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Signs and symptoms of new-onset atrial fibrillation in patients with metabolic syndrome

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Abstract
The purposeof this study was to carry out a comparative analysis of signs and symptoms by scale EHRA, type of paroxysm flow and structural-functional state of the myocardium in the patients with new-onset atrial fibrillation (NOAF) depending on the presence of insulin resistance. 114 patients (66 male, 48 female; age: 66 ± 10 years) with NOAF and metabolic syndrome (MS) by ATP III (2001) were observed. Depending on the endogenous insulin (EI) levels patients were divided into 3 groups: group 1 consisted of 44 patients with normal plasma EI levels; group 2 consisted of 31 patients with reactive hyperinsulinemia (HI); group 3 consisted of 39 patients with spontaneous HI.
In old age under NOAF with reactive and spontaneous HI permanent form of AF is formed more often with an increased risk of thrombotic events and increasing complaints associated with arrhythmias by a scale EHRA and progression of chronic heart failure (CHF). The increase in the metric and volume left heart indexes is accompanied by an imbalance between the sympathetic and parasympathetic links autonomic nervous system (ANS), the formation of the adrenergic type of AF with increasing average HR, decrease RMSSD and increase of SDANN parameters of HRV.

Keywords: new-onset atrial fibrillation, insulin resistance, heart rate variability, echocardiography.

1. Introduction
The emergence and recurrence of AF associated with cardiovascular diseases such as AH and CHD with CHF [6]. Hypertension reveals a pronounced negative impact on the size and function of the LA and its morphology. Changes in the LA lead to a breach of the pulse and fragmented atrial conduction, which is a risk factor for AF [1].
According to scale CHA_2DS_2-VASc risk of thromboembolic complications in AF increases under systolic blood pressure (BP) above 160 mmHg [5, 8] and the presence of diabetes. However, the presence of insulin resistence with reactive HI and impaired glucose tolerance in patients with MS is not taken into account. Since insulin resistance in patients with MS can occur not only with spontaneous HI, but with reactive HI also. Thus, the question about the features of AF depending on the HI needs further more detailed study [2, 4].
In the current international and national guidelines the first episode of AF is defined as a separate clinical form of AF, which can then be transformed into paroxysmal, persistent or permanent AF [3]. Newly diagnosed AF is manifested by various clinical signs and symptoms and there was the cause of hospitalization for timely eveluating of background disease and life-threatening extracardial causes of AF. On the severity of NOAF manifestations age, gender, preferences of the activity ANS and even characterological features of the patient are influenced [6, 12]. However, remain poorly understood NOAF clinical course in the patients with MS depending on the presence of insulin resistance with different plasma EI levels.
Purpose - to carry out a comparative analysis of signs and symptoms by a scale EHRA, type of paroxysm flow and structural-functional state of the myocardium in the patients with NOAF depending on the presence of insulin resistance.

2. Materials and Methods.
The study involved 114 patients (66 male, 48 female; age 66 ± 10 years) with NOAF and MS according to the criteria ATP III (2001) [2]. There was urgent hospitalization in 47 (41.23%) cases and planned for referral clinics in 67 (58.77%) cases. AF was first recorded in the last month by ECG in 81 patients, during Hm ECG in 33 patients. In all cases the duration of AF was at least 30 seconds.
Depending on the plasma EI levels patients were divided into 3 groups: group 1 consisted of 44 (38.59%) patients with normal plasma EI levels (8 – 20 mU/ml); group 2 consisted 31 (27.19%) patients with reactive HI (fasting EI levels within the normal range and after 2 hours

load EI >20 mU/ml); group 3 consisted 39 (34.21%) patients with spontaneous HI (fasting and after 2 hours load EI levels > 20 mU/ml).

Class of symptoms associated with NOAF (palpitations, dyspnoe, oedema, dizziness) was measured on a scale EHRA [5]: I – no symptoms; II – symptoms that do not violate normal daily activities; III – symptoms that violate daily activities; IV – symptoms that making it impossible daily activities. Each of the most common complaints assessed by the four-point scale: 0 points – no; 1 – slightly concerned; 2 – moderately concerned; 3 – bother much.

A determination of complaints, medical history, physical examination, body mass index, systolic and diastolic BP, heart rate (HR), OGTT with parallel determination of glucose (using oxidase method) and plasma EI levels by ELISA method (firm DRG, USA) were performed. Evaluation of OGTT carried out according to the recommendations of the American Diabetes Centre (ADA) [2]. Plasma EI level was considered as normal in the ranges of 8 – 20 mU/ml.

