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ERYTHROCYTES AGGREGABILITY AND INTRACARDIAC HEMODYNAMICS IN PATIENTS WITH ATRIAL FIBRILLATION

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ABSTRACT

According to the World Health Organization the morbidity of atrial fibrillations is 1-2% of the general population, which is extremely high number due to the severity of the disease. The frequency of morbidity will increase by about 2.5 times (1). Namely, the unfavorable epidemiological picture of atrial fibrillation makes the project relevant. There are numerous studies, although intracardiac hemodynamics and hemorheologycal parameters and their role in the course of atrial fibrillation have not been studied; We have studied the hemorheological profile in patients with atrial fibrillation. Changes of rheological parameters and hemodynamics were assessed against the background of rhythm disturbances. We examined 50 patients (women-22, men - 28, the average age of 65±10) and 20 healthy volunteers. We have studied the Index of the Erythrocytes aggregability, which is the area of aggregated erythrocytes divided by the full area of the erythrocytes. These new innovative methods "Georgian Technique" is created by Georgian scientists and they are famous in the world as direct, numeral and exact [G. Mchedlishvili, 2004; N. Maeda, 2010; M. Mantskava M., 2011]. Also, all patients the studies: ECG, ECHOcardioscopy was performed. After statistical processing of the material, it was found that erythrocytes aggregability is highly impaired in patients with permanent and persistent forms of atrial fibrillation. Mean value of EAI is 41.7 ± 10.4 compared to the control group, where the average EAI value is within 25.6 ± 1.2. The Index of erythrocytes aggregability (EAI) are significantly increased in inverse proportion to the decrease of the left ventricular ejection fraction. A negative correlation was revealed between the Index of erythrocytes aggregation and the left ventricular ejection fraction (R=0.4); According to the obtained data, changes of rheological parameters deepen in the wake of disruption of intracardiac hemodynamics; This confirms the notion that a small blood vessel is the "target" in the case of atrial fibrillation. From hemodynamic mechanisms rheology plays an important role. They are determinants of hemodynamic processes in the body (2).

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Introduction.

Project relevance: Atrial fibrillation is a global health problem with dynamic increases in prevalence and frequency worldwide (3). According to the World Health Organization the morbidity of atrial fibrillations is 1-2% of the general population. The situation is almost similar in case of Georgia. Out of 3.7 million Georgians population 36000 persons (0.9%) are diagnosed with Atrial Fibrillation, which is extremely high number due to the severity of the disease (4). Namely, the unfavorable epidemiological picture of atrial fibrillation makes the project relevant. Patients in this group have an increased risk of hospitalization, chronic heart failure, thromboembolic complications, and sudden cardiac death. Lack of coordination of atrial contractions contributes to blood coagulation, the formation of blood clots, which leads to the creation of an embolism (5). Therefore, against the background of this rhythm disorder, it is common to develop ischemic strokes and systemic thromboembolism. In patients with reduced ejection fraction paroxysm of atrial fibrillation increases the risk of heart failure. The reason of is due to further deterioration of the global contractile function of the heart; Timely cessation of paroxysms is necessary in such patients to avoid complications - pulmonary edema, cardiogenic shock. The complexity of the disease requires a multifaceted, multidisciplinary approach to patient management. Despite numerous studies, Intracardiac hemodynamics and hemorheological parameters and their role in the course of atrial fibrillation have not been tested. It is also not known effect of atrial fibrillation on intracardiac macro- and microcirculation. The blood Hemorheological condition is not considered either at the initial diagnosis of the disease, or during preventive measures, and, of course, neither as a target for treatment; Our research interest was to understand what processes occur in the conditions of atrial fibrillation. There is no physiological and pathophysiological process that does not take in progress at the microcirculation level (Barrett, O. S. H.; Macdonald, S. P. J.; Playford, D. A., 20 15), where hemorheology plays a crucial role in terms of blood flow intensity and volumetric velocity. It is very important to consider and introduce new innovative approaches, that will help to reduce and control the number of patients with atrial fibrillation.

The aim of the research was to evaluate of hemorheological parameters and intracardiac hemodynamics for different forms of atrial fibrillation. Also, to understand the different aspects of the relationship between hemodynamic and rheological characteristics.

