood pressure -  $85.86 \pm 10.23$  mm Hg. and  $105.22 \pm 6.86$  mm Hg, diastolic blood pressure.  $63.45 \pm 3.90$  and  $75.22 \pm 2.37$  mm Hg, I and II groups, respectively (Table No. 2).

**Table №2. Clinical parameters of patients with peripartum cardiomyopathy**

Measures	I-group (n-58)	II- group (n-46)	p
clinical evaluation scale for congestive heart failure, points	10,50 ± 1,0	7,05 ± 0,67	0,005
distance according to the 6-minute walking test, meters	82,24 ± 20,45	170,22 ± 23,15	0,005
systolic blood pressure, mm Hg.	85,86 ± 10,23	105,22 ± 6,86	0,12
diastolic blood pressure, mm Hg	63,45 ± 3,90	75,22 ± 2,37	0,11
heart rate (in a minute)	106,55 ± 5,34	93,8 ± 3,29	0,04

Analysis of the parameters of intracardiac hemodynamic in the compared groups showed moderate dilatation of the left ventricle in both groups; mm) and LVIDs, 12% (55.72 ± 6.63 and 49.05 ± 5.24). The dimensions of the left atrium had no significant differences of 40.51 ± 7.01 mm and 39.8 ± 7.04, respectively, in groups 1 and 2. In both groups was observed thinning of the walls of the interventricular septum and the posterior wall: IvST – 8.15 ± 1.45 8.87 ± 1.56; LVWt – 8.49 ± 1.13 8.87 ± 1.56; (Table 3).

**Table № 3. EchoCG measures of patients with peripartum cardiomyopathy**

Measures	I-group (n-58) LV EF < 35%	II-group (n-46) LV EF 36-45	p
Aorta, mm	28,86 ± 2,83	28,78 ± 3,03	0,996
LVIDd, mm	66,15 ± 6,56	60,6 ± 8,54	0,607
LVIDs, mm	55,72 ± 6,63	49,05 ± 5,24	0,433
LVEDv ml	221,7 ± 50,2	185,45 ± 39,12	0,570
LVESv, ml	153,45 ± 40,1	112,43 ± 28,8	0,408
stroke volume, ml	67,99 ± 16,68	82,68 ± 19,01	0,562
LVEF %	29,65 ± 6,34	40,34 ± 6,25	0,232
Left Atrium, mm	40,51 ± 7,01	39,8 ± 7,04	0,943
Right Atrium, mm	36,29 ± 8,97	36,65 ± 5,58	0,972
Right Ventricle, mm	32,069 ± 8,99	34,10 ± 7,49	0,862
IvST, mm	8,15 ± 1,45	8,8 ± 1,09	0,720
LVWt, mm	8,49 ± 1,13	8,87 ± 1,56	0,844
LVMM gr	262,66 ± 69,37	243,12 ± 69,02	0,842

Notes: LVIDd - Left Ventricular Internal End-Diastolic Diameter, LVIDs - Left Ventricular Internal End-Systolic Diameter, LVEF - Left Ventricular Ejection Fraction, LVEDv - Left Ventricular End-Diastolic volume, LVESv - Left Ventricular End-Systolic volume, IvST - Interventricular Septum Thickness, LVWt - Left Ventricular Wall Thickness, LVMM - Left Ventricular Myocardial Mass

When studying the results of Holter monitoring, a relationship was established between the frequency and characteristics of ventricular arrhythmias and inotropic function of the left ventricle. In particular, episodes of high grades of ventricular arrhythmias were significantly often recorded in patients with LVEF less than 35% relative to the comparison group. Pair ventricular extrasystoles was recorded in 43 and

41% of cases, respectively, in groups 1 and 2. A life-threatening form of ventricular arrhythmia (short episodes of ventricular tachycardia) was recorded in more than 30% of patients with LVEF less than 35%, and in the comparison group 15% of cases. It should be noted that 1 case of sustained ventricular tachycardia stopped by electrical defibrillation occurred in a patient with LVEF less than 35% (Table 4)

**Table №4. The frequency and characteristics of cardiac arrhythmias and conduction disorders in patients with peripartum cardiomyopathy in groups**