The Hm ECG was performed using the apparatus EC-3H / ATS and software Cardiospy ECG Holter (Labtech Ltd, Hungary) definition of daily average HR and HRV parameters. During the study, the patients were diary with detailed descriptions of physical or emotional stress, periods of sleep, rest, meals, health.

Daily average timing of HRV were analyzed during each successive 5 - minute intervals all the daily record, including HR; the standard deviation of the averaged normal NN intervals for all 5-minute segments (SDANN); the root mean square of the difference between the coupling intervals of adjacent NN intervals (RMSSD).

Echocardiographic studies were performed on ultrasound system «Sonoace-4800» («Medison», Korea) for the conventional protocol of M- and B-modes to detect or denial of valve heart disease, estimates of the size and function of atrial systolic function of the LV, end-systolic volume (ESV) and end-diastolic volume (EDV) and LV structural and functional status of other heart chambers. There were measured maximal and minimal LA size, interventricular septum thickness (IVST) and rear wall LV (RWLV) and LV EF. LV myocardium mass (LV MM) determined by the formula R.B. Devereux in a modification ASE cube [4]:

$$LV\ MM = 0{,}8 \times \{1{,}04 \times ([EDS + LVPWd + IVSTd]^3 - [EDS]^3)\} + 0.6\ (g)$$

Where EDS – end-diastolic size; LVPWd – left ventricular posterior wall in diastole, IVSTd – interventricular septum thickness in diastole. The index was calculated as LV MM and body surface area.

Decisions on treatment strategies taken individually, with a history, clinical and instrumental examination. In 29 (25.44%) cases sinus rhythm recovered independently to 7 days. In 15 (13.16%) cases, the first episode of AF to sinus rhythm restoration applied amiodarone, 8 (7.02%) patients were directed to conduct electrical cardioversion. In 12 (10.53%) patients with a duration of more than 7 days paroxysm rhythm restored after a routine transesophageal echocardiogram or anticoagulant training. In the case of new diagnosed permanent AF and asymptomatic paroxysmal AF there was HR control only. There was monitor HR using selective β_1-blockers, digoxin or a combination there of. In a hospital in all cases, according to current recommendations [3, 9] antithrombotic agents were administered.

According to current recommendations for AF [3] the patients were divided into clinical groups by AF forms: 32 – with paroxysmal AF, 12 – with permanent AF and 70 – with persistent form of AF.

Statistical analysis of the results done using the software package Statistika, v. 6.0 (StatSoft, USA). Reliability of mean value differences was performed using paired Student *t*-test. The factors were considered reliable at $p<0.05$. Paired factor correlation analysis was done to calculate Pearson's correlation coefficient – r.

3. Results and Discussion

All of the patients belonged to the category of elderly with polimorbiding and the presence of AH and CHD (Table 1). Acute cerebrovascular accident or transient ischemic attack at 7 (6.14%) patients, postinfection cardio sclerosis at 5 (4.39%) patients were earlier. Transient forms of AF (paroxysmal and persistent) were recorded in 27 (61.36%) patients without insulin resistance, permnent form in 53 (75.71%) cases with reactive and spontaneous HI. In the most patients (73%), risk of thromboembolic complications by a scale CHA_2DS_2-VASc was assessed as high, and increasing the degree of HI was assessed as high that was associated with an increased risk of thrombotic events.

Old age of the patients with HI was associated with the permanent form of AF, which generally corresponds to the idea of the progression of AF from paroxysmal to permanent forms [7, 10]. Obviously, the permanent form of AF detection may indicate heart disease long background and reflect the severity of its course.

The analysis of complaints depending on the HI suggests the influence of insulin resistance on clinical manifestations of NOAF (Table 2). Significantly expressed palpitations disturbed patients with spontaneous HI more often than the patients without insulin resistance and with reactive HI. However, the frequency of dyspnoe and dizziness equally increased in the patients with both reactive and spontaneous HI. Periferal oedema as a sign of heart failure was noted in ever than half patients (56%) with spontaneous HI. In 30 (68.18%) patients (group 1) clinical symptoms attributed to I – II clases by EHRA and only in 14 (31.82%) cases there were observed symptoms III – IV clases EHRA. The most patients with HI have symptoms of III – IV clases EHRA particulary in 22 (70.97%) (group 2) and in 29 (74.36%) (group 3) cases, respectively. In addition, in the patients with complaints of palpitations, in more than half the cases of reactive and spontaneous HI permanent form of AF was diagnosed that was associated with sever and longer course of AF.