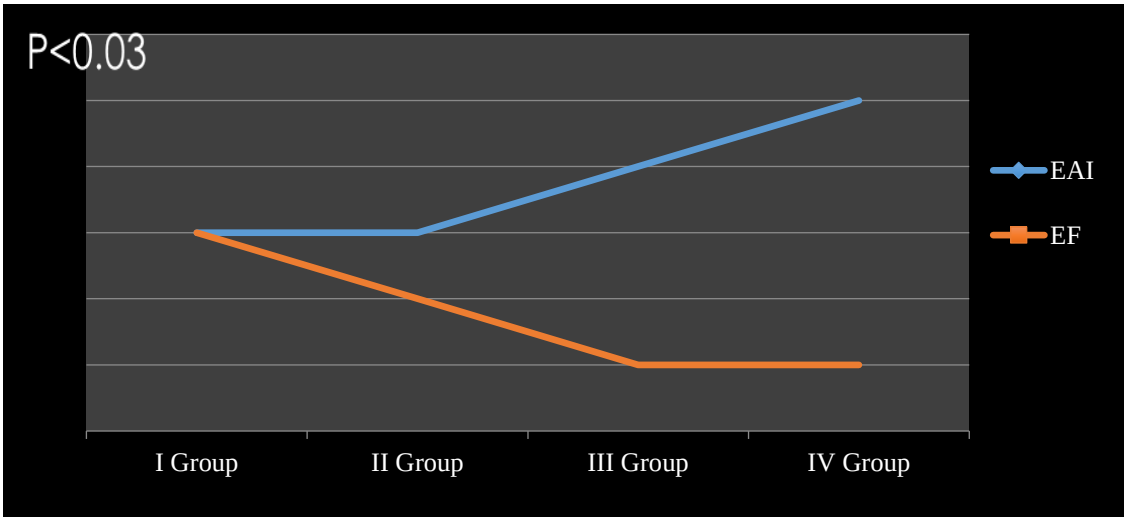
Materials and methods: We examined 50 patients (women 22, men - 28, the average age of 65±10). Possible concomitant pathology: CAD, Arterial hypertension, Chronic heart failure stage I-II (NIHA); Criteria of exclusion were diabetes mellitus, thyroid gland pathologies, valvular heart diseases. According to the classification recommended by the Escardio and AHA/ACC, we divided patients into three groups: I - Patients with paroxysmal form of arrhythmias (n=18, men-11, women - 10); II Persistent Forms (n=10,men-12, women-6); III permanent forms (n=22, men-15, women-8). In the study there were practically healthy people- the control group (n=20, men-12, women-8). Their age was in line with the mean age of the study groups, 62 ± 3.4 years. These individuals did not have any pathology, were not taking any medication during this period, and had a normal electrocardiogram. All patients were done the following cardiac studies: ECG to diagnostic the forms of rhythm disorders with cardiograph NIHON KONDEV cardiofax GEM (Japanese), Echocardiography with PHILIPS clearVue 550 (Netherlands).There were evaluated intracardiac hemodynamics, sizes and volumes of heart chambers, regional and global motional function, ejection fraction; Patients underwent hemorheological parameters: index of erythrocytes aggregability (IEA), deformability, plasma viscosity; This studies have been made in the Department of Rheological and Diagnostic-Analytical Services of LEPL Beritaishvili Center for Experimental Biomedicine and NRAP Society of Rheology. Hemorheological researches was done with the newest methodologies: we have studied the Index of the Erythrocytes aggregation, wich is the area of aggregated erythrocytes divided by the full area of the erythrocytes. These new innovative methods “Georgian Technique” is created by Georgian scientists and they are famous in the world as direct, numeral and exact [G. Mchedlishvili, 2004; N. Maeda, 2010; M. Mantskava M., 2011]. The database was statistically processed in the special statistic program SPSS.