<b>Cardiac arrhythmias and conduction disorders</b>	<b>I-group (n-58) LV EF &lt; 35%</b>	<b>II-group (n-46) LV EF 36-45%</b>	<b>X<sup>2</sup></b>	<b>P</b>
<b>Ventricular arrhythmia:</b>				
	44	37	0,31	0,577
I class by Lown	12	9	0,02	0,001
II class by Lown	38	22	3,29	0,007
III class by Lown	23	15	0,55	0,459
IVA class by Lown	25	19	2,49	0,854
IVB class by Lown	12	7	0,51	0,474
unstable form of ventricular tachycardia	6	4	0,08	0,777
stable form of ventricular tachycardia	1	0	0,8	0,371

Discussion of the results. Among the numerous instrumental research methods, the leading place rightly belongs to electrocardiography (ECG). This method of studying the bioelectrical activity of the heart is indispensable for the conduction of ventricular and atrial myocardial hypertrophy in heart diseases.



In the vast majority of cases, during the primary ECG registration in most cases (more than 80%) in patients with peripartum cardiomyopathy, sinus tachycardia was noted (heart rate more than 90 beats / min), atrial fibrillation (AF) on a standard ECG was recorded from them in isolated cases.

The conduction disturbance of an electrical impulse along the conduction of the ventricular system are characterized by blockade of the right and / or left bundle branch block.

They are frequent complications of heart disease recorded on the ECG. According to the results of our study, it was noted that the most common conduction disorder in patients with peripartum cardiomyopathy was the blockade of the left bundle branch block (LBBB) 26%, which was several times more often recorded than the blockade of the right bundle branch block (RBBB) 9% ( $p > 0.003$ ). According to Kass [7], changes in the geometry and dilatation of the heart contribute to the chaotic uncoupling of early and late activated areas of the myocardium, which in turn exacerbates conduction disturbances that already exist as a result of existing fibrosis, weakening contractility and slowing down the speed of impulse conduction.

A statistically significant relationship between LVEF and the duration of the QRS complex has been proven [8,9]. At the same time, a widened QRS complex and high heart rate were associated with systolic and diastolic left ventricular dysfunction [9].

When studying the relationship between the frequency and characteristics of ventricular arrhythmias and parameters within cardiac hemodynamics, it was found that in the group of patients with initial LVEF  $< 35\%$ , the frequency of registration of episodes of ventricular arrhythmia of high classes according to the graduation of Lawn Wolf was significantly higher compared to women suffering from peripartum cardiomyopathy and "mild" decreased LVEF.

The result of our study allows us to add to the opinion of the study, indicating that severe contractile dysfunction in patients with structural lesions of the left ventricle determines the scale of electrophysiological myocardial disorders.

Expansion of the LV cavity due to structural damage to the heart above individual threshold values triggers a "vicious circle" of pathological processes in the myocardium, including further stretching, hypertrophy, architectural restructuring and apoptosis of cardiomyocytes, which contributes to the further progression of dilatation and the occurrence of systolic dysfunction of the left ventricle [10,11, 12 ].

In tissues with structural and morphological cellular deformations, with an altered orientation of muscle fibers and an increase in interstitial collagen (due to fibrosis, apoptosis), leading to ionic heterogeneity, impulse conduction becomes intermittent and inhomogeneous [13]. This leads to a change in the duration and propagation of the action potential (AP) of the cell and contributes to the occurrence of post-depolarizations and the formation of the "re-entry" mechanism. Electric AP is conducted through tissue cells, where it flows faster, to tissues where its formation is delayed, changes in action potential in neighboring parts of the myocardium occur in antiphase, heterogeneity of the refractory period occurs with the formation of favorable conditions (electrophysiological substrate) to trigger the "re-entry" mechanism. Ventricular Extrasystoles entering this "vulnerable window" of repolarization are able to induce ventricular tachycardia or ventricular fibrillation [14].

In general, according to the analysis of the conducted studies, the mortality rate in peripartum cardiomyopathy is 44%, but in developed countries this figure is much lower - 2-8% [15]. About a third of deaths in peripartum cardiomyopathy are due to sudden cardiac death due to the development of cardiac arrhythmias [16]. It should be noted that against the background of a significant decrease in mortality from other

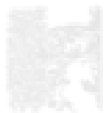
complications of pregnancy, peripartum cardiomyopathy begins to play an increasingly important role in the structure of maternal mortality. According to one study [17], peripartum cardiomyopathy accounts for about 23% of all maternal deaths due to cardiovascular pathology, which is extremely high, given the low incidence of this disease.

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