The data on the incidence of various complaints consistent with prevalence return forms of AF in the patients without insulin resistance, and permanent AF – at present HI. Typical complaints of AF associated with more pronounced levels of HI and higher HR [2].

Often AF starts on the background of increased parasympathetic tone or sympathetic nervous system. Accordingly, there are three types of paroxysmal AF – vagal, adrenergic and mixed types [4, 6].

To assess the types of paroxysmal AF by Hm ECG parameters the patients were divided into groups depending on the prevalence of a linc ANS (Table 3). In 36 (31.58%) of the patients vagal form of AF was revealed, including 14 (38.89%) patients with normal blood EI levels and 22 (61.11%) patients with HI. Adrenergic type of AF was predominant in 30 (26.31%) cases, including 10 (33.33%) patients with normal EI levels and 20 (66.67%) patients with HI. Mixed type AF was revealed in 48 (42.11%) cases, including: 20 (41.67%) patients

with normal EI levels and 28 (58.33%) patients with HI.

Patients with vagal type AF and HI characterized by lower HR during the paroxysm ($p<0.05$) compared to the patients with adrenergic and mixed types AF. The maximum value of the average HR that was determined during the paroxysm, observed in the patients with type adrenergic and HI, which was significantly higher compared to the rate in the patients with both vagal and mixed types AF ($p<0.05$). However, significant differences was not revealed between the patients of all groups in the number and duration of paroxysm AF ($p<0.1$).

Thus, in the patients with NOAF and insulin resistance, the conditions with reactive and spontaneous HI often formed adrenergic type AF, that confirming published data on HI adverse impact on the course of AF [1, 11].

Imbalance between links ANS reduces functional reserves of cardiovascular system, the deterioration of the coronary circulation and the development of AF, particularly in the patients with insulin resistance [4].

For state parasympathetic link of ANS index RMSSD is considered informative [12]. In analyzing RMSSD rate depending on the plasma EI levels (Table 4) we found it decreased by 17% and 37% in patients with HI vs. in control and at normal EI levels, respectively ($p<0.05$). In the analysis depending on the type of AF we revealed a significant decreasing of RMSSD 14% in 11 (34%) cases among the patients with HI in paroxysmal form AF and somewhat rarely in the patients with persistent and permanent AF ($p<0.05$).

SDANN parameter reflects the activity of the sympathetic nervous system [4, 5]. Thus, in the patients with HI this indicator was increased by 14.53% vs. the level in control ($p<0.05$). In analyzing the SDANN parameter depending on the type of AF there was revealed its changes of varying intensity. Specifically, in patients with paroxysmal AF at HI this indicator was increased by 17.47% ($p<0.05$). At the same time in the patients with persistent and permanent AF in 42 (51.22%) cases marked an increase parameter by 15% ($p<0.05$). In 23 (28.05%) cases there was upward trend indicator ($p<0.1$), and in 17 (20.73%) cases without change of SDNN ($p<0.1$).

In the analysis of Hm ECG parameters depending on the type of paroxysm (Table 5) a significant increase in HR revealed ($p_1<0.05$) in the patients with adrenergic type AF compared to the patients with vagal type. The imbalance between the activity of the sympathetic and parasympathetic nervous systems in this groups characterized by a decrease RMSSD and a parallel increase the SDANN index. In particular, the RMSSD parameter under HI was reduced to 38.65% compared to the patients with vagal type ($p_1<0.05$) and by 19.40% compared to the patients with mixed type ($p_2<0.05$), and the rate SDANN maximally increased by 25.45% and 16.21% compared to the patients with vagal and mixed types respectively ($p_{1;2}<0.05$).

Thus, the presence of insulin resistance in the patients with adrenergic type AF is characterized by reduce time HRV parameters, including RMSSD and increase SDANN. Signs hypersympathicotonia with the overall decrease in HRV and parasympathetic effects on reducing HR are signs of autonomic dysfunction and may, along with other factors contribute to the support of AF, which is supported by results of others studies [5]. It is proved there is a correlation between changes in autonomic regulation, cardiac rhythm and increased activity of the sympathetic branch of ANS in the patients with AF and insulin resistance.