Results: As a result of our research, in group I the ejection fraction (EF) was mainly retained (55-65%); The average value was 52.4 ±6.7%; In group II - main value of EF% was 37.4±10.3%. And in patients from group III the mean ejection fraction was 40.14 ±6.7%. There was found, that index of erythrocytes aggregability to be highly violated in patients with permanent and persistent forms of

atrial fibrillation. The maximum value of EAI reaches in patients with heart failure and reduced ejection fraction. The most manifest changes of EF% were observed in those patients where the EAI was increased by 93%, i.e., Approximately twice as much as the control group. In this group EAI is significantly increased and its mean value is 41.4±10.8 compared to the control group, where the average value of EAI is 25.6±1.08. It should also be noted that in patients with persistent forms of atrial fibrillation after the restoration of sinus rhythm, there was an improvement of EF, especially in patients with moderately reduced EF% (37.4± 10.3); The confidence interval (CI) was 3%. The data obtained clearly show the following: Hemorheological parameters worsen in parallel with hemodynamic changes. In particular, in patients with reduced ejection fraction, EAI increases in parallel with the severity of heart failure (6). The picture is somewhat different in patients with paroxysmal forms of atrial fibrillation and preserved ejection fraction. Here, despite the violation of intracardiac hemodynamics, the systolic volume of the heart is preserved, although some negative dynamics is still observed in terms of changes in rheological parameters. EAI rises moderately, blood flow changes; The opposite picture are in the control group. The EF here - it is good, patients have not some rhythm disturbances, the rheological parameters are within the norm;

Left ventricular function indicator	Control group	Paroxysmal form of AF	Perm. and persistent forms of AF
End diastolic volume (vol, ml) End systolic volume (vol. ml) Ejection fraction (EF)%	70.6±1.7 35±8.2 59.1±2.5	80±1.5 36±4.3 52.4±6.7	130±3.2 40±5.2 37.4±5.7
Index of erythrocytes aggregability EAI	25.6±1.2	33.9±9.4	41.7±10.4

Our studies have shown that the index of erythrocytes aggregability reliably increases in inverse proportion to the decrease of left ventricular ejection fraction.CI =3%.



A negative correlation was found between the IEA and the left ventricular ejection fraction (R = 0.3). The decrease of the lVEF by 12% results in an almost two fold increase of erythrocytes aggregation compared to the control group.

Discussion: Based on the obtained results, the deterioration of intracardiac hemodynamics leads to negative changes of rheological profile, which is associated with a decrease of tissues blood supply, including the heart muscle; The increase of IEA is associated with a decrease of myocardial shortening fraction, i.e. It affects myocardial contractility. The ability of erythrocytes to aggregate

increases in direct proportion to the increase of disease age. Increased erythrocyte aggregation leads to exacerbation of heart failure, hence with all the harmful manifestations: raised blood pressure, left ventricular hypertrophy, volume strain of all four heart chambers, congestion, etc. Increased blood viscosity plays a role of the heart remodeling processes, which in turn is one of the strongest risk factors for the development of atrial fibrillation. Rheological changes associated with increased erythrocytes aggregability lead to increased peripheral resistance; This leads to increase of the hearts "afterload", which makes it even more difficult for the heart to work efficiently with an already irregular ventricular response. The risk of fatal complications is increases. As it is known, the increase of blood viscosity significantly changes the conditions for blood circulation. These changes cause blood flow disturbances hence with detrimental consequences (7). This is due to reduction of linear velocity of blood flow, also due to increase of displacement velocity and consequently the formation of turbulent flows. Therefore, the hemorheology plays one of the crucial roles in this complex chain of pathogenesis. Rheological changes lead to increase of pre- and post-load. Studies show that in the early stages of the disease, the organic changes (meaning chambers dilatation, hypertrophy) are not yet pronounced, but the rheological parameters are already violated. Cardiac output is preserved; Deterioration of hemodynamics is related not only with the changes of intracardiac hemodynamic, but also with the periphery stasis, which develops due to increase of blood viscosity (8). This in turn decrease blood flow into the heart and consequently lowers the amount of cardiac output (SV, EF). These processes take the form of a kind of vicious circle (9).

Conclusions: For the first time by us were evaluated Intracardiac hemodynamics and hemorheological parameters and their relationship in patients with different forms of atrial fibrillation; According to the obtained dates, changes of intracardiac hemodynamics have a significant impact on rheological parameters and vice versa. Changes of rheological parameters deepen in the wake of disruption of intracardiac hemodynamics; This confirms the opinion that the capillary bed is a target organ for atrial fibrillation. Thus, the hemodynamic mechanisms intersect in one common node where rheology plays an important role. They are determinants of hemodynamic processes in the body.

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