It is known that increasing the tone of the sympathetic nervous system is accompanied by structural and functional changes in the cardiovascular system [6]. According to the echocardiographic examination LA diameter > 4.0 cm is considered to be an independent determinant of LV filling pressure [6]. Analysis of individual LA parameters (Table 4) revealed an its increase > 4.0 cm in 8 (18.18%) cases (group 1) to (4.31±0.14) cm ($p<0.05$); in 7 (22.58%) cases (group 2) to (4.34±0.19) cm ($p<0.05$) and in 14 (35.89%) cases (group 3) up (4.54±0.34) cm vs. the control levels ($p<0.05$), which confirms indicate the aggravating effect of insulin resistance on the structural parameters of the heart [8].

It was established that the size of the left heart and LV MM increasing in parallel with increasing of HI levels. Index of LV MM significantly increased by 1.5 times (Group 1) and almost 2.0 times (2 and 3 groups) vs. the controls group ($p<0.05$) and the patients group 1 ($p_1<0.05$). The largest volume of LV performance were revealed the conditions of spontaneous HI ($p<0.05$). Significant increasing of EDV and ESV compared to control ($p<0.05$) are evidence of volume overload of the heart and formation of CHF [1, 5].

In all patients with NOAF and MS the IVST and LVPW indicators were significantly increased vs. the controls ($p<0.05$). The highest values were characterized for the groups 2 and 3 patients and were higher nearly 35% than the corresponding indexes in the control ($p_1<0.05$).

It is known that LV IMM increasing associated with increasing of the LA size [5, 6]. Direct moderate correlation between LA size and LV IMM ($r=0.3899$; $p=0.00009$) are in the patients with HI.

All patients with MS and NOAF have index LVEF ranged on the lower limit of normal (EF > 50%), indicating a preserved LV systolic function ($p<0.05$).

Analyzing structural and functional cardiac parameters depending on the type of AF revealed ambiguous changes. In particular, the LA diameter in the patients with adrenergic type AF and HI was significantly increased by 13.74% compared with the patients with normal EI levels ($p_1<0.05$) and tended to increase compared to the patients with vagal and mixed types ($p_1<0.1$). Increase LV MM and LV IMM were accompanied by a rise in the ESV parameter in all groups, but reached maximum values in the patients with adrenergic type and HI. Thus, LV MM was increased by 27.77% compared to the patients with vagal type ($p_1<0.05$) and tended to increase by 9.14% compared to the patients with mixed type AF respectively ($p_2<0.1$). Index LV MM in the patients with adrenergic type AF tended to increase ($p_2<0.1$) compared to the patients with mixed type and was significantly increased by almost 15% compared to the patients with vagal type of paroxysms ($p_1<0.05$).

Thus, a more pronounced degree in the patients with NOAF and HI with adrenergic type AF is associated with increased LA diameter, LV dilatation, LV IMM with preserved LV systolic function. The expression degree of the myocardium structural changes suggests that these changes are the cause of more than a consequence of AF in the patients with NOAF and HI.

Table 1: Demographic characteristics, risk factors, concomitant diseases and forms of AF in patients with MS depending on the plasma EI levels

Indicators	Group 1 (n=44)	Group 2 (n=31)	Group 3 (n=39)
Age, years	62.31±3.39	67.61±3.54	68.92±2.60
Men	31 (70.45%)	19 (61.29%)	16 (41.03%)
Women	13 (29.55%)	12 (38.71%)	23 (58.97%)
CHD	44 (100.0%)	31 (100.0%)	39 (100.0%)
Hypertension	44 (100.0%)	31 (100.0%)	39 (100.0%)
Postinfarction cardiosclerosis	1 (2.27%)	1 (3.23%)	3 (7.69%)
Permanent AF	17 (38.64%)	19 (61.29%)	34 (87.18%)
Persistent AF	7 (15.91%)	4 (12.90%)	1 (2.56%)
Paroxysmal AF	20 (45.45%)	8 (25.80%)	4 (10.25%)
Scores for CHA_2DS_2-VASc	2.01±0.05	3.28±0.03	5.13±0.02

Notes:
1. n - the absolute number of the patients;
2. figures in parentheses are percentage of the total number of the patients in the group.

Table 2: Complaints NOAF in patients with MS depending on the plasma EI levels

Complaints	The detection rate indicator in patients with MS and NOAF		
	Group 1 (n=44)	Group 2 (n=31)	Group 3 (n=39)
Palpitation			
0 points	16 (36.36%)	2 (6.45%)	0 (0.00%)
1 point	21 (47.73%)	5 (16.13%)	1 (2.56%)
2 points	5 (11.36%)	8 (25.81%)	10 (25.64%)
3 points	2 (4.55%)	16 (51.61%)	28 (71.79%)
Dyspnea			
0 points	11 (25.00%)	4 (12.90%)	1 (2.56%)
1 point	14 (31.82%)	5 (16.13%)	6 (15.38%)
2 points	15 (34.09%)	9 (29.03%)	13 (33.33%)
3 points	4 (9.09%)	13 (41.94%)	19 (48.72%)
Oedema legs			
0 points	11 (25.01%)	7 (22.58%)	2 (5.13%)
1 point	26 (59.09%)	2 (6.45%)	4 (10.26%)
2 points	7 (15.91%)	10 (32.26%)	11 (28.21%)
3 points	0 (0.00%)	12 (38.71%)	22 (56.41%)
Dizziness			
0 points	37 (84.09%)	5 (16.13%)	0 (0.00%)
1 point	6 (13.64%)	6 (19.35%)	4 (10.26%)
2 points	1 (2.27%)	5 (16.13%)	17 (43.59%)
3 points	0 (0.00%)	15 (48.39%)	18 (46.15%)
Class EHRA			
I	17 (38.64%)	2 (6.45%)	1 (2.56%)
II	13 (29.55%)	7 (22.58%)	9 (23.08%)
III	10 (22.73%)	20 (64.52%)	22 (56.41%)
IV	4 (9.09%)	2 (6.45%)	7 (17.94%)

Notes:
1. n - the absolute number of the patients;
2. Figures in parentheses are percentage of the total number of the patients in the group.

Table 3: Anamnestic and clinical characteristics of the patients with MS and NOAF and taking into account on the autonomic heart effects

Indexes	Vagal type AF (n=36)		Adrenergic type AF (n=30)		Mixed type AF (n=48)	
	Normal EI levels (n=14)	Hyperinsulinemia (n=22)	Normal EI levels (n=10)	Hyperinsulinemia (n=20)	Normal EI levels (n=20)	Hiperinsulinemia (n=28)
Number of AF paroxysms, per month	13.66±1.20°	17.88±1.36*	10.28±1.11$^{\Delta}$	19.31±0.98*	10.61±1.35$^{\Delta}$	16.60±1.89*°
The duration of paroxysm AF, hours	28.21±5.39°	36.33±6.20*°	24.12±4.48$^{\Delta}$	30.55±4.19*$^{\Delta}$	74.29±11.20$^{\Delta}$°	83.64±13.71$^{\Delta}$°
Heart rate during AF paroxysm, in min	115.39±3.61°	120.11±3.20°	136.28±3.59$^{\Delta}$	146.57±2.21$^{\Delta}$	126.31±3.57	138.66±4.12$^{\Delta}$

Notes:
n - number of the patients;
* - compared with patients with normal EI levels ($p<0.05$);
$^{\Delta}$ - compared with patients with vagal type AF ($p_1<0.05$);
° - compared with patients with adrenergic type AF ($p_2<0.05$).

Table 4: Performance HRV and structural-functional state of the myocardium in the patients with NOAF and MS depending on the plasma EI levels

The indicator	The control (n=20)	Group 1 (n=44)	Group 2 (n=31)	Group 3 (n=39)
HR, beats/min	71±4	125.93±11.37*	135.11±12.01*	142.39±14.90*
RMSSD, ms	27±4	35.78±6.53	23.01±1.51*^	22.21±1.82*^
SDANN ms	127±10	129.33±3.64	143.71±3.67*	145.46±4.02*
LA, cm	2.91±0.30	3.62±0.32*	3.79±0.41*	3.95±0.39*
IVST, cm	0.88±0.04	1.12±0.04*	1.22±0.03*	1.24±0.05*
LVPW, cm	0.99±0.01	1.14±0.04*	1.21±0.03*	1.24±0.04*
LV MM, g	171.00±11.00	265.83±25.11*	284.91±20.10*	307.66±21.03*
LV IMM, g/m	91.67±5.32	140.25±8.21*	156.69±4.48*	166.51±4.17*^
ESV, ml	38.88±5.59	68.17±9.12*	75.21±5.24*	80.87±8.87*
EDV, ml	118.12±6.23	136.55±9.85*	146.63±9.83*	150.43±7.24*
LV EF, %	63.20±3.71	54.12±2.45*	53.36±4.31*	51.07±1.43*

Notes:
n – number of the patients;
* – compared with the control ($p<0.05$);
^ – compared with patients in group 1 ($p_1<0.05$).

Table 5: Performance HRV and structural-functional state of the myocardium in the patients with MS and NOAF depending on the type of paroxysms

Indexes	Control (n=20)	Vagal type AF (n=36)		Adrenergic type AF (n=30)		Mixed type AF (n=48)	
		Normal EI levels (n=14)	Hyperinsulinemia (n=22)	Normal EI levels (n=10)	Hyperinsulinemia (n=20)	Normal EI levels (n=20)	Hiperinsulinemia (n=28)
HR, beats/min	71±4	102.37±4.12	118.56±6.22*	132.06±5.39°$^{\Delta}$	149.51±5.28*$^{\Delta}$	116.27±4.79$^{\Delta}$	133.51±4.19*$^{\Delta}$
RMSSD, ms	27±4	31.27±3.59°	28.10±2.30°	22.87±1.36$^{\Delta}$	17.24±1.31*$^{\Delta}$°	24.69±2.29$^{\Delta}$	21.39±3.64*$^{\Delta}$
SDANN,ms	127±10	120.83±4.37	118.29±4.31	137.22±3.57$^{\Delta}$	148.39±4.27$^{\Delta}$°	132.29±4.12	127.69±3.30
LA, cm	2.91±0.30	3.54±0.66	3.69±0.31	3.76±0.37	4.22±0.28*	3.74±0.34	3.93±0.19
IVST, cm	0.88±0.04	1.13±0.02	1.16±0.03	1.21±0.02	1.23±0.02	1.13±0.02	1.18±0.03
LVPW, cm	0.99±0.01	1.14±0.03	1.17±0.04	1.22±0.04	1.24±0.03	1.20±0.02	1.21±0.02
LV MM, g	171.00±11.00	209.33±18.73°	243.93±19.27*°	271.34±16.81$^{\Delta}$	311.68±19.30*$^{\Delta}$	249.86±18.27$^{\Delta}$	283.19±20.61*$^{\Delta}$
LV IMM, g/m	91.67±5.32	131.82±4.67	147.69±6.33*	151.29±5.37$^{\Delta}$	169.55±7.20*$^{\Delta}$	138.60±4.13	156.71±5.23*
ESV, ml	38.88±5.59	64.19±5.27	72.31±5.22*°	70.16±5.91	82.36±7.39*$^{\Delta}$	68.24±6.17	76.51±6.73*
EDV, ml	118.12±6.23	127.66±6.37	143.21±6.30	136.27±7.33	155.27±6.18*	138.73±8.30	145.61±7.19
LV EF, %	63.20±3.71	56.39±2.57	53.81±1.44	55.37±2.55	51.29±1.06	54.68±1.64	53.40±1.21

Notes:
n - number of the patients;
* - compared to patients with normal EI levels ($p<0.05$);
$^{\Delta}$ - compared to patients with vagal type AF ($p_1<0.05$);
° - compared to patients with mixed type AF ($p_2<0.05$).

4. Conclusions

1. In elderly patients with NOAF and reactive / spontaneous HI permanent AF form are formed in 70% cases with the risk of thrombotic complications by CHA_2DS_2-VASc more than 2 points and with an increasing intensity of complaints from I - II class (30% cases) to class III-IV (70% cases) by scale EHRA.
2. At the patients with NOAF and insulin resistance volume and metric indicators of left heart are increased. Direct correlation between LV IMM and LA (r=0,3899; p=0.00009) and the imbalance between sympathetic and parasympathetic ANS links are characterized also.
3. Under the insulin resistance paroxysm of AF is more often adrenergic type with increasing average HR, maximal rate decreasing RMSSD and increasing SDANN parameters and the formation of CHF.

Perspectives for further research

Further scientific research should direct on the study coagulation and platelet hemostasis parameters changes in hypertensives with NOAF background of MS.